ADMINISTRATIVE ORDER ON CONSENT
QUALITY ASSURANCE PLAN

Prepared by:
Chino Mines Company
210 Cortez Avenue
Hurley, New Mexico 88043

and

Steffen Robertson and Kirsten (U.S.), Inc.
7175 West Jefferson Avenue
Suite 3000
Lakewood, CO 80235

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1. INTRODUCTION

This Quality Assurance Plan (QAP) presents the management, control and validation procedures for data collected in support of the Administrative Order on Consent (AOC) for the Chino Mines Company (CMC) project. The AOC is an agreement between CMC and the New Mexico Environment Department (NMED) to investigate the potential effects of historic mining operations on environmental media within an historic mining district. The investigation consists of a remedial investigation, feasibility study and, if necessary, the development, design and implementation of a remedial action plan(s) consistent with the National Oil and Hazardous Substances Contingency Plan (NCP) (400 CFR Part 300).

This QAP has been prepared for use by CMC and its technical consultants in conducting environmental measurements and monitoring during AOC activities. The Remedial Investigation (RI) will generate data necessary to determine constituent concentrations and to evaluate potential risks to health and to the environment, if any, and to evaluate potential alternative remedial actions.

The QAP is intended to ensure that appropriate quality assurance (QA) and quality control (QC) measures are instituted and monitored during data collection activities and sample analyses. The QAP also documents procedures to verify that deviations are corrected or justified. The use of a centrally managed QA program, as described herein, for sampling and analysis activities assures that precision, accuracy, representativeness, completeness and comparability (PARCC) of data are known and documented in a consistent fashion. The Data Management Plan (DMP) (Appendix A) describes how electronic data will be recorded, stored, checked and transmitted by CMC and its technical consultants.

This QAP addresses general data requirements associated with RI activities in the AOC Investigation Area. CMC anticipates that the procedures outlined herein for assessing data quality and data usability will remain the same; however, quantitative QA objectives may require modification based on investigation-specific data needs. Each RI Proposal (also future work plan submittals and deliverable data quality assessment reports) will incorporate this QAP by reference and present investigation-specific QA objectives as necessary.

1.1 Project Overview

Figure 1 presents the AOC Investigation Area (IA) and associated Investigation Units (IUs). In accordance with the AOC, CMC prepared draft RI Proposals for NMED review in January, 1996. Data quality objective (DQO) planning was used to identify data collection needs in each IU. Field Sampling Plans (FSPs), included as part of the RI Proposals, identify the environmental media to be sampled along with location, frequency and specific analytical procedures. If, upon completion of work detailed in the RI Proposals additional investigations are warranted, additional work plans/proposals will be developed.

Standard Operating Procedures (SOPs), adopted by CMC, are included as part of this QAP (Appendix B). The SOPs serve as a guide for sample collection, field measurements and field testing. Deviations from the SOPs will be documented in the FSPs and/or, RI Reports and/or the project files along with justification for changes in the procedure(s).

1.2 Summary of Guidance

This QAP was developed using guidance in the following documents:

- "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations", (EPA QA/R-5);
- "Data Quality Objectives Process for Superfund", (EPA-540/R-93/071);
- Section 3-107.B of New Mexico Water Quality Control Commission (WQCC) regulations (incorporates several published technical references for sampling and analytical technique e.g., EPA, ADPHA, USGS, ASTM, etc.);
- Section 1-103 of New Mexico WQCC Water Quality Control Standards for Interstate and Intrastate Streams in New Mexico (incorporates several published technical references for sampling and analytical technique e.g., EPA, ADPHA, USGS, ASTM, etc.);
- "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", (EPA/540/G-89/004);
- "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", (EPA-540/R-94-013); and

- "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", (EPA-540/R-94/012).

Deviations from the QAP procedures will only be permitted with written documentation of the reason and a detailed explanation and justification of the change. QA/QC procedures detailed in this QAP are based on good laboratory practices. Appendix C contains the laboratory QAP(s) for CMC's contract laboratory(ies). If other laboratories are required to complete AOC-related analyses, then the laboratory's QAP will be submitted as an addendum to this AOC QAP.

2. PROJECT DESCRIPTION

CMC owns and operates a copper mine, concentrator, smelting complex, precipitation plant and solution extraction/electrowinning facility approximately 12 miles east of Silver City, New Mexico. Figure 1 shows the CMC site and surrounding areas. The following IUs are designated within the AOC IA:

- Lampbright Draw IU: This IU is located in the northeast corner of the IA and includes the area around the Lampbright Stockpile;
- Hanover Creek Channel IU: The Hanover Creek Channel is located in the north central part of the IA;
- Whitewater Creek Channel IU: This IU is located hydraulically downgradient from Hanover Creek and extends to U.S. Highway 180, south of CMC's tailing impoundment facilities. Hanover Creek and Whitewater Creek are contiguous and located in the same watershed;
- Smelter IU: The Smelter IU is located on the east side of the town of Hurley. This IU includes all areas containing and proximal to CMC's copper smelter and all ancillary facilities;
- Hurley Soils IU: This IU includes soil in the town of Hurley and soil in the three clusters of residences immediately north of the Town of Hurley;
- Tailing Impacted Soils IU: The Tailing Impacted Soils IU is located in the southern portion of the IA. This area includes those soils that the investigation may delineate as being affected by the tailing; and
- Ecological IU: A site-wide ecological investigation to be completed under the AOC. Although referred to as an IU, the ecological investigation will assess potential ecological impacts within the AOC IA.

2.1 RI Background Report

In accordance with the AOC, the final RI Background Report (CMC, 1995) was transmitted to NMED on October 5, 1995 and approved by NMED on October 27, 1995 (NMED, 1995). The RI Background Report assessed existing environmental conditions for each IU and identified conceptual data needs for further investigation. Consistent with the NCP and as outlined in the AOC, the next phase of the project scope of work is the RI.

2.2 RI Proposals

Each RI Proposal describes sampling stations and sampling frequencies for media of concern. In addition, each RI Proposal presents quantitative QA objectives based upon intended data end use. Target analytes vary for each IU and may include compounds that were identified in previous investigations.

