Air Quality Monitoring Work Plan
Yerington Mine Site
Revision 2

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INTRODUCTION

The Atlantic Richfield Company ("ARC") has developed this revised Air Quality Monitoring ("AQM") Work Plan ("Work Plan") in compliance with the Unilateral Administrative Order ("UAO") for Initial Response Activities at the Yerington Mine Site ("Site") issued by the U.S. Environmental Protection Agency ("EPA"). The Site is located adjacent to the City of Yerington, in western Nevada. Major objectives for the AQM program at the Site include:

- Evaluate what metals and radiochemicals contained in the surface materials at the Site are migrating off-site and in what concentrations of PM_{10}[1] and TSP[2]; and
- Provide sufficient data for a human health and ecological risk assessment.

Approval and implementation of this Work Plan will be made by a planning team that consists of: EPA's Remedial Project Manager ("RPM") and advising technical staff; ARC's Project Manager and technical staff; and the Yerington Technical Workgroup which includes representatives from the U.S. Bureau of Land Management ("BLM"), the Nevada Division of Environmental Protection ("NDEP") and others. Technical staff supporting EPA, ARC or other groups may include, at a minimum, a risk assessor, toxicologist, meteorologist, chemist, quality assurance specialist and field sampling personnel. The primary decision maker is EPA's RPM, who is responsible for reviewing and approving work plans and related documents, as well as providing guidance and suggestions for work plan implementation.

1.1 Air Monitoring Background

On September 1, 2004, ambient air monitoring at the Site was first requested in the *Memorandum of Understanding Agencies Action Plan* ("MOU"). In September and October 2004, EPA provided ARC with a map of proposed air monitoring locations and an air sampling protocol outline that proposed analytes and detection limits. On November 2, 2004, ARC

[1] PM_{10} refers to particulate matter with an aerodynamic diameter of 10 microns or less
[2] TSP refers to total suspended particulates

submitted a draft air quality monitoring plan and EPA provided comments on November 23, 2004. On December 21, 2004, ARC incorporated EPA comments and submitted the *Draft Air Quality Monitoring Work Plan* (Brown and Caldwell, 2004).

On January 19, 2005, EPA conditionally approved the *Draft Air Quality Monitoring Work Plan* (Brown and Caldwell, 2004) "… based on the need to begin air monitoring as soon as possible, in conjunction with the fact that the work plan was developed with significant input from EPA's oversight contractor". During December 2004 to January 2005, PM_{10} and TSP high volume air samplers were installed at six air monitoring locations, AM-1 through AM-6, located near the Site perimeter. A meteorological station had been installed previously in May 2002 near the northern boundary of the Site. On January 28, 2005, air monitoring began on the NAAQS[3] 6-day sampling schedule. The *Draft Air Quality Monitoring Work Plan* (Brown and Caldwell, 2004) specified gravimetric analysis of PM_{10} and TSP filters and chemical analysis of 21 metals and ten radiochemicals. On July 1, 2005, EPA provided ARC with a list of the Contaminants of Potential Concern ("COPCs") that comprised the analyte list of metals and radiochemicals to be evaluated under the AQM program. Note that the TSP high volume air samplers were shut down from March 2, 2005 to June 1, 2005 pending resolution of the analyte list. On December 19, 2005, ARC submitted the *Final Air Quality Monitoring Work Plan* (Brown and Caldwell, 2005).

On April 3, 2006, ARC submitted the *Fourth Quarter 2005 Air Quality Monitoring Report* (Brown and Caldwell, 2006) and a letter requesting AQM program scope reduction. On June 16, 2006, EPA responded and approved the elimination of the following AQM program components effective July 1, 2006: 1) TSP monitoring at locations AM-1 through AM-5; 2) PM_{10} monitoring at locations AM-2, AM-4, and AM-5; and 3) 13 metals and five radiochemicals from the analyte list. EPA recommended that sulfate be added to the analyte list. In addition, EPA recommended that ARC install and operate: 1) continuous particulate monitors at locations AM-1, AM-3, and AM-6; 2) an automatic filter sampler at location AM-6 for episodic sampling during elevated PM_{10} ambient concentration periods; and 3) additional wind sensors at locations AM-1 and AM-3.

[3] NAAQS refers to the National Ambient Air Quality Standards

On August 3, 2006, ARC responded to EPA's June 16, 2006 letter by requesting elimination of the following AQM program components suggested by EPA: 1) PM_{10} sampling at locations AM-1, AM-3 and AM-6; 2) TSP sampling at AM-6; 3) installation of continuous particulate monitors; and 4) installation of additional wind sensors at locations AM-1 and AM-3. On October 19, 2006, EPA responded and approved elimination of TSP sampling at AM-6. However, EPA reiterated that PM_{10} high volume sampling at locations AM-1, AM-3, and AM-6 on the 6-day schedule should be continued until April 2007, at which time a re-evaluation of the need for continued high volume sampling would be made. In addition, EPA reiterated that continuous particulate monitoring at locations AM-1, AM-3 and AM-6 (with episodic sampling at AM-6) and two additional wind sensors at locations AM-1 and AM-3 should be installed and operated. On October 27, 2006, ARC agreed to comply with the additional AQM program requirements. ARC committed to provide EPA with this Work Plan, which incorporates the changes to the AQM program.

The high volume PM_{10} monitoring resumed at locations AM-1, AM-3, and AM-6 on February 5, 2007, in accordance with this Work Plan. In addition, the continuous particulate monitors have been installed and are operating at locations AM-1, AM-3, and AM-6 as of February 7, 2007. The 10-meter towers have been installed and wind monitors are operating at AM-1, AM-3, and AM-6 as of February 16, 2007. On March 23, 2007, ARC submitted the *Revised Air Quality Monitoring Work Plan* which documented the modifications to the air quality monitoring program (Brown and Caldwell, 2007a). Correspondence to date regarding the air quality monitoring program has been included in Appendix A.

1.2 Air Monitoring Program Goals and Data Uses

CERCLA[4] requires the characterization of contaminant migration pathways to the environment, including the air pathway, and an evaluation of the impacts as part of the Preliminary Assessment and Site Inspection phases. EPA has developed technical guidance documents for air pathway assessments, including the following documents listed below.

[4] CERCLA refers to the Comprehensive Environmental Response, Compensation, and Liability Act

- Air/Superfund National Technical Guidance Study Series: Volume I – Overview of Air Pathway Assessments for Superfund Sites (EPA, 1992a)
- Air/Superfund National Technical Guidance Study Series: Volume IV – Guidance for Ambient Air Monitoring at Superfund Sites (EPA, 1993)
- Design Considerations for Ambient Air Monitoring at Superfund Sites (EPA, 1992b)
- Superfund Program Representative Sampling Guidance: Volume II – Air Short-term Monitoring (EPA, 1995)

These guidance documents describe the purpose and need for air pathway assessments and air monitoring programs. The stated goals for air assessments are to determine the migration of compounds of potential concern from the Site via the air pathway, and to evaluate the exposure of off-site populace and the environment. These goals are similar to the objectives stated by EPA for the AQM program at the Site. In the October 19, 2006 EPA comment letter on ARC's request for AQM program scope reduction, EPA states that the AQM program objectives at the Site are twofold:

1) Evaluate what metals and radiochemicals contained in the surface materials at the Site are migrating off-site and in what concentrations of PM_{10} and TSP; and
2) Provide sufficient data for a human health and ecological risk assessment.

EPA provided the following four potential goals or Data Quality Objectives ("DQOs") for the AQM program in the February 24, 2005 revised review comments on the *Draft Air Quality Monitoring Work Plan* (Brown and Caldwell, 2004).

1) Initial assessment of what is migrating off-site and at what ambient concentrations. EPA stated that this DQO can be achieved with TSP sampling and analysis.
2) Impact on local populations and potential receptors. EPA stated that this DQO could be achieved primarily with PM_{10} sampling and analysis. The TSP data would not be useful for human exposure assessment because the coarse particle size of TSP is not respirable.
3) Human health and ecological risk assessment. EPA stated that this DQO could potentially be achieved by both PM_{10} and TSP sampling and analysis. The TSP data could be used to help evaluate deposition of particles.
4) Degradation of air quality over background levels. This DQO can be achieved by both PM_{10} and TSP sampling and analysis.

The first and fourth of these potential DQOs are related to the first AQM program objective regarding evaluation of the off-site migration of PM_{10}, TSP, metals and radiochemicals. The second and third of these potential DQOs are related to the second AQM program objective regarding the collection of adequate data for a human health and ecological risk assessment. This Work Plan describes the revised AQM program that will be implemented to produce data that meet the two AQM program objectives described above.

1.3 Air Monitoring Program Design Considerations

EPA's *Air/Superfund National Technical Guidance Study Series: Volume IV – Guidance for Ambient Air Monitoring at Superfund Sites* (EPA, 1993) describes the general design of an air monitoring network used to assess off-site migration and exposure via the air pathway. The approach involves measuring the concentration target analytes at the fence line of the Site for ground-level emission sources. Data are collected at locations upwind and downwind of the Site. The data are compared to action levels to determine if there is a cause for concern at downwind locations. The difference in concentrations measured downwind and upwind of the Site yields an adjusted concentration that represents the contribution of the Site emissions to local air quality. For pre-remediation studies, the EPA guidance document recommends four to 12 air sampling locations, with a minimum of one upwind location.

EPA states that the factors that affect the selection of the air monitoring method include the list of target analytes, data turn-around time, detection limits, data quality, temporal resolution, spatial resolution, and cost. Sampling duration and frequency depend upon the monitoring program goals and the relevant action levels. Compliance with long-term action levels is usually determined using a sampling frequency of once every six days. For short-term action levels, continuous sampling may be needed if feasible. In some cases, sampling periods may also depend upon the amount of sample needed to achieve acceptable detection limits. Wind and other meteorological measurements are also recommended so the direction of potential air pathway migration from the Site can be assessed during air sampling periods. The modified AQM program follows EPA's recommendations and guidance described above. Section 1.4 of this Work Plan describes the monitoring locations, Section 1.5 summarizes the air monitoring methods used, and Section 1.6 summarizes the sampling periods, frequencies, and durations.

1.4 Air Monitoring Location Selection and Rationale

On September 28, 2004, EPA provided ARC with a map describing six air monitoring locations. Meteorological data including wind speed and direction, collected at the Site since May 2002 were used to assist in the location of the original monitoring locations. Figures 1 and 2, respectively, present the original and revised air quality monitoring locations. Wind rose plots for the years 2005 and 2006 are presented in Figure 3 and Figure 4, respectively. The wind rose plots indicate that the predominant wind directions (especially for high wind speed periods) are from the southwest. The six monitoring locations along with the placement rationale are discussed below.

- AM-1: Upwind of Site when winds are blowing from the predominant southwestern directions and downwind of the tailings pile and process area when winds are blowing from the northeast. This location was established primarily as an upwind background monitoring location.
- AM-2: Upwind of Site when winds are blowing from the predominant southwestern directions and downwind of the evaporation ponds when winds are blowing from the northeast. This location was established primarily as an upwind background monitoring location.
- AM-3: Downwind of the tailings pile and process area when winds are blowing from the predominant southwestern directions. This location was established primarily as a downwind monitoring location. It is also the closest location to the City of Yerington residential areas, and can be used to conservatively estimate population exposure.
- AM-4: Downwind of Site when winds are blowing from the westerly directions and upwind of the Site when winds are blowing from the north and northeast. This location was established primarily as a downwind monitoring location to supplement AM-3 on the eastern border of the Site perimeter.
- AM-5: Downwind of evaporation ponds when winds are blowing from the predominant southwestern directions and upwind of the Site when winds are blowing from the north and northeast. This location was established primarily as a downwind monitoring location.
- AM-6: Downwind of evaporation ponds when winds are blowing from the predominant southwestern directions and upwind of the Site when winds are blowing from the north

and northeast. This location was chosen so that it would be proximate to the original meteorological station. This location was established primarily as a downwind monitoring location.

The approximate coordinates and original equipment for each air monitoring location are summarized in Table 1.

Table 1. Monitoring Locations and Equipment

Location	Original Equipment	Latitude	Longitude
AM-1	PM_{10} high volume samplers (primary and co-located duplicate) and TSP high volume sampler	38° 59.678	119° 12.737
AM-2	PM_{10} and TSP high volume sampler	39° 00.535	119° 13.197
AM-3	PM_{10} and TSP high volume samplers	38° 59.885	119° 11.581
AM-4	PM_{10} and TSP high volume samplers	39° 00.722	119° 11.007
AM-5	PM_{10} and TSP high volume samplers	39° 01.126	119° 11.958
AM-6	PM_{10} and TSP high volume samplers	39° 01.476	119° 12.204
--	Original meteorological station	39° 01.477	119° 12.267

1.5 Summary of Air Monitoring Methods

There are three main monitoring methods that have been, or will be, used in the Yerington AQM program: high volume PM_{10} and TSP samplers, low volume continuous PM_{10} samplers (and associated episodic filter samples), and meteorological monitoring equipment. The objectives for each of these monitoring methods are described below:

- High Volume Samplers: collection of high volume PM_{10} and TSP samples followed by detailed chemical and radiochemical analyses. The high volume samplers are the EPA reference method for collection of PM_{10} data. They collect a relatively large sample of particulate matter, which is important because of the required detection limits for some analytes. These high volume samplers are operated on the NAAQS 6-day sampling schedule. This sampling schedule allows for accurate estimation of the annual mean and maximum daily ambient concentrations.
- Continuous Particulate Samplers: collection of hourly PM_{10} data to help evaluate short-term peak concentration events at the Site, and to allow for a robust hour-by-hour evaluation of upwind and downwind concentrations at the Site. The hourly upwind and downwind data will help evaluate the contributions of on-site versus off-site sources to the measured daily PM_{10} concentrations. These samplers are EPA equivalent samplers, and the 24-hr averaged data (midnight-to-midnight) can be directly compared to the

NAAQS. The continuous particulate samplers will also be programmed to collect particulate samples on Teflon filters during peak particulate concentration events. The Teflon filters will then be analyzed for as many analytes as possible on the revised analyte list.

- Meteorological Monitoring Equipment: meteorological data will be collected to help evaluate the type of emission processes and contributing sources (upwind and downwind sources) that cause the observed ambient concentrations of PM_{10} and other analytes. The primary parameters are wind speed, wind direction, and precipitation, but other parameters are also collected to allow for the use of EPA air dispersion models to simulate the transport and dispersion of air emissions.

1.6 Air Sampling Frequencies and Duration

EPA's *Air/Superfund National Technical Guidance Study Series: Volume IV – Guidance for Ambient Air Monitoring at Superfund Sites* (EPA, 1993) provides guidance on the duration and frequency of air monitoring programs. For pre-remediation monitoring studies, this guidance describes an upper bound on the scope of air monitoring of 24-hour sampling events on a once-every-six-day schedule, resulting in a duration of up to one year. In addition, the duration of data collection is affected by the averaging period of the applicable action level (e.g., if action levels are expressed as long-term, annual averages, sampling for a one-year period will result in average concentrations that reflect seasonal variations in climate and emission processes).

Other EPA guidance documents also discuss the duration of air monitoring programs. EPA's *A Preliminary Risk-based Screening Approach for Air Toxics Monitoring Data Sets* (EPA, 2006a) states that one year of sampling data are sufficient for evaluation of chronic and acute exposures and sufficiently capture seasonal variability, storm events, and fluctuations in source material. EPA's *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (EPA, 1987) states that pre-construction and post-construction air monitoring programs should be conducted for a one- year period to account for seasonal variations in ambient concentrations. EPA's *Guidelines on Air Quality Modeling* (EPA, 2006b) and *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA, 2000a) state that one year of site-specific meteorological data is an adequate length of record for representative meteorological data.

The preponderance of EPA guidance recommends that one year of data collection is adequate to evaluate chronic and acute health exposures, and to account for seasonal variations in meteorology and source emissions. However, EPA's stated position on the duration of air data collection at the Site is that"… in many cases at least three years of data is needed for ambient air level determinations". EPA states in the October 19, 2006 letter that at least one year of PM_{10} sampling at AM-1, AM-3, and AM-6 (including analysis of metals and radiochemicals on the revised analyte list) following the completion of the tailing pile capping in April of 2006 should be performed and, at that time, a re-evaluation of the approach would be merited. This time frame results in the duration of the AQM program at the Site of greater than two years for these high volume PM_{10} samplers.