Concentrations of analytes will be determined through use of standard analytical techniques (or appropriate modifications) in accordance with:

- Section 3-107.B of New Mexico Water Quality Control Commission (WQCC) regulations;
- Section 1-103 of New Mexico WQCC Water Quality Control Standards for Interstate and Intrastate Streams in New Mexico; and
- Other appropriate guidance approved by NMED.

In addition, X-Ray Fluorescence (XRF) analysis may be used to assess concentrations of constituents at select locations.

2.3 Data Quality Objective Planning

IU-specific data needs and data gaps were identified, in part, through the use of the seven stage DQO process (EPA, 1994). The DQO process includes the following steps:

- Step 1: State the problem - Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem;
- Step 2: Identify the decision - Identify what questions the study will attempt to resolve, and what actions may result;
- Step 3: Identify the inputs to the decision - Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement;
- Step 4: Define the study boundaries - Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected;

- Step 5: Develop a decision rule - Define the statistical parameter(s) of interest, specify the action level and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions;
- Step 6: Specify tolerable limits on decision errors - Define the decision maker's tolerable decision error rates based on a consideration of consequences of making an incorrect decision; and
- Step 7: Optimize the design - Evaluate information from previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

A detailed discussion of how the DQO process was utilized to define RI data needs is presented in Section 3 of each RI Proposal. Each RI Proposal also includes a series of conceptual site models which describe potential exposure pathways. Section 4 of each IU-specific RI Proposal identifies the exposure pathways that require further evaluation and defines the objectives, decisions, data inputs, data sources, decision criteria, sampling and analytical techniques and study boundaries.

The RI Proposals utilize the DQO process to assist strategic planning for data collection activities. Data end uses for samples were identified and the number and location of samples for data needs were optimized. The DQO process provides a systematic approach to define the criteria that data collection design should satisfy, including when to collect samples, where to collect samples, the tolerable level of decision errors for the IU and how many samples to collect.

The results of the DQO process are of critical importance to the data quality assessment process described herein (Sections 9 and 10) because the DQO results provide criteria for assessing the usability of the data for its intended end use. The data validator will utilize the DQO-derived QA objectives and DQO-defined end use of the data to assess the usability of the data. Therefore, in addition to the quantitative and qualitative analytical procedures defined herein (Section 4), data quality assessment will include reconciliation with DQOs (Section 13).

3. PROJECT ORGANIZATION AND RESPONSIBILITIES

Figure 2 presents the project organization chart and depicts the primary lines of communication among personnel. The organization chart is intended for communication purposes and does not represent electronic data flow or transfer. The DMP (Appendix A) presents a detailed discussion of procedures for electronic data transfer.

The quality assurance organization for this project and the individuals responsible for ensuring the quality of field and laboratory operations and data collected are provided below:

NMED AOC Project Manager:

- Oversight of AOC activities;
- Approve QAP;
- Review quarterly reports;
- Review and approve AOC deliverables; and
- Responsible for collection of split samples and receipt of split sample data results.

CMC AOC Project Manager:

- Overall responsibility for AOC activities;
- Review QA needs, problems and requests;
- Approve QAP and appropriate QA corrective actions as needed;
- Submit quarterly progress reports to NMED AOC Project Manager as required by the AOC; and
- Responsible for regulatory correspondence and central database management.

CMC Community Relations Representative:

- Responsible for presenting AOC-derived data to the community;
- Schedule and promote community meetings;
- Act as point of contact for community; and
- Work closely with CMC AOC Project Manager regarding progress of AOC investigation activities.

CMC AOC Data Administrator:

- Coordinate scheduling with IU Project Managers and laboratories;
- Receive electronic data deliverables and upload into CMC database system;
- Manage laboratory invoices;
- Coordinate schedule and progress of data validation work;
- Track and file laboratory deliverables;
- Coordinate database management activities;
- Responsible for maintaining database and final evidence files; and
- Assure that project timeliness and data deliverable quality standards are met.

Project Quality Assurance Officer:

- Receive laboratory deliverables and pertinent field data;
- Complete appropriate validation activities for data to be used in AOC decisions;
- Assign data qualifiers;
- Assist CMC AOC Data Administrator as necessary;
- Independent checks of completeness, data usability and overall QA;
- Provide interim IU-specific Data Quality Assessment reports for each deliverable and recommends QA problem solutions to CMC; and
- Communicate with the CMC AOC Data Administrator and the analytical laboratory.

IU Project Manager:

- Develop and oversee IU-specific AOC activities;
- Provide technical oversight;
- Ensure delivery of data and IU-project deliverables to CMC;
- Implement necessary action and adjustments for activities to accomplish project objectives; and
- Work closely with the IU QA officer and CMC AOC Data Administrator to ensure that data are available on time.

IU Quality Assurance Officer:

- Provide technical assistance;
- Review and initially approve QAP;
- Coordinate development of IU-specific work plans/proposals;

- Monitor field investigations;
- Ensure that appropriate field QC samples are collected per SOPs;
- Coordinate data quality issues for IU level project work to ensure compliance with the QAP; and
- Review interim IU-Specific Data Quality Assessment report and write the final IU-specific Data Quality Assessment report for each IU deliverable.

Project Data User(s): The Project Data Users comprise the largest group of project team members. These staff have responsibility to interpret the project data in accordance with the objectives of the AOC. The Project Data User requests and receives data from the IU Project Manager. Project data may have several end uses (e.g., RI/FS, HERA).

NMED Analytical Laboratory: The independent laboratory which is responsible for chemical analyses of split samples collected by NMED. Analytical procedures utilized by the NMED analytical laboratory will be similar to the procedures used by CMC's analytical laboratory. Hardcopy data results from split samples analyzed by the NMED analytical laboratory will be forwarded to the NMED AOC Project Manager. Electronic deliverables will be transmitted to the CMC data administrator.

CMC Analytical Laboratory: The Analytical Laboratory (AL) is a third party contractor, selected by CMC, who is responsible for the off-site chemical and/or physical sample analyses. AL staff may include the following personnel: laboratory director, QA officer, sample custodian and bottle shipment coordinator. The laboratory director is the primary contact who will oversee AOC-related analytical work and be responsible for timely delivery of data results. The laboratory QA officer will ensure that instruments are calibrated and maintained as specified, internal QC measures and analytical methods are performed as required and corrective action is taken. The laboratory QA officer will also notify the Project QA Officer when problems occur, and ensure that data and QA information are reported properly. The sample custodian will ensure that sample receipt and custody records are properly handled. The bottle shipment coordinator will be responsible for sending the appropriate sample containers and coolers to the job site in a timely manner.