EPA guidance on risk screening activities also suggests that a dataset consisting of 24-hour samples collected over one year also is sufficient for evaluation of acute, or short-term, exposures. Nevertheless, EPA's October 19, 2006 letter expressed a concern that this sampling design and duration are not sufficient to adequately characterize short-term exposures during peak wind events. The revised monitoring program addresses this concern.

The primary purpose of the continuous particulate monitors is to evaluate short-term peak concentration events at the Site, including high wind speed events. The following decision rules will be applied to this evaluation. A peak dust storm event shall be defined as having a 1-hour PM_{10} concentration equal to or greater than 300 micrograms per cubic meter ($\mu g/m^3$). Peak dust storm events meeting this criterion will be sampled for 12 months, from February 2007 through February 2008. After the one year of monitoring has been completed, an evaluation report will be submitted to EPA and EPA will then determine if the monitoring can be terminated.

SECTION 2.0
DATA QUALITY OBJECTIVES

The DQOs for field sampling and analytical activities described in this Work Plan have been developed to ensure that reliable data are acquired for decision making by RPMs and risk assessors. A systematic seven-step planning approach outlined in the EPA quality assurance document *Guidance for the Data Quality Objective Process* (EPA, 200b) is used to help guide the thought processes in developing a well planned investigation that will provide the information needed to support defensible site decisions. The DQO process defines the criteria that a data collection program should satisfy, including: 1) when, where and how to collect the samples; 2) determination of tolerable decision error rates and other data performance requirements; and 3) the number of samples that should be collected.

Based on the discussion of AQM program objectives in Section 1.2, three DQOs have been identified. The first is an assessment of the off-site migration of COPCs via the air pathway. The second and third DQOs are risk-based health and ecological assessments, one for long-term chronic exposure to average COPC air concentrations and the second for short-term acute exposure to peak COPC air concentrations. The seven planning steps are presented below for these DQOs.

2.1 Air Pathway Off-site Migration DQO

The first DQO describes the assessment of the off-site migration of COPCs via the air pathway.

<u>Step 1. State the Problem</u>

COPCs, including metals and radiochemicals in particulate matter, may be migrating off site via the air pathway.

Step 2. Identify the Decision

To determine if off-site migration of COPCs via the air pathway is occurring, and if so to quantify the long-term average and maximum short-term ambient air concentrations that represent the contribution of the site emissions to local air quality. This data will then be used as input to the DQOs related to health and ecological assessments.

Step 3. Identify the Inputs to the Decision

Inputs to the decision include adequate air sampling data at upwind and downwind locations, concurrent meteorological data, and available analytical results from on-site soil characterization. An approach for determining how to identify upwind and downwind locations will need to be determined given the variability of wind direction at the Site. This work plan describes the criteria that will be used for determining if air sampling and meteorological data collected at the Site are adequate for the DQO. These criteria include the rationale and justification for specified sample locations, monitoring methods and associated accuracy and precision levels, minimum detection limits, sampling frequency and duration, and data completeness criteria. If the collected data meet the criteria described in this work plan, then they will be deemed adequate for this DQO.

Step 4. Define the Boundaries of the Study

The boundaries of the Site consist of spatial and temporal boundaries. The spatial boundaries are defined by the area outside of the Site perimeter that represents off-site air quality. The air monitoring data collected at the perimeter monitoring stations will provide a conservatively high estimate of the COPC air concentrations at locations further downwind of the Site, including population and ecological areas. The temporal boundaries are defined by the status of the Site. The air monitoring data have been collected before any remediation activities have been performed and, therefore, the data will represent baseline air quality and existing conditions at the site. The data collection frequency and duration criteria described in this work plan will ensure that accurate long-term average and maximum short-term ambient air concentrations will be measured.

Step 5. Develop a Decision Rule

If a statistical analysis of upwind and downwind data indicates that the COPC air concentrations in downwind samples are greater than upwind samples, then the long-term average and maximum short-term air concentrations that represent the contribution of the site emissions to local air quality will be quantified.

Analytical results that are non-detects will be treated according to EPA recommendations in *Guidance for Data Quality Assessment, QA/G-9* (EPA, 2000c) which will vary depending on the frequency of detection. Generally, a concentration equal to one-half of the detection limit ("DL") will replace the DL. The distribution of air data then will be characterized using ProUCL (EPA 2004, Version 3.00.02) to determine the appropriate statistical test to be used to compare the upwind and downwind samples. In general, the data will be evaluated using a two-population statistical comparison to determine whether concentrations in downwind samples exceed concentrations in upwind samples. The general null hypothesis ("H_o") is that downwind concentrations are less than or equal to upwind concentrations. A rejection of the null hypothesis leads to the acceptance of the alternative hypothesis ("H_a") that downwind concentrations are greater than upwind concentrations. The hypotheses statements can be represented as:

- H_o = downwind concentration = upwind concentration; and
- H_a = downwind concentration > upwind concentration.

Statistical methods that may be used to conduct the two-sample comparison analyses, depending on the distribution of the data, include:

- Two-sample t-tests for populations with equal or unequal variances;
- Wilcoxon rank sum ("WRS") test (or the closely-related Gehan test if multiple detection limits are present for non-detect values);
- Quantile test; and/or
- Test of proportions.

The t-test will be used for normally distributed data and the remaining tests will be used if the data are distribution free. The WRS test will be applied if the percentage of detected values is at least 60 percent in both data sets. If the null hypothesis for the WRS test is rejected, the COPC will be determined to be present at concentrations above upwind concentrations. If the null hypothesis is accepted, the quantile test will be performed, and the determination of whether downwind concentrations exceed upwind concentrations will depend on results of the quantile test. Use both the WRS and quantile tests in the most powerful method to detect true differences between two populations (EPA, 2000c). Both the quantile test and the test of proportions will be conducted if the percentage of detected values in either data set is less than 60 percent.

Step 6. Specify the Limits on Decision Errors

COPC downwind concentrations will be compared with upwind concentrations to determine if downwind concentrations exceed upwind concentrations. The two decision errors that can be made are: 1) deciding that downwind exceeds upwind when it does not; and 2) deciding that downwind does not exceed upwind when, in fact, it does. A false rejection error (Type I) occurs when the decision maker erroneously rejects the null hypothesis. A false acceptance error (Type II) occurs when the null hypothesis is erroneously accepted. For purposes of the initial comparison of downwind to upwind concentrations, a 10 percent error rate was selected for both the Type I (a) and Type II (ß) errors.

Step 7. Optimize the Design

The purpose of this step is to develop a sampling and analysis plan that will yield quality data meeting the objectives outlined in the previous steps. The remainder of this work plan provides the details of how the monitoring program has been revised to satisfy data quality requirements. Assumptions and limitations of the proposed statistical analyses also are provided in this section.

t-Test for Populations with Equal or Unequal Variance

The underlying assumptions are that the sample populations are independent of each other, a random sample design was used, and that both populations are approximately normally distributed. The t-Test for equal variances is robust to distributional and variance assumptions but is not robust to outliers. The decision rules for the t-Tests are:

- H_o = mean downwind concentrations = mean upwind concentration
- H_a = mean downwind concentrations > upwind concentrations;
- a = 10 percent (false rejection rate); and
- ß = 10 percent (false acceptance rate).

Wilcoxon Rank Sum (or Gehan) Test

Both populations are assumed to have the same distribution and variance. Also, the populations are assumed to be independent and have a random sampling design. For the WRS test, misleading results may be obtained when many of the data points are the same. The WRS test is robust to outliers. The decision rules for the WRS test are:

- H_o = the position of downwind concentrations is shifted below (e.g., lower concentration than) that of upwind concentrations;
- H_a = the position of downwind concentrations is shifted above (e.g., higher concentrations than) that of upwind concentrations;
- a = 10 percent (false rejection rate);
- ß = 10 percent (false acceptance rate); and
- A ratio of MDD:s = 1 is assumed; where *s* is the standard deviation of the site data and MDD is the minimum detectable difference (also called "width of the gray region").

Quantile Test

The quantile test is used to find population differences when only parts of the population differ rather than finding a shift in the entire population. It is assumed that the populations are independent of one another, the variance underlying the distribution of each population is the same, and that a simple or systematic random sampling design was employed. The quantile test is not robust to outliers. The decision rules for the quantile test are:

- H_o = e = 0 and ?/s = 0;
- H_a = e > 0 and ? /s > 0;
- a = 10 percent;
- ß = 10 percent;

- e = proportion of the downwind data at which chemicals are present at concentrations lower than upwind concentrations; and
- A ratio of MDD:s = 4 is assumed.