Appendix D presents the names, phone numbers and addresses of the personnel currently assigned to the various positions of responsibility listed above, except project data users. Appendix D will be updated as necessary throughout the project.

4. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

The overall QA objective for measurement data for the AOC is to ensure the data collected are sufficient and of adequate quality for their intended uses. Potential data end uses include:

- Site Characterization;
- Health and Environment Risk Assessment (HERA);
- Feasibility Study;
- Remedial Design and Remedial Action; and/or
- Demonstration of Compliance with Remedial Action Criteria.

As described in Section 2, DQO planning was used during preparation of each RI Proposal to identify data needs and final QA objectives for measurement in each IU. Specific field sampling plans are presented in each RI Proposal as well as decisions, decision criteria and other essential data quality criteria that further characterize the intended use of the data. Details of the decisions and the desired statistical confidence levels for the data are presented in Section 4 of each RI Proposal. The data validation and quality assurance assessment will be completed to support evaluation of the usability of the data for the intended end use in light of the DQOs developed in the RI Proposals.

The following levels of data quality/usability will be applied during the AOC:

- "Acceptable";
- "Acceptable with Qualification"; and
- "Unusable or Rejected Data".

The quality of "acceptable" data will allow use of the data without limitation in its intended end use (i.e., all aspects of the AOC process for which they were collected). The quality of data identified as "acceptable with qualification" will be used as deemed appropriate in the data usability assessment. Data rejected as a result of the validation process will be considered unusable.

"Acceptable" quality defines data that meet the following criteria:

- Samples collected and documented in accordance with appropriate field sampling protocols (e.g., standard operating procedures);
- Laboratory analyses performed in a qualified analytical laboratory implementing good laboratory practices (i.e., established protocols and QA procedures). Field measurement data collected using appropriate sampling and measurement protocols. QA/QC protocols and documentation are applied to minimize error; and
- Data meet validation requirements and the data validation contractor determines that the data are usable for the intended DQO end use.

Data determined to be "acceptable with qualification" define data that do not meet the complete set of criteria established for "acceptable" quality. The data may not provide the statistical significance necessary to make certain decisions, however, the data may still be useful for the AOC process. The acceptable with qualification data may be used to support the acceptable data.

"Rejected or unusable" data will be identified and qualified during the validation process. Rejected data can be associated with either poor field QA/QC or poor laboratory QA/QC. Examples of rejected or unusable data would include results from a sample from an unknown sample location or results from a sample that fails to meet certain control limits for that sample.

XRF analysis results are generally considered as "acceptable with qualification" data. However, based on the validation of the XRF results (e.g., accuracy and precision), the results can be classified as "acceptable" data. This qualification will be based on the data quality objectives developed for the samples and the data validator's data usability assessment.

It is anticipated that much of the data generated as part of the AOC will be analyzed in accordance with CLP procedures and will be validated using guidance from the CLP National Functional Guidelines for Data Review. These data, if not qualified, will meet the "acceptable" quality criteria for data usability. Non-CLP data will also be considered acceptable if they are analyzed in accordance with appropriate laboratory methodologies

(e.g., those listed in Table 4-1) and, after validation, are considered sufficient for its intended use. Data validation procedures are discussed in detail in Section 9.

4.1 Indicators of Data Quality

Five parameters are used to evaluate the quality of data measurement:

- Precision;
- Accuracy;
- Representativeness;
- Completeness; and
- Comparability.

The parameters precision and accuracy provide a quantitative measure of the data quality based on evaluation of quality control measurements. Completeness provides a method to compare the desired or planned number of results from DQO planning with the number of valid results. The remaining parameters, representativeness and comparability, use field documentation and laboratory procedures to qualitatively evaluate the success achieved in collecting appropriate data for the end uses identified in the DQO process.

QC samples from the field and laboratory are used to monitor the precision and accuracy of the data gathered. These samples include blanks, duplicates, matrix spikes, laboratory control samples, etc. All phases of sample collection, shipment preparation and analysis are monitored through use of QC samples and checks.

Specific quantitative and qualitative objectives for each parameter or characteristic are established to develop sampling protocols and identify applicable documentation, sample handling procedures and data acquisition procedures. Those presented herein are expected to be appropriate for several applications, but should be modified as appropriate to support the quality assurance objectives established in each work plan (e.g., RI Proposal). These objectives are based on the anticipated end use of the data and knowledge of available measurement systems. The subsequent use of these measurements in calculations and evaluations is also subject to aspects of this QAP as described in the following sections.

4.2 Quantitative QA Objectives

Quantitative detection limit objectives for anticipated laboratory analytical methods are presented in Table 4-1. Each RI Proposal identifies appropriate laboratory methods and parameters from the list presented in Table 4-1. Each RI Proposal also addresses the adequacy of the detection limits required to make AOC decisions regarding data collection. Future AOC sampling plans, if necessary, will also use the DQO process to address the adequacy of laboratory methods and detection limits. If modification to the analytical methods or detection limits is necessary, it may be indicated in the appropriate FSP or an addendum to this QAP will be submitted to NMED.

Typical precision, accuracy and completeness QA objectives are summarized in Table 4-2; however, it should be noted that these need to be evaluated on a case-by-case basis in light of the intended end use of the data. Holding time objectives, including preservation and containerization, are included in SOP-14 (Appendix B).

It is anticipated that "acceptable" quality data will meet the appropriate QA objectives. Attainment of investigation-specific quantitative QA objectives will ensure that the data collected are sufficient and of adequate quality (e.g., "acceptable" quality) for their intended uses. Data that do not meet the QA objectives may be qualified during data validation (e.g., "acceptable with qualification" or "rejected"). If data are obtained outside of QA objective limits, the data will be further evaluated to determine whether they are of sufficient quality for their specific intended use. The rationale for such judgments will be fully described in each validation report and discussed further in each deliverable QA assessment for NMED review.

Table 4-1 presents the anticipated maximum reporting limits for AOC-related analyses. The reporting limits for metals are based primarily upon Contract Required Detection Limits (CRDLs). CRDLs represent the CLP SOW defined maximum detection limits for the analytical methods on clean matrices. Where CRDLs were not defined in the CLP SOW (i.e., boron and molybdenum) or CRDLs were considered too high (i.e. arsenic and beryllium), decision criteria were incorporated as the maximum reporting limit. Decision criteria were developed as part of the RI Proposals. The maximum reporting limits shown in Table 4-1 represent the anticipated QA objective for measurement for metals analyses.

As stated previously, these QA objectives may need to be modified based on considerations of end use. The rationale for any such modifications will be presented in the data validation reports.

CRDLs are not applicable to non-CLP analyses and decision criteria were not developed for the general chemistry analyses. Therefore, estimated instrument detection limits are presented for general chemistry analyses. The detection limits for non-CLP analyses are the estimated instrument detection limits for the analytical methods on clean matrices. Specific instrument detection limits are highly matrix dependent and the quantitation limits are provided for guidance and may not always be achievable.

4.2.1 Precision

Precision is the measure of variability between individual sample measurements under prescribed conditions. Three types of precision are defined as having QA objectives:

- Laboratory precision;
- Field sampling and analysis precision; and
- XRF analysis precision.

Laboratory and field precision are stated in terms of Relative Percent Difference (RPD) according to the formula:

$$RPD = \frac{|(S - D)|}{(S + D) \times 0.5} \times 100$$

where, RPD = Relative Percent Difference
S = Sample result (first measured value)
D = Duplicate sample result (second measured value)

4.2.1.1 Laboratory Precision

Analytical precision reflects the laboratory's ability to replicate a previously obtained value using identical testing procedures. For inorganic analyses, the laboratory will create a

laboratory duplicate sample (e.g., splits) of the same sample, and each aliquot will be treated exactly the same throughout the analytical method. The non-aqueous laboratory duplicate is also a measure of the homogeneity of the sample matrix in that it can measure the effectiveness of grinding, sieving and mixing preparations. Precision will be measured as the RPD between these replicate measurements.

The anticipated quantitative QA objective for laboratory precision for soil/sediment samples will be an RPD of ± 35% if both sample results are greater than five times the reporting limits. If the first measured value or the second measured value is less than or equal to five times the reporting limits, the QA objective will be ± two times the reporting limits. The quantitative QA objective for laboratory precision for aqueous samples will be an RPD of ± 20% if both sample results are greater than five times the reporting limits. If the first measured value or the second measured value is less than or equal to five times the reporting limits, the QA objective will be ± the reporting limits.

These quantitative QA objectives are consistent with EPA's guidance for CLP data validation and it is anticipated that these objectives will be incorporated by reference in each RI Proposal. QA objectives, however, may vary based on the intended end use of the data. The QA objectives for each investigation may be refined through the iterative DQO process and will be presented in the RI Proposals or in data validation reports.

The number of samples analyzed for laboratory precision will be in accordance with the method requirements. The anticipated number of samples analyzed for laboratory precision is expected to be one laboratory duplicate sample prepared and analyzed per Sample Delivery Group (SDG) of 20 or fewer samples of a given matrix.

4.2.1.2 Field Sampling and Analysis Precision

Field sampling and analysis precision and the degree to which a given sample analysis represents the medium being sampled will be assessed through the analysis of homogenized and/or co-located field duplicate samples submitted blind to the laboratory. Blind field duplicates will be prepared and submitted to the analytical laboratory in accordance with SOP-3, Field Quality Control. The number of blind field duplicates

submitted to the laboratory will be one per week or ten percent of all samples of a given matrix, whichever is greater.

The QA objectives for field sampling and analysis precision are RPDs of ± 50% for soil/sediment samples and ± 30% for aqueous samples if both results are greater than five times the reporting limit. If either result is less than or equal to five times the reporting limit, the QA objective for soil/sediment samples will be within three times the reporting limit for both aqueous and soil/sediment samples.

Note that field duplicates measure both field and laboratory precision and therefore, the results may have more variability than laboratory duplicates which only measure laboratory performance. Soil field duplicates will likely have a greater variance than aqueous samples due to difficulties associated with collecting identical field samples. EPA has not established "required" review criteria and the criteria identified above are to be used for advisory purposes only in data review. The independent data validator will use the field precision results to form a professional opinion on the overall data quality and data usability.

Field sampling and analysis precision will be further evaluated through the collection of split samples by NMED. The split samples will be submitted by NMED to an independent laboratory for chemical analysis.

4.2.1.3 XRF Analysis Precision

The QA objective for XRF measurement (metallic inorganic parameters) precision for soil samples is based on the Relative Standard Deviation (RSD) of the mean of the Site Specific Calibration Samples (SSCS). A SSCS is analyzed at the start and the end of sample analysis and after approximately every tenth sample. Precision of XRF results will be determined according to the formula:

$$RSD = \frac{s}{X} \times 100$$

where, RSD = Relative standard deviation
s = Standard deviation
X = Sample mean

The RSD should be within ± 20% for the data to meet the anticipated QA objective. Similar to field sampling and analysis precision, this criterion is not "required" and is to be used for advisory purposes during data review.

4.2.2 Accuracy

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. The accuracy will be measured as the percent recovery of a given target analyte relative to its known concentration. The accuracy criterion, expressed as percent recovery, is evaluated by the formula:

$$\text{Accuracy} = \frac{(SS - S_1)}{SA} \times 100$$

where, SS = Spiked sample result

S_1 = Sample result (first measured value, no spike)

SA = Spike added (known or true value)

Accuracy can be assessed for the following:

- Laboratory performance in conducting analyses;
- Laboratory analysis on the site-specific matrix; and/or
- XRF measurement.