Test of Proportions

The test of proportions assumes a random sampling design for both populations, is robust to outliers and is acceptable for any distributional shape. Decision rules for this are:

- H_o = P downwind – P upwind = 0 (where P is the proportion of observations exceeding a value, C, and C is the greater of the 95^{th} percentiles of each population);
- H_a = P downwind – P upwind > 0;
- a = 10 percent; and
- ß = 10 percent.

2.2 Long-Term Chronic Health and Ecological Effects Assessment DQO

The problem statement is that the health and ecological risk associated with long term chronic exposure to COPCs at off-site locations is unknown. The decision rule will be based on a comparison of long-term average measured concentrations to appropriate screening concentrations such as preliminary remediation goals ("PRGs"). The development of this DQO will be presented in the *Screening-Level Inhalation Risk Evaluation Work Plan*, but some general guidelines are provided in this section.

Step 1. State the Problem

If metals and radiochemicals in particulate matter are migrating off-site in fugitive dust, then off-site residents may or may not be exposed to COPC levels of concern.

Step 2. Identify the Decision

To quantify chronic exposures to off-site residents and to compare estimated exposures to acceptable exposure limits.

Step 3. Identify the Inputs to the Decision

Inputs to the decision include adequate air sampling data and acceptable exposure levels. Exposure levels will be described in a separate *Screening-Level Inhalation Risk Evaluation Work Plan* and report, that will describe the criteria that will be used for determining if air sampling data collected at the Site are adequate for this DQO. These criteria include the rationale and justification for specified sample locations, monitoring methods and associated accuracy and precision levels, minimum detection limits, sampling frequency and duration, and data completeness criteria. If the collected data meet the criteria described in the *Screening-Level Inhalation Risk Evaluation Work Plan*, then they will be deemed adequate for this DQO.

Step 4. Define the Boundaries of the Study

The boundaries of the Site consist of spatial and temporal boundaries. The spatial boundaries are defined by the area outside of the Site perimeter that represents off-site air quality. The air monitoring data collected at the perimeter monitoring stations will provide a conservatively high estimate of the COPC air concentrations at locations further downwind of the Site, including population and ecological areas. The temporal boundaries are defined by the status of the Site. The air monitoring data has been collected before any remediation activities have been performed, and therefore the data will represent baseline air quality and existing conditions at the site. The data collection frequency and duration criteria described in this Work Plan will ensure that accurate long-term average and maximum short-term ambient air concentrations will be measured.

Step 5. Develop a Decision Rule

The database will be prepared for calculation of exposure point concentrations by treating non-detect values, field duplicates, and blanks as described in this Work Plan. Calculation of exposure point concentrations will be performed according to EPA guidance *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA, 2002) and through the use of EPA software, ProUCL (EPA 2004, Version 3.00.02). Exposure point concentrations will be compared to chronic screening levels, which will be identified in the *Screening-Level Inhalation Risk Evaluation Work Plan*.

If exposure point concentrations are less than chronic screening levels, then it will be assumed that risks to off-site residents are not of concern and no further evaluation will be necessary. If exposure point concentrations are greater than chronic screening levels, then further evaluation will be necessary under the advisement of EPA and partners.

Step 6. Specify the Limits on Decision Errors

Typically, the consideration of decision errors in risk assessment involves a qualitative evaluation of assumptions made at various points in the process. The potential for decision error is limited by the use of conservative or health-protective assumptions in the risk evaluation. The potential for over- or under-estimation of potential health risks will be discussed in detail in a future *Screening-Level Inhalation Risk Evaluation Report*.

Step 7. Optimize the Design

The potential for design optimization will be discussed with the EPA and other partners during development of the *Screening-Level Inhalation Risk Evaluation Work Plan*.

2.3 Short-Term Acute Health and Ecological Effects Assessment DQO

The problem statement is that the health and ecological risk associated with short term, acute exposure to COPC at off-site locations is unknown. The decision rule will be based on a comparison of risk-based screening concentrations such as California EPA Reference Exposure Levels ("RELs") to maximum measured short-term (24-hour) concentrations that have been adjusted to reflect the averaging time of the selected risk-based screening level. The development of this DQO will be presented in the *Screening-Level Inhalation Risk Evaluation Work Plan* but some general guidelines are provided in this section.

Step 1. State the Problem:

If metals and radiochemicals in particulate matter are migrating off-site in fugitive dust, then off-site residents may or may not be exposed to COPC levels of concern.

Step 2. Identify the Decision

To quantify acute exposures to off-site residents and to compare estimated exposures to acceptable exposure limits.

Step 3. Identify the Inputs to the Decision

Inputs to the decision include adequate air sampling data and acceptable exposure levels. Exposure levels will be described in a separate screening-level inhalation risk evaluation work plan and report that will describe the criteria that will be used for determining if air sampling data collected at the Site are adequate for the DQO. These criteria include the rationale and justification for specified sample locations, monitoring methods and associated accuracy and precision levels, minimum detection limits, sampling frequency and duration, and data completeness criteria. If the collected data meet the criteria described in the *Screening-Level Inhalation Risk Evaluation Work Plan*, then they will be deemed adequate for this DQO.

Step 4. Define the Boundaries of the Study

The boundaries of the Site consist of spatial and temporal boundaries. The spatial boundaries are defined by the area outside of the Site perimeter that represents off-site air quality. The air monitoring data collected at the perimeter monitoring stations will provide a conservatively high estimate of the COPC air concentrations at locations further downwind of the Site, including population and ecological areas. The temporal boundaries are defined by the status of the Site. The air monitoring data has been collected before any remediation activities have been performed, and therefore the data will represent baseline air quality and existing conditions at the Site. The data collection frequency and duration criteria described in this work plan will ensure that accurate long-term average and maximum short-term ambient air concentrations will be measured.

Step 5. Develop a Decision Rule

The database will be prepared for calculation of exposure point concentrations by treating non-detect values, field duplicates, and blanks as described in this Work Plan. Calculation of exposure point concentrations will be performed according to EPA guidance *CalculatingUpper*

Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (EPA, 2002) and through the use of EPA software, ProUCL (EPA 2004, Version 3.00.02). Exposure point concentrations will be compared to acute screening levels, which will be identified in the *Screening-Level Inhalation Risk Evaluation Work Plan*.

If exposure point concentrations are less than acute screening levels, then it will be assumed that risks to off-site residents are not of concern and no further evaluation will be necessary. If exposure point concentrations are greater than acute screening levels, then further evaluation will be necessary under the advisement of the EPA and partners.

Step 6. Specify the Limits on Decision Errors

Typically, the consideration of decision errors in risk assessment involved a qualitative evaluation of assumptions made at various points in the process. The potential for decision error is limited by the use of conservative or health-protective assumptions in the risk evaluation. The potential for over- or under-estimation of potential health risks will be discussed in detail in a future *Screening-Level Inhalation Risk Evaluation Report.*

Step 7. Optimize the Design

The potential for design optimization will be discussed with EPA and other partners during development of the *Screening-Level Inhalation Risk Evaluation Work Plan*.

SECTION 3.0
MONITORING EQUIPMENT

Original AQM equipment at the Site consisted of high volume air samplers and a meteorological station. Prior to installation of the high volume air samplers, six monitoring locations were constructed during December 2004 to January 2005. Each air monitoring location was serviced with permanent electrical supply and small 3 foot by 3 foot concrete pads were installed to secure the high volume air samplers. Each location originally had one PM_{10} and one TSP high volume air sampler. Air monitoring location AM-1 has a secondary PM_{10} high volume air sampler co-located with the primary sampler for duplicate analyses.

For security purposes, as approved by EPA, a chain link fence was constructed around air monitoring equipment at off-site locations AM-1, AM-2 and AM-3. The original meteorological station was installed near the northern boundary of the Site in May 2002. Air monitoring location AM-6 was located so that it would be proximate to the original meteorological station. The monitoring locations and placement of the equipment comply with criteria specified in 40 CFR 58 (Appendix E; Section 8) including appropriate vertical placement and spacing from roads and obstructions.