The accuracy of the laboratory performance in conducting analyses will be assessed through analysis of Laboratory Control Samples (LCS). A LCS is a clean matrix sample spiked with a known amount of target analytes. Utilizing the formula above for accuracy, the sample result (S_1) would be dropped from the equation and the spiked sample result would be compared to the known spike added value. One LCS is analyzed with every SDG of 20 or fewer samples per matrix. The anticipated QA objective for percent recovery for aqueous inorganic analysis (except antimony, silver and mercury) is within the range of 80% to 120%. There is no percent recovery laboratory QA objective for antimony, silver and mercury. The control limits for soil matrix LCSs are set by the LCS supplier.

The accuracy of the laboratory analysis on the site-specific matrix will be assessed through the analysis of a Matrix Spike (MS). The field sampling team will identify the MS associated with each SDG. Additional sample volume is required for aqueous MS analyses. A sample matrix spike is prepared by adding a known amount of a compound to an aliquot of the submitted sample before digestion or extraction. The compound added is the same as that being analyzed for in the environmental sample. The accuracy will be measured as the percent recovery of a given target analyte relative to the level spiked into the sample. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method (i.e., sample preparation and analysis of the site-specific matrix).

The anticipated QA objective for percent recovery on inorganic MS analysis is within the range of 75% to 125% for soil/sediment and aqueous MSs. Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of four or greater.

Evaluation of accuracy of XRF measurement is accomplished by submitting confirmation samples for laboratory metal analysis. A total of 20% of the XRF samples collected will be confirmation samples sent to the analytical laboratory. The XRF and laboratory results will be evaluated with a regression analysis and the anticipated correlation coefficient is expected to be 0.7 or greater.

4.2.3 Completeness

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount of valid data that was planned to accomplish project objectives. Completeness is evaluated according to the following formula:

$$\text{Percent Completeness} = \frac{TVM}{TM} \times 100$$

where, TVM = Total number of valid measurements
TM = Total number of measurements requested

The TM value is defined as the total number of analyses for which raw analytical results and corresponding QA/QC results are requested. The TVM value is defined as the number of these analytical results determined to be acceptable (including estimated values) through data validation and evaluation.

The analytical completeness objective for each IU is anticipated to be 80 percent for AOC-related samples. Results of iterative DQO planning may refine the completeness objective. If data are rejected (i.e., not a valid measurement), CMC will be notified and a determination made of whether or not the rejected data are critical in meeting project objectives. This determination will be based on whether AOC decisions can be made with an appropriate statistical confidence. If data are considered critical, corrective action may be required.

4.3 Qualitative QA Objectives

Qualitative QA objectives are criteria that are used to assess the representativeness and comparability of site sample analyses. The DQO process considers the representativeness and comparability of data when developing the sample design. The DQO process provides a systematic procedure that identifies time, location and method of sample collection. The DQO process was used in the development of the RI Proposals and will be utilized in preparing future sampling plans, as required.

4.3.1 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The DQO process was instituted in the development of the RI Proposals, thereby optimizing the sample design for IU RI activities. Representativeness will be maintained during sampling efforts by completing sampling in compliance with the RI Proposals, FSPs and relevant SOPs.

Consistent, uniform sample handling protocols, including such tasks as storage, preservation and transportation, will be used to ensure that the representativeness of the samples gathered during the AOC will meet project objectives. Proper documentation in

the field and laboratory will verify that protocols have been followed and that sample identification as well as integrity have been preserved.

4.3.2 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability can be related to accuracy and precision as these quantities are measures of data reliability. Data are considered comparable if site conditions, collection techniques, and measurement procedures, methods and reporting are of equivalent quality for the samples within a given sample set.

The DQO process, implemented in the development of the RI Proposals, was utilized to avoid having to use data gathered by different organizations or among different analytical methods that cannot reasonably be compared because of differences in sampling conditions, sampling procedures, etc.

Comparability implies that the personnel involved in data acquisition and reduction operate measurement systems within the calibrated range of the particular instrument. In addition, analytical methodologies should produce comparable results. Analyses will be conducted using standard EPA analytical methods or EPA recommended methods and samples will be collected following SOPs in order to maximize the data comparability.

4.4 Sampling and Analysis Strategy

The sampling strategy for obtaining data that meet the project objectives is detailed in each IU-specific RI Proposal. A summary of the number of samples to be collected for each matrix and the type of analysis to be performed is provided in each RI Proposal. Analysis of blind field duplicates, laboratory matrix duplicates, matrix spikes and laboratory control samples will be used to evaluate data quality as described in the previous sections. Appropriate quality assurance objectives are dependent on the specified end use of the data in the corresponding work plan. Data validators will carefully consider the end use of the data when assessing data quality.

Future AOC investigations, if necessary, will, similar to the RI Proposals, utilize the DQO process to ensure that the data collected meet project objectives. If the QA

objectives for measurement outlined in this section are not appropriate for RI or future investigations, appropriate objectives will be identified in those submittals and data validation will be fully explained in the validation reports.

5. SAMPLING PROCEDURES

The quality of the data collected in an environmental study depends on the thoroughness applied in planning the sampling activities and the quality of the sampling activities. To ensure that data of appropriate quality and quantity are being obtained, the DQO process has been rigorously applied in the development of the RI Proposals. Each IU-specific RI Proposal presents details on sample site selection and sampling procedures. Similar details will be included in future AOC work plans.

To assure consistency, the SOPs for sampling procedures will be adhered to during field activities. Detailed procedures for sample collection and handling, including documentation and shipping, are specified in the SOPs presented in Appendix B. Appropriate deviations from the SOPs or supplemental sampling procedures are explained in detail in the RI Proposals (generally in the FSP).

6. SAMPLE CUSTODY

Sample and document chain-of-custody procedures will be strictly adhered to during sample collection, transport and laboratory handling to assure the identity of and the quality of samples. Improper sample and data handling and inadequate chain-of-custody procedures affect the credibility and acceptability of analytical results, regardless of their accuracy or precision. Chain-of-custody documentation should document the proper processing of samples from the time of collection to the time of analysis. A sample or an evidence file is under custody if, it is:

- In the actual possession or view of an individual;
- Locked or sealed to prevent tampering; or
- Stored in a secure area.

Custody is divided into three parts:

- Sample collection;
- Laboratory sample; and
- Final evidence files.

6.1 Sample Collection

Sample custody procedures are presented in SOP-4. Chain-of-custody records are employed to document custody transfers of the samples en route to their final destination. The possession and proper handling of samples must be traceable from the time the samples are collected until the analytical data have been accepted. Sample collection, handling and shipping procedures are detailed in the SOPs in Appendix B.

6.2 Laboratory Sample

Off-site laboratories are responsible for tracking and documentation of samples upon receipt of the samples at their facility. Laboratory custody will conform to procedures established for the USEPA Contract Laboratory Program (CLP). The laboratory sample custodian at each laboratory will ensure that the chain-of-custody records are filled out upon receipt of the samples and will note questions or observations concerning sample

integrity. The CMC Data Administrator will be notified if problems are noted with the chain-of-custody or the sample integrity. In addition, the laboratory sample custodian will provide sample receipt confirmation by sending a copy of chain-of-custody via facsimile to the CMC AOC Data Administrator. The laboratory sample custodian is responsible for control of the samples while in the laboratory's custody.

The analytical laboratory will document sample processing activities in accordance with the procedures outlined in the CLP SOW, laboratory QAP (Appendix C) and the requirements of the final evidence file discussed below. This documentation is filed in laboratory project notebooks and will be available to CMC upon request.

6.3 Final Evidence Files

During AOC activities, the final evidence file is assembled for the project at the CMC AOC project office. The final evidence file consists of the field project evidence file and off-site laboratory data and documentation. The final project evidence file contains the following information:

- Sample and QA/QC analytical data;
- Field laboratory data originals or copies (sample record forms, chain-of-custody records, equipment calibrations, sample preparation log, etc.);
- Field logs;
- Field measurement data;
- Photographs;
- Calculations and notes;
- Written AOC correspondence between NMED and CMC; and
- Reports and drawings.

A copy of data files, logbooks and other documentation generated by the off-site analytical laboratory will be available to CMC upon request for completed analytical work. Electronic data will be archived in accordance with the provision of the DMP (Appendix A).

7. CALIBRATION PROCEDURES

Equipment used during the investigation will require calibration to assure adherence to QA/QC objectives. Calibration will be performed for on-site equipment used for testing, inspections and analytical purposes, as required by the manufacturer, throughout the project. Equipment utilized in the field will be calibrated prior to use each day, unless otherwise specified by the manufacturer or in the IU-specific RI Proposal. Information on the manufacturer's name and serial number of the equipment used will be recorded in the daily log maintained by the operator of that equipment. The time and date of instrument calibration, along with other pertinent calibration information, shall be documented in the field logbook or calibration log and signed.

The instruments associated with the off-site chemical analysis of samples from the site will be calibrated in accordance with the suggested protocol by the instrument manufacturer, and modified as required to reflect operational experience and U.S. EPA methodology. Calibration of analytical equipment presented in the laboratory's QAP is included in Appendix C. Repairs and maintenance to analytical instrumentation will be recorded on an instrument maintenance log kept with the instrument.

8. ANALYTICAL PROCEDURES

The anticipated analytical procedures for AOC-related investigation activities are presented in Table 4-1. The analytical procedures on Table 4-1 have been compiled based on the data needs presented in the RI Proposals. The media to be sampled and the specific constituents to be analyzed are presented in each RI Proposal. Appropriate changes or additions to the analytical procedures listed in Table 4-1 have been noted in each IU-specific RI Proposal. If future investigations warrant an analytical procedure that differs from those presented in Table 4-1, an addendum to the table will be prepared. For those analytes that have an EPA-approved or EPA-recommended method, an EPA method will be followed.

Field and laboratory QC checks (Section 10) will be employed to evaluate the performance of the laboratory's analytical procedures. The QC checks represent controlled samples introduced into the sample analysis stream and are used to calculate the accuracy and precision of the chemical analysis program.

Laboratory analysis of samples collected during the AOC will be performed by laboratories that have established protocols and QA procedures. Field analytical procedures will be performed in accordance with the relevant SOP. Deviations from laboratory or field analytical procedures will be documented (e.g., laboratory data reports and field logbooks).

9. DATA REDUCTION, VALIDATION AND REPORTING

The primary goal of the QA/QC program is to ensure that environmentally-related measurements produce data of known quality and that data are of adequate quality for their intended uses. The quality of data is known when all components associated with its derivation are thoroughly documented, with such documentation being verifiable and defensible. Data reduction, validation and reporting will be performed in accordance with this QAP and the associated DMP (Appendix A). The DMP provides a detailed description of protocols for receiving electronic data from the laboratory and organizing field and laboratory records. In addition, the DMP describes the procedures that will be used to record, store, analyze and transmit data generated by CMC and each technical consultant.

The analytical data review process for analyses under this QAP will consist of three levels of review. The first level of review is performed by the analytical laboratory. The laboratory review program is designed to ensure that analytical data of known and acceptable quality have been provided by the laboratory. The second level of review is performed by the Project QAO designated by CMC. The Project QAO is responsible for conducting reviews of data packages received from the analytical laboratories to ensure compliance with the QA/QC provisions of this QAP. In addition, the Project QAO will compile an interim data usability assessment for each investigation based on the intended end use of the data. Finally, the third level of review is the IU QAO who is responsible for preparing each data quality assessment report.

Data validation will be used to make an overall assessment of the data set and the usability of each analytical result. CMC intends that all data analyzed using the methods listed in Table 4-1 and determined to be acceptable through data validation, will be suitable for AOC activities.

9.1 Laboratory Data Reduction and Review

Data reduction is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective identified in Section 4.3.2 of this Plan. Reduction of analytical data will be completed according to the

laboratory QAP presented in Appendix C. The exact equations used to calculate the analyte concentrations are described within the analytical methods and procedures (e.g., CLP SOW ILMO 4.0).

The first level of review, which may contain multiple sublevels, will be conducted by the analytical laboratory who has the initial responsibility for the correctness and completeness of the data. The laboratory data reviewer will evaluate the quality of the analytical data based on an established set of laboratory guidelines (Appendix C) and this QAP. This person will review the data packages to confirm the following:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- The appropriate SOPs have been followed;
- Analytical results are correct and complete and all soil results are reported on a dry weight basis;
- QC samples are within established control limits;
- Blanks are within appropriate QC limits;
- Analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, laboratory control samples and Inductively Coupled Plasma emission spectrometer (ICP) interference check samples are correct and complete;
- Tabulation of reporting limits related to the sample are correct and complete; and
- Documentation is complete (all anomalies in the preparation and analysis have been documented; holding times are documented).