Meteorological monitoring has been conducted at the Yerington Mine Site since May 2002 and air quality monitoring with the high volume air samplers has been conducted since January 2005. The revisions to the AQM program include the following equipment changes:

- Termination of all TSP monitoring and removal of the TSP high volume samplers at all locations;
- Addition of continuous particulate monitors at locations AM-1, AM-3, and AM-6;
- Re-location of the original meteorological station to location AM-6 and installation of a 10-meter tower;
- Addition of a 2- and 10-meter delta temperature system to the meteorological station at location AM-6; and
- Addition of wind sensors on 10-meter towers at location AM-1 and AM-3.

The following sections describe the AQM equipment for high volume air sampling, continuous particulate monitoring, and meteorological monitoring.

3.1 High Volume Air Sampling Equipment

Tisch Environmental, Inc. manufactures the high volume air sampling equipment used in the AQM program, and was approved by the EPA under Federal Reference Method Number RFPS-0202-141. The PM_{10} and TSP high volume air sampler specifications are summarized in, and described below.

Table 2. High Volume Air Sampler Specifications

Type	PM_{10}	TSP
Manufacturer	Tisch Environmental, Inc.	Tisch Environmental, Inc.
Model	TE-6070D	TE-5170-D
Construction	anodized aluminum	anodized aluminum
Inlet	size selective, vertically symmetric	n/a
Flow Rate	36 to 44 ft^3/min	39 to 60 ft^3/min
Flow Control	mass flow controlled w/ probe	mass flow controlled w/ probe
Motor Blower	2-stage vacuum, 0.6 hp	2-stage vacuum, 0.6 hp
Flow Indicator	continuous flow/pressure recorder	continuous flow/pressure recorder
Timer	digital timer/elapsed time indicator	digital timer/elapsed time indicator
Electrical supply	110 V, 60 Hz, 5 A (12 A start)	110 V, 60 Hz, 6 A (12 A start)

3.1.1 PM_{10} High Volume Sampler

The TE-6070D is a mass flow controlled high volume air sampler for PM_{10} measurements. The system components are housed in an anodized aluminum shelter that supports a size selective, vertically symmetric PM_{10} inlet. A blower motor assembly draws air through the 8 inch by 10 inch quartz fiber filter which is held in place by a filter paper cartridge. A combination mass flow controller with air flow probe, digital timer, and digital elapsed time indicator provides a constant flow rate and programmable operation. A continuous flow/pressure recorder verifies the sample duration and ensures the target volume is achieved.

3.1.2 TSP High Volume Sampler

The TE-5170D is a mass flow controlled high volume air sampler for measurement of TSP. The system components are housed in an anodized aluminum shelter with a gabled roof. A blower motor assembly draws air through the 8 inch by 10 inch quartz fiber filter which is held in place by a filter paper cartridge. A combination mass flow controller with air flow probe, digital timer, and digital elapsed time indicator provides a constant flow rate and programmable operation. A continuous flow/pressure recorder verifies the sample duration and ensures the target volume is achieved. The system components in the TE-5170D are nearly identical to those in the TE-6070D. The revisions to the AQM program include the termination of all TSP monitoring and the removal of TSP high volume air samplers from all monitoring locations. TSP high volume air samplers were decommissioned and removed during from December 2006 to January 2007.

3.2 Continuous Particulate Monitoring Equipment

For consistency of data, ARC proposed to install the same type of continuous particulate monitors at all three air monitoring locations (AM-1, AM-3, and AM-6). The equipment consists of three Thermo Electron TEOM[5] Series 1400a continuous particulate monitors housed in custom outdoor enclosures to provide full weather protection. The enclosures are secured to a concrete pad and supplied with permanent electrical power. The unit at AM-6 features an ACCU[6] intelligent sampling system so that sample collection on a filter cassette can be triggered by particulate concentration. The specifications of the equipment installed during the period from December 2006 to January 2007 are listed below.

- Thermo Electron (previously Rupprecht and Patashnick) TEOM Series 1400a ambient particulate monitors. The equipment has received EPA PM_{10} equivalency approval EQPM-1090-079.
- Thermo Electron ACCU (for the TEOM unit located at AM-6 only) and 47-mm Teflon filter cassettes.
- Outdoor enclosure equipped with heating and air conditioning. The enclosure is a custom built shed on a 7-foot by 9-foot concrete pad. The TEOM inlet protrudes through the roof such that the sampling elevation is at approximately 4 meters.

[5] TEOM refers to the patented Tapered Element Oscillating Microbalance technology
[6] ACCU refers to the Automatic Cartridge Collection Unit

- Thermo Electron Mass Calibration Verification Kit.
- Bios DryCal® DC-Lite flow calibrator.

3.3 Meteorological Monitoring Equipment

The original meteorological station was operational from May 2002 through December 2006, and was installed adjacent to pumpback well 6 (PW-6) near the northern boundary of the Site. Air monitoring location AM-6 was located so that it would be proximate to the original meteorological station. During the implementation of the AQM program, the original meteorological station was initially audited and certified by the EPA in January 2005. The revisions to the AQM program include the following changes to the meteorological equipment:

- Re-location of the original meteorological station to AM-6 and installation of a 10-meter tower;
- Addition of a 2- and 10-meter delta temperature system to the meteorological station at AM-6; and
- Addition of wind sensors on 10-meter towers at AM-1 and AM-3.

3.3.1 Original Meteorological Station

The original meteorological station was equipped with instruments for measuring wind speed and direction, ambient temperature and relative humidity, barometric pressure, precipitation, and solar radiation. The specifications of the equipment installed on the original meteorological station are listed below:

- RM Young 05305 Wind Monitor-AQ for measuring wind speed and direction. This model is specifically designed for air quality measurements and according to Campbell Scientific, meets or exceeds requirements published by the EPA. The instrument is rated for wind speeds between 0 to 90 miles/hour and single gusts of 100 miles/hour.
- Vaisala HMP45C Temperature/ Relative Humidity probe and RM Young 12 plate gill solar radiation shield.
- Vaisala CS105 Barometric Pressure Sensor PTB101B.
- Texas Electronics TE525WS 8-inch Rain Gage with tipping bucket (0.01 tip) and CS705 snowfall adapter.

- Kipp & Zonen Silicon Pyranometer. This instrument is typically used in solar radiation applications such as plant growth and evapotranspiration investigations. It was mounted on the south cross arm and was unobstructed.
- CR10X measurement control and data logger and PC208W data logger software.
- Campbell Scientific PS100 power supply with 12V charging regulator, sealed rechargeable battery, and 18V 1.2A wall charger.
- Weatherproof 16" by 18" enclosure.
- CM10 10-foot tripod with grounding kit.
- Universal aluminum cross arm sensor mount.
- Pyranometer cross arm stand and Kipp & Zonen base and leveling fixture.
- RS-232 Interface and serial cable for downloading data.

Primary power to charge the 12V battery was supplied from the electrical service to PW-6. The meteorological station equipment was mounted to a tripod with a nominal height of 10 feet. The base diameter of the tripod was about 10 feet and did not obstruct access to well PW-6. The leg configuration of the tripod was adjustable for uneven terrain and was adequately leveled according to the manufacture specifications. The unit was designed to withstand a sustained wind of 70 miles per hour (mph) and gusts of 100 mph. Three rebar stakes held the station in place, and one of the two-foot stakes was cemented into the ground.

3.3.2 Additional Wind Sensors/Relocation of Original Meteorological Station

During December 2006 to January 2007, ARC installed additional wind sensors on 10-meter towers at air monitoring locations AM-1 and AM-3. For consistency with these two new locations, ARC proposed to move the original meteorological station to location AM-6 and elevate the wind sensor to 10 meters. The original sensors for ambient temperature and relative humidity, barometric pressure, precipitation, and solar radiation were moved to location AM-6 as well. ARC proposed to add a 2- and 10-meter delta temperature system to the meteorological station at location AM-6.