The laboratory will perform the in-house analytical data reduction and QA review under the direction of the laboratory director or designee. The laboratory is responsible for assessing data quality and advising the CMC Data Administrator and/or the AOC contractor responsible for generation of the field samples of data which were rated "preliminary" or "unacceptable," or other notations which would caution the data user of possible unreliability.

Data reduction, QA review, and reporting by the laboratory will be conducted as follows:

- Raw data produced by the analyst are processed and reviewed for attainment of quality control criteria as outlined in this QAP and/or established EPA methods for overall reasonableness;
- The data reviewer will check all manually entered sample data for entry errors and will check for transfer errors for all data electronically uploaded from the instrument output into the software packages used for calculations and generation of report forms and will decide whether any sample re-analysis is required;
- The laboratory will review initial and continuing calibration data, and calculation of response factors, surrogate recoveries, matrix spike/matrix spike duplicate recoveries, post-digestion spike recoveries, internal standard recoveries, laboratory control sample recoveries and sample results; and
- Upon acceptance of the preliminary reports by the data reviewer, the Laboratory QA Officer or designee will review and approve the data packages prior to the final reports being generated.

The data reduction and the QC review steps will be documented, signed and dated by the analyst.

9.1.1 Laboratory Reporting

The laboratory will retain full analytical and QC documentation. The laboratory will report data in a Sample Delivery Group (SDG) of related samples. The SDG will be comprised of those samples designated as being in a given SDG by the field sampling personnel and designated on the chain-of-custody.

During the AOC, CLP analysis deliverables will meet CLP SOW reporting requirements. Non-CLP analysis deliverables will be consistent with the specified method requirements and will include the following, where applicable:

- Case narrative summarizing the analyses performed, the identification of all samples including the client IDs and Laboratory IDs, a summary of all reduction formulas or algorithms and identification of data outliers or data deficiencies;

- Sample receipt, shipping and tracking documentation including identification of the organization and individuals performing the analysis, and the dates of sample receipt, extraction and analysis;
- Sample data report sheets; and
- Quality control data report sheets.

Prior to issuing a report, the analytical laboratory will conduct a review of data values, calculations, dilutions, etc. including the following, where applicable:

- Calibration standards including traceability data and preparation dates;
- Initial and continuing calibration standards, interference checks, serial dilution checks, blanks and preparation blanks;
- Diluted and undiluted sample, control sample, spike and duplicate results including all supporting data such as sample weights, moisture corrections, volumes, dilutions, spike sources, sample counts, background counts, count efficiencies and reduction formula;
- Instrument identification, setup and adjustment formation;
- Time and date of each analysis including all instrument run logs; and
- All sample preparation, digestion, moisture analysis and distillation logs.

The laboratory will also be responsible for ensuring that information contained in the electronic (disk) deliverable matches that contained in the hard copy reports. The procedure for delivery of data from the laboratory is detailed in the DMP (Appendix A).

9.2 Data Validation

The second level of review and validation of the analytical data produced under this QAP will be performed under the supervision of the Project QAO. The purpose of this second level of review is to provide an independent review of the data package, including a review of laboratory performance criteria and sample-specific criteria. Only qualified data validation chemists will complete data validation activities for CMC.

The second level of review will include a verification of the laboratory review of the performance criteria for 10 percent of the data packages for each analysis type and each laboratory for those operations which are in the control of the laboratory to verify that the

laboratory QC program was functioning adequately and that the laboratory met the performance criteria. The second level of review will also include a review of sample-specific criteria for 100 percent of the data packages from each laboratory for each analysis type for those parameters that are sample-related such as: holding times, surrogate recoveries, matrix spike recoveries, field duplicate, matrix spike duplicate and laboratory duplicate precision, post digestion (analytical) spike recoveries, ICP serial dilution analysis agreement and qualification of sample data based on analytes reported as detected in blank analyses as described in Section 9.2.2. Since transcription and calculation are reviewed and verified by the laboratory and are in the laboratory's control, these parameters will be evaluated from the results reported by the laboratory.

Any significant problems identified during the review of the laboratory performance criteria that indicate a systematic problem will also be included during the review of the sample-specific criteria.

The CLP analytical sample data for inorganic and organic analyses for samples collected under this QAP will be validated using guidance in U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994 (EPA-540/R-94/013) and U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, February 1994 (EPA-540/R-94/012). Non-CLP data will be validated by implementing all applicable data validation protocols outlined in this QAP (e.g., typical QA objectives summarized in Table 4-2) and the principal criteria outlined below, where applicable.

The laboratory(s) will be contacted in regards to any missing or incorrect deliverables in the data packages noted during the validation process. The data reviewer will document all subsequent submittals and re-submittals from the laboratory, recalculations and data reviewer corrections. After all laboratory data packages have been validated, compliance with the QA objectives for completeness for each IU will be assessed. Reports will be written by the data reviewer summarizing the results of the data validation and the effect on the quality and usability of the data.

9.2.1 Laboratory Performance Criteria

The following sections provide descriptions of procedures to be followed for evaluation of the laboratory performance criteria.

9.2.1.1 CLP Analyses

A minimum of 10 percent of the data packages from each laboratory for the CLP inorganics will be reviewed for the following laboratory performance criteria using guidance in Functional Guidelines and the provisions of this QAP:

- Initial Calibrations;
- Continuing Calibration Verifications;
- ICP Interference Check Samples;
- Laboratory Control Samples; and
- Result Calculations.

Ten percent of the data on the summary forms will be checked back to the raw data for potential transcription errors and data transfer errors. If significant or systematic errors are found, either the laboratory will be contacted and revised data packages obtained containing corrected information for the whole data package, or 100 percent of the data type for which the error was found will be checked.

For CLP organics, 10 percent of the data packages will be reviewed using guidance in Functional Guidelines for instrument performance checks, initial and continuing calibrations, pesticide cleanup checks and compound quantitations.