Each meteorological monitoring location currently has its own weatherproof enclosure, data logger, permanent electrical power supply, and cellular modem for telemetry. At off-site locations AM-1 and AM-3, each tower was placed inside the fenced compound for security. The placement still allows the tower to be tilted down through the gate opening for sensor maintenance and calibration. The specifications of the equipment installed solely on the meteorological station at AM-6 are listed below:

- Vaisala HMP45C Temperature/ Relative Humidity probe and RM Young 12 plate gill solar radiation shield.
- Vaisala CS105 Barometric Pressure Sensor PTB101B.
- Texas Electronics TE525WS 8-inch Rain Gage with tipping bucket (0.01 tip) and CS705 snowfall adapter with antifreeze.
- Kipp & Zonen Silicon Pyranometer. This instrument is typically used in solar radiation applications such as plant growth and evapotranspiration investigations. It is mounted on the south cross arm and is unobstructed.
- Pyranometer cross arm stand and Kipp & Zonen base and leveling fixture.
- RM Young RTD[7] Temperature Probe with 2- and 10- meter aspirated shields.

The specifications of the equipment installed at locations AM-1, AM-3, and AM-6 are listed below.

- RM Young 05305 Wind Monitor-AQ for measuring wind speed and direction.
- Universal UT30 30-foot tower and adjustable mast with concrete mounting base and guy wires.
- Universal aluminum cross arm sensor mount.
- Campbell Scientific CR1000 measurement and control data logger.
- Permanent electrical supply.
- Campbell Scientific PS100 power supply with 12V charging regulator, sealed rechargeable battery, and 18V 1.2A wall charger.
- Weatherproof 16” by 18” enclosure.
- Airlink Raven 100 cellular digital modem for Verizon systems with Yagi cellular antenna.
- Verizon data plan with static IP[8] addresses for each location.

[7] RTD refers to resistance temperature device
[8] IP refers to Internet Protocol

SECTION 4.0
SAMPLING SPECIFICATIONS

This section describes the EPA-approved specifications for air sampling and meteorological monitoring performed at the Yerington Mine Site.

4.1 Air Sampling

PM_{10} sampling has been conducted in accordance with 40 CFR, Chapter I, Appendix J to Part 50, *Reference Method for the Determination of Particulate Matter as PM-10 in the Atmosphere* (EPA, 1998a). TSP sampling has been conducted in accordance with 40 CFR, Chapter I, Appendix B to Part 50, *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)* (EPA, 1998b). Specifications for high volume sampling and continuous particulate sampling are described below.

4.1.1 High Volume Sampling

The high volume air monitoring will involve collecting an integrated (i.e., continuous) 24-hour air sample from midnight to midnight on the target day. Targeted values for sample duration, flow rate, and volume for both PM_{10} and TSP samples are provided in Table 3, which also includes parameter variances that are allowed by the PM_{10} and TSP methods.

Table 3. High Volume PM_{10} and TSP Sample Specifications

Parameter		PM_{10}	TSP
Sample Duration	Target	1,440 min	1,440 min
	Allowable variance	1,380 to 1,500 min	1,380 to 1,500 min
Sample Flow Rate	Target	40 ft^3/min (1.13 m^3/min)	50 ft^3/min (1.40 m^3/min)
	Allowable variance	36 to 44 ft^3/min (1.02 to 1.24 m^3/min)	39 to 60 ft^3/min (1.10 to 1.70 m^3/min)
Sample Volume	Target	57,600 ft^3 (1,630 m^3)	72,000 ft^3 (2,016 m^3)

Although the monitoring equipment has a digital timer and mass flow controller, actual sample duration and flow rate differ from targeted values. The actual detection limits achieved are dependent upon the instrument detection limit and sample volume (e.g., sample volumes less than targeted values result in higher than targeted detection limits).

4.1.2 Continuous Particulate Sampling

The TEOM units will be programmed to record integrated PM_{10} continuous measurements every hour. The ACCU system for the TEOM unit at AM-6 will be programmed to collect a sample on the 47-mm Teflon filter cassette when one 1-hour average PM_{10} concentration exceeds 300 µg/m^3. The ACCU system will continue to sample as long as the 1-hour average PM_{10} concentration exceeds 300 µg/m^3. The sample flow rate is 13.67 liters per minute (l/min) and the sample duration will be set for a minimum of two hours and a maximum of eight hours. This results in a sample volume range between approximately 1,640 liters and 6,560 liters and an average target sample volume of 4,100 liters (or 4.1 m^3). The filter cassette will then be analyzed at an off-site laboratory.

To minimize volatilization and the occurrence of negative mass results, the TEOM temperature settings will be lowered during winter months (from approximately October 31st to April 1st). The set points for operation of the TEOM units at the lower temperature are listed below.

- Enclosure Temperature (if applicable): 25° C
- Case Temperature: 30° C
- Air Temperature: 30° C
- Cap Temperature: 0° C (off)

4.2 Meteorological Monitoring

Meteorological monitoring has been conducted during each quarter, including the following parameters:

- Precipitation in inches;
- Temperature in degrees Celsius (ºC);
- Relative humidity in percent;
- Barometric pressure in milliBars (mBar);
- Solar radiation in kiloJoules per square meter (kJ/m^2);
- Wind speed in meters per second (m/s); and
- Wind direction in degrees.

The data loggers at each location will be programmed to sample every 2 seconds and record data every 15 minutes. At 24-hour intervals, the data logger calculates and records summary data (e.g., sum of precipitation readings) for the previous 24 hours.

SECTION 5.0
ANALYTICAL PARAMETERS AND METHODS

This section describes analytical parameters and methods, laboratory reporting limits, and sample hold times for high volume air sampling and continuous particulate air sampling, respectively.

5.1 High Volume Air Sampling

The AQM program began with gravimetric analysis of PM_{10} and TSP filters and chemical analysis of 21 metals and ten radiochemicals present on PM_{10} and TSP filters as shown in Table 4. Beginning with Event 88 on July 4, 2006, the analyte list was revised to eight metals and five radiochemicals present on PM_{10} and TSP filters as shown in Table 4. Also, sulfate was added as an analysis.

Table 4 summarizes the analytical methods, laboratory reporting limits, and sample hold times for high volume air sampling with the quartz fiber filter. Mercury is analyzed by EPA Method 7471A using CVAA[9] instrumentation. Aluminum, calcium, iron, magnesium, and sodium are analyzed by EPA Method 6010B using ICP[10] instrumentation. The remaining metals are analyzed by EPA Method 6020 using ICP/MS[11] instrumentation. Sulfate is analyzed by EPA Method 9056 using ion chromatography. Gas proportional counters are used to analyze gross alpha and gross beta by EPA Method 900.0 and radium-228 by EPA Method 904.0. Radium-226 is analyzed by EPA Method 903.1 using an alpha scintillation counter. Alpha spectrometry is used to analyze thorium species by Standard Method 7500-U-C and ASTM[12] Method D-5174 and uranium species by modified EPA Method 908.0. Target sample volumes for quartz fiber filters are 1,630 m^3 and 2,016 m^3 for PM_{10} and TSP, respectively. Actual reporting limits achieved for samples from any given monitoring location during any given monitoring event will depend on the actual sample volume collected, which can vary.

[9] CVAA refers to cold vapor atomic adsorption
[10] ICP refers to inductively coupled plasma instrumentation
[11] ICP/MS refers to inductively coupled plasma/mass spectrometry instrumentation
[12] ASTM refers to American Society for Testing and Materials

Table 4. High Volume Air Sampling Analytical Parameters and Methods

Parameter	Analyte List	Method	Reporting Limit	Sample Hold Time	Sample Media
Aluminum	**Revised**	6010B	240 µg	6 months	8" x 10" quartz fiber filter
Arsenic	**Revised**	6020	3.6 µg	6 months	
Barium	Original	6020	120 µg	6 months	
Beryllium	Original	6020	1.2 µg	6 months	
Cadmium	**Revised**	6020	1.2 µg	6 months	
Calcium	Original	6010B	3,000 µg	6 months	
Chromium, Total	**Revised**	6020	12 µg	6 months	
Cobalt	**Revised**	6020	12 µg	6 months	
Copper	**Revised**	6020	6 µg	6 months	
Iron	Original	6010B	120 µg	6 months	
Lead	Original	6020	1.2 µg	6 months	
Magnesium	Original	6010B	600 µg	6 months	
Manganese	**Revised**	6020	6 µg	6 months	
Mercury	Original	7471A	0.12 µg	28 days	
Molybdenum	Original	6020	6 µg	6 months	
Nickel	**Revised**	6020	6 µg	6 months	
Selenium	Original	6020	3.6 µg	6 months	
Silver	Original	6020	1.2 µg	6 months	
Sodium	Original	6010B	6,000 µg	6 months	
Vanadium	Original	6020	12 µg	6 months	
Zinc	Original	6020	24 µg	6 months	
Sulfate	**Revised**	9056	480 µg	28 days	
Alpha, Gross	**Revised**	900.0	20 pCi	6 months	
Beta, Gross	Original	900.0	5 pCi	6 months	
Radium-226	**Revised**	903.1	1 pCi	6 months	
Radium-228	**Revised**	904.0	3.1 pCi	6 months	
Thorium-228	**Revised**	IsoTh	1 pCi	6 months	
Thorium-230	**Revised**	IsoTh	1 pCi	6 months	
Thorium-232	Original	IsoTh	1 pCi	6 months	
Uranium-234	Original	908.0 Modified	1 pCi	6 months	
Uranium-235	Original	908.0 Modified	1 pCi	6 months	
Uranium-238	Original	908.0 Modified	1 pCi	6 months	
PM_{10}	**Revised**	40 CFR Appendix J	100 µg	6 months	
TSP	**Revised**	40 CFR Appendix B	100 µg	6 months	

Reporting limits provided are mass per filter.

5.2 Continuous Particulate Air Sampling

The Teflon filters generated from the ACCU system for the TEOM unit at AM-6 will be analyzed for the eight metals and sulfate on the revised list. In addition, the Teflon filters will be analyzed for total mass of radium, uranium, and thorium. The metals and radiochemicals will be analyzed by EPA Compendium Method IO 3.3 using XRF[13] instrumentation. XRF is a non-destructive and sensitive analytical technique for a wide variety of elements. XRF can quantify total radium, uranium, and thorium by weight; however, XRF cannot quantify specific uranium,

[13] XRF refers to X-ray fluorescence spectroscopy

radium, and thorium isotopes or gross alpha/beta. The radium mass would most likely be radium-226; however, mass contributions from radium-228 may interfere with precise determinations and there is no method to distinguish between the two. The uranium and thorium masses can be treated as uranium-238 and thorium-232. Subsequent to XRF analysis, the Teflon filters will be digested for sulfate analysis by EPA Method 9056 using ion chromatography.

Table 5 summarizes the analytical parameters and methods, laboratory reporting limits, and sample hold times for continuous particulate air sampling. The target sample volume for Teflon filters is 4,100 liters (or 4.1 m^3). The combined use of XRF and Teflon filter media will allow for minimum ambient concentration reporting limits similar to the existing reporting limits for the high volume sampler with ICP/MS analysis of quartz filter filters for metals on the revised analyte list.

Table 5. Analytical Parameters and Methods For Continuous Particulate Air Sampling

Parameter	Method	Reporting Limit	Sample Hold Time	Sample Media
Aluminum	IO 3.3	0.269 µg	6 months	47-mm Teflon filter
Arsenic	IO 3.3	0.009 µg	6 months	
Cadmium	IO 3.3	0.147 µg	6 months	
Chromium, Total	IO 3.3	0.024 µg	6 months	
Cobalt	IO 3.3	0.020 µg	6 months	
Copper	IO 3.3	0.028 µg	6 months	
Manganese	IO 3.3	0.082 µg	6 months	
Nickel	IO 3.3	0.022 µg	6 months	
Sulfate	9056	0.750 µg	6 months	
Radium, Total	IO 3.3	0.10 µg	6 months	
Uranium, Total	IO 3.3	0.10 µg	6 months	
Thorium, Total	IO 3.3	0.10 µg	6 months	

Reporting limits provided are mass per filter.

SECTION 6.0
QUALITY ASSURANCE PLAN

Quality assurance for the Yerington Mine Site is described in the *Quality Assurance Project Plan, Yerington Mine Site, Revision 2* ("QAPP") (ESI and Brown and Caldwell, 2007). The program incorporates the following items: standard operating procedures ("SOPs"), equipment calibration and maintenance, independent audit, field and laboratory quality control ("QC") samples, data validation, corrective action, and data completeness.

6.1 Standard Operating Procedures

Calibration, operation, and maintenance of the air monitoring equipment has been, and will be, conducted in accordance with the SOPs provided in the QAPP. The SOP for calibration, operation, and maintenance of the PM_{10} high volume air sampling equipment is provided in Appendix B. This SOP includes detailed instructions on sampler operation, digital timer operation, and total sample volume calculations. This SOP can be used for calibration, operation, and maintenance of the TSP high volumes as well. The SOP for calibration, operation, and maintenance of the continuous particulate monitoring equipment is provided in Appendix C.

6.2 Equipment Calibration

Equipment calibration for the high volume air samplers and meteorological station has been, and will be, performed in accordance with manufacturer specifications and/or EPA guidance as described below. This section also describes the calibration report that will be included in the quarterly and annual reports.

6.2.1 High Volume Air Samplers

Calibration of the PM_{10} and TSP air sampling equipment has been, and will be, performed by Brown and Caldwell. The manufacturer recommends the equipment be calibrated according to the following schedule:

- Upon installation;
- After any motor maintenance;
- Once every 3 months (quarterly); and
- After 360 sampling hours.

The same calibration SOP is used for both the PM_{10} and TSP high volume air samplers, and is provided in Appendix B. The Tisch Environmental, Inc. variable resistance calibration kit is used for the calibration process and includes a variable orifice, NIST traceable calibration certificate, adapter plate, slack tube manometer and tubing. A digital manometer is used in place of the slack tube manometer during cold weather. In addition to following the calibration procedures specified in the SOPs, the following calibration criteria must be met:

- Minimum of five calibration points;
- Three calibration points within the allowable variance range (e.g., for PM_{10}, three points must be within 36 to 44 ft^3/min); and
- Correlation coefficient greater than 0.990.

6.2.2 Continuous Particulate Air Samplers

Calibration of the continuous particulate monitoring equipment will be performed in accordance with manufacturer recommendations, as summarized below:

- Flow controller calibration every 3 months (quarterly)
- Mass calibration verification every 12 months (annually)
- Ambient temperature and barometric pressure calibration every 3 months (quarterly)
- Analog calibration every year (annually)

6.2.3 Meteorological Station

Calibration of the meteorological station(s) was performed at the start of the AQM program and continues on a semi-annual basis.

6.2.4 Calibration Report

Calibration results for the high volume air samplers and meteorological station(s) will be included in the quarterly and annual monitoring reports. The following information will be provided in the calibration report:

- Calibration summary
- Calibration methods
    - PM_{10} high volume samplers
    - TSP high volume samplers
    - Continuous particulate monitors
    - Meteorological station(s)
- Calibration equipment
- Calibration results and comments

6.3 Equipment Maintenance

Maintenance for the PM_{10} and TSP high volume air sampling equipment and meteorological station(s) has been, and will be, performed by Brown and Caldwell. Equipment maintenance for the PM_{10} and TSP high volume air samplers is provided in Appendix B and consists of routine maintenance, motor brush replacement, and troubleshooting/corrective action. The manufacturer recommends checking or replacing motor brushes every 300 to 500 hours of operation. Meteorological station maintenance is provided in Appendix D. Maintenance of the continuous particulate monitoring equipment will be performed as described in Appendix C, and summarized below:

- Inspect/clean PM_{10} inlet every 3 months (quarterly).
- Replace large bypass in-line filters every 6 months (semi-annually).
- Clean air inlet system every 12 months (annually).
- Perform leak test every 3 months (quarterly) or after any component in the flow system is replaced.
- Rebuild sample pump every 18 months.

6.4 Independent Audit

EPA has conducted quarterly audits, and will continue to conduct quarterly audits, on the high volume air samplers and semi-annual audits on the meteorological station(s). EPA will also perform quarterly audits on the continuous particulate monitoring equipment. All audits follow EPA guidelines and accuracy criteria.

6.5 Field and Laboratory QC Samples

Field and laboratory QC samples for the AQM program are specified in the QAPP. Field QC samples consist of co-located samples, filter blanks, and field blanks as described below. Co-located samples (sometimes referred to as duplicate samples for air sampling) are used to check for sampling and analysis error, reproducibility, and homogeneity. The co-located sample will be obtained by collecting a simultaneous sample from the secondary high volume air sampler co-located with the primary sampler at location AM-1. One co-located sample will be collected per 10 primary samples for the high volume air sampling only. Analyses of filter blanks (sometimes referred to as trip blanks for air sampling) are used to assess the contamination of samples from the native presence of target analytes in the filters used for air sample collection.

A filter blank consists of a clean filter that is transported with associated primary samples, but is never taken out of its protective sleeve. A filter blank will be collected and analyzed for every 20 primary samples. Analyses of field blanks are used to assess the contamination of samples during sample collection. A field blank consists of a clean filter that is placed onto the air sampler and then taken off without running the sampler. A field blank will be collected and analyzed for every 20 primary samples. All field QC samples have been, and will be, submitted blind to the laboratory. Field QC samples will be analyzed for the same parameters specified for the associated primary samples. Laboratory QC samples consist of method blanks, laboratory control samples (LCSs), and laboratory duplicate (LD) samples as specified in the QAPP.

6.6 Data Verification and Validation

The laboratory provides a standard data package for all samples and a comprehensive validation package for 10 percent of all samples. Data verification for 100 percent of all samples has been, and will continue to be, performed using the standard data package and the criteria provided in the QAPP. Data verification has been, and will continue to be, performed on 100 percent of all meteorological data according to the criteria provided in Appendix E A third party has been conducting data validation on 10 percent of all samples using the comprehensive validation package and the criteria provided in the QAPP. Beginning with 3rd quarter 2007, data validation will be performed on 20 percent of all samples per the latest revision of the QAPP.

6.7 Corrective Action

In the event of error or omission during the execution of this air quality monitoring program, a corrective action procedure is implemented. The procedure begins with prompt notification to the Project Manager, an investigation into the cause and effect of the incident, implementation of the corrective action, and submittal of a corrective action letter to the lead agency. The letter will describe the incident, investigation results and corrective action taken.

6.8 Data Completeness

Program goals for data completeness consist of quarterly valid data retrieval of 90 percent for meteorological data and 80 percent for air quality data. The completeness goal for air quality data is to be tracked for each of the six monitoring locations (i.e., AM-1 through AM-6). If one or more of the high volume air samplers malfunctions during a sampling event, such that valid data cannot be retrieved, then a makeup run can be conducted on the immediately following NAAQS 3-day schedule event.

SECTION 7.0
DATA MANAGEMENT

Data management for the Yerington Mine Site is described in the *Data Management Plan for the Yerington Mine Site* (Brown and Caldwell, 2007b). Data management for the AQM Program consists of data acquisition, database management, and data retrieval. Data acquisition consists of field data for high volume air sampling, analytical laboratory results, and continuous measurements from the meteorological station/additional wind sensors and continuous particulate monitors. Meteorological data acquisition is summarized in Table 6. Continuous particulate monitoring data acquisition is summarized in Table 7. Information from high volume air sampling is recorded manually on field data sheets and calibration data sheets and hand-entered into corresponding Excel spreadsheets. After the spreadsheets are checked for accuracy, they are used to calculate calibration curves and sample volumes which are loaded into the project database with an automatic data loading program. Analytical results are submitted by laboratories via electronic data deliverable (EDD) files and loaded into the database with an automatic data loading program. The data generated from the meteorological stations and continuous particulate monitors at AM-1, AM-3, and AM-6 will be transmitted by cellular modem via static IP addresses. Data will be retrieved daily during business days and loaded into the database with automatic data loading programs.

Table 6. Meteorological Data Acquisition

Parameter	Location			Units	Frequency	
	AM-1	AM-3	AM-6		15 min	60 min
Wind direction (resultant mean vector & stand. dev.)	X	X	X	degrees	X	X
Wind speed (scalar avg. & resultant mean vector)	X	X	X	m/s	X	X
Barometric pressure			X	mBar	X	X
Ambient temperature			X	°C	X	X
Relative humidity			X	percent	X	X
Solar radiation			X	kJ/m2	X	X
Precipitation			X	inches	X	X
Aspirated 2m/10m temperature			X	°C	X	X

All data are stored in a Microsoft SQL Server relational database which is maintained by the database administrator. Data are retrieved and queried with a Microsoft Access graphical user interface. Tables for AQM reporting are generated automatically from the project database.

Table 7. Continuous Particulate Monitor Data Acquisition

Parameter	Location			Units	Freq.	Criteria	Action
	AM-1	AM-3	AM-6				
Continuous PM10 (hourly & 24-hr running avg.)	X	X	X	µg/m3	60 min	>= 300 @ AM-6	Begin ACCU sample @ AM-6
Status code	X	X	X		60 min	> 0	Check system
Filter loading value	X	X	X	percent	60 min	>= 75	Replace filter
Total mass	X	X	X	µg	60 min		
Main flow rate	X	X	X	L/min	60 min	< 2.9 or < 3.1	Check system
Auxiliary flow rate	X	X	X	L/min	60 min	< 13.6 or > 13.8	Check system
Noise	X	X	X	µg	60 min	>= 0.1	Check system
Frequency	X	X	X	hz	60 min	< 150 or > 400	Check system
Cap temperature	X	X	X	°C	60 min	< 49.9	Check system
TEOM air temperature	X	X	X	°C	60 min	< 49.9	Check system
Ambient temperature	X	X	X	°C	60 min	> 1 difference	Check system
Barometric pressure	X	X	X	atm	60 min	> 0.05 difference	Check system
TEOM date/time	X	X	X		60 min	> 1 min	Check system
Shed temperature	X	X	X	°C	60 min		

SECTION 8.0
REPORTING

Reporting consists of quarterly and annual reports. Electronic data submittals are included in each report, as described below.

8.1 Quarterly Report

Quarterly reports include a summary of monitoring activities and analytical results during the quarter, data collected, results of calibration, and maintenance performed. Tables are used to summarize analytical results by monitoring event and average meteorological conditions by month. Field data sheets, calibration report, analytical laboratory reports and data verification results are included in the report appendices. Quarterly reports are to be submitted to the EPA within three months following the end of the subject quarter.

8.2 Annual Report

The annual report will present the information provided in a quarterly report, summarize the activities for the entire year, present an interpretation of the results, and provide conclusions and recommendations. Tables and appendices will be similar in format to those included in the quarterly report but will be comprehensive for the entire year. The annual report will be submitted to the EPA within three months following the end of the monitoring period.

8.3 Electronic Data Submittal

Electronic copies of the monitoring data in Microsoft Excel format have been, and will be, provided to EPA with the quarterly and annual reports.

SECTION 9.0
SCHEDULE

The schedule for the AQM program has been in accordance with the NAAQS monitoring schedule for PM_{10} with monitoring conducted every sixth day. A sampling and analysis plan ("SAP") is provided in Appendix F that documents actual samples collected previously and planned collection of samples. The SAP lists the sample event dates, locations, primary samples, and field QC samples. Note that the SAP serves as a guide for field personnel and the actual location and timing of collecting field QC samples may vary somewhat.

Air monitoring began with Event 1 on January 28, 2005. Beginning with Event 88 on July 4, 2006, the air monitoring program scope was revised per the EPA letter dated June 16, 2006. Beginning July 1, 2006, PM_{10} high volume air samplers at AM-1, AM-3, and AM-6 and the TSP high volume air sampler at AM-6 operated under the revised air monitoring program. TSP high volume air sampler operation at AM-6 terminated with the completion of Event 116 on December 19, 2006.

During December 2006 to January 2007, field activity consisted of re-locating/raising the original meteorological station, installing the additional wind sensors and towers, installing the continuous particulate monitors and weatherproof enclosures, and calibrating all equipment. During this time, operation of the original meteorological station and PM_{10} high volume air samplers at AM-1, AM-3, and AM-6 was suspended. The high volume PM_{10} monitoring resumed at AM-1, AM-3, and AM-6 on February 5, 2007. The continuous particulate monitors have been installed and are operating at AM-1, AM-3, and AM-6 as of February 7, 2007. The 10-meter towers have been installed and wind monitors are operating at AM-1, AM-3, and AM-6 as of February 16, 2007.

To generate adequate data for Step 3. Identify the Inputs to the Decision for the Short-term Acute Health and Ecological Effects Assessment DQO, ARC will operate the continuous particulate monitors for a 12 month period from February 2007 through February 2008. After the one year of monitoring has been completed, an evaluation report will be submitted to EPA and EPA will then determine if the monitoring can be terminated.

SECTION 10.0

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