If non-CLP methodology (i.e., SW-846) is used for the above analytical parameters, then the Quality Control limits specified in this QAP or in the analytical methods will replace the Control limits in the Functional Guidelines for validation. If there is a quality control sample or measure specified in the Functional Guidelines that is not required when using non-CLP analytical methods, the response by the validator will be "not applicable". If a validation question in the Functional Guidelines refers to similar processes (in CLP versus the analytical method) with somewhat differing protocols, such as calibration

requirements, the validation question will be evaluated and answered with respect to the analytical method requirements.

9.2.1.2 Non-CLP Analyses

A minimum of 10 percent of the data packages from each laboratory for the non-CLP analyses will be reviewed for the applicable portions of the following laboratory performance criteria:

- Evaluation of calibration and tuning information to determine compliance with specifications contained within the individual methodologies;
- Comparison of spike recoveries (control sample spikes) with the accuracy and precision limits outlined in Section 4 of this QAP or in the analytical methods. Recoveries that do not comply with the QA objectives will be qualified as estimated, "J" (or rejected, "R," if the data validation indicates the data are unusable for the intended end uses); and
- Evaluation of compound quantitation with recalculation of values from the raw data for ten percent of the data packages. If problems are found, additional data calculations will be checked or the laboratory will be contacted and revised data packages obtained.

9.2.2 Sample-Specific Criteria

All of the data packages for each analyses type from each laboratory will be reviewed for the sample-specific criteria described in the sections below. In addition to the specific criteria noted below, the reviewer will investigate the effect of any systematic problems noted in the review of the laboratory performance criteria and of any problems noted by the laboratory in the Case Narrative and qualify data where appropriate. No recalculation of results from the raw data or transcription error checking will be performed during the review of the sample-specific criteria. As described in Section 4, any data that are qualified by the procedures described below will be assessed for usability as part of the data validation process for the specified end uses developed in the data collection work plan.

9.2.2.1 General

Criteria for evaluating field duplicate results are not provided in the Functional Guidelines. Therefore, the following criteria will be used for validation of field duplicate results for both CLP and non-CLP analyses. Homogenized field duplicates will be evaluated against quality assurance objectives such as those listed in Table 4-2. Where both the sample and duplicate values are greater than five times the laboratory reporting limit, anticipated acceptable sampling and analytical precision for the two field duplicate results is indicated by an RPD of less than or equal to 50 percent (30 percent for aqueous samples). Where one or both analytes of the field duplicate pair are less than five times the laboratory reporting limit, satisfactory precision is indicated if the field duplicate results agree within three times the laboratory reporting limit. If the QA criteria are not met for an analyte, associated sample data for that analyte is estimated ("J").

9.2.2.2 CLP Analyses

CLP inorganic data will undergo evaluation from the reported results of the following sample-specific criteria utilizing the criterion in Functional Guidelines and the provisions of this QAP:

- Holding Times;
- Blanks;
- Duplicate Sample Analysis;
- Matrix Spike Sample Analysis;
- Graphite Furnace Atomic Absorption QC;
- ICP Serial Dilutions; and
- Field Duplicate Result Agreement.

For CLP organics, the data will be evaluated from the reported results utilizing the criterion in Functional Guidelines for holding times, blanks, surrogate spike results, matrix spike/matrix spike duplicate analyses, target compound identification, tentatively identified compounds and field duplicate result agreement.

9.2.2.3 Non-CLP Analyses

Data validation will consist of the applicable portions of the following as defined by QA/QC sample-specifications contained in this QAP and the analytical methodology:

- Evaluation of compliance to holding time limits, with data outside of the holding time limits specified in SOP 14 (Sampling, Preservation, and Containerization) qualified as estimated (or rejected if the data validation indicates the data are unusable for the intended end uses);
- Comparison of spike recoveries (control sample spikes) and duplicate analysis precision (field duplicates, matrix spike duplicates, or laboratory duplicates) with the accuracy and precision limits specified in Sections 4 and 9.2.2.1. Results that do not comply with appropriate QA objectives will be qualified as estimated, "J" (or rejected, "R," if the data validation indicates the data are unusable for the intended end uses); and
- Evaluation of field blank contamination with qualification of data from samples associated with contaminated blanks using the following guidance adapted from Functional Guidelines.

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. No positive sample results should be reported unless the concentration of the analyte in the sample exceeds five times the amount (in any blank). In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value. Specific actions are as follows:

- If a compound is found in a blank, but not found in the sample, no action is taken;
- If a blank has a positive result for an analyte, qualify associated sample data as follows: If the sample result is greater than the laboratory reporting limit but less than five times the blank concentration, flag the sample result as a non-detect ("U"). If the sample result is reported as detected at a concentration less than the reporting limit and less than five times the blank concentration, qualify the sample result as not-detected at the laboratory reporting limit. For aqueous blanks applied to soil/sediment samples,

compare the sample result to the equivalent concentration of the blank. The equivalent concentration is determined by assuming that all of the analyte present in the blank aliquot analyzed is present in the sample aliquot analyzed.

The reviewer should note that the blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "five times" criteria, such that a comparison of the total contamination is actually made.

9.3 Data Validation Qualifiers

Data validation qualifiers will be assigned to the analytical results during the data validation process and will include the qualifiers listed on Table 9-1. The Project QAO will assign a qualifier, if necessary, based on QA/QC criteria outlined in Section 4 and Section 9.2 and detailed in the U.S. EPA National Functional Guidelines for Inorganic Data Review (EPA-540/R-94-013) and U.S. EPA National Functional Guidelines for Organic Data Review (EPA-540/R-94-012).

It is essential that written explanation detailing the reason why a qualifier was attached to the data should be included as part of the final data package. The comments will be written directly on the final data package and the information will be entered into the database. In accordance with the DMP, the Project QAO may update the database as necessary to assign appropriate data validation qualifiers.

10. INTERNAL QUALITY CONTROL

Quality control procedures are established for laboratory and field activities and the elements of QC fall into three groups:

- Instrument QC;
- Method QC; and
- Field QC.

10.1 Instrument QC Checks

Instrument QC checks ensure that any instrument is calibrated and functioning properly. The frequency and nature of laboratory instrument QC checks are presented in the laboratory QAP (Appendix C). For CLP analyses, CLP specified procedures, frequencies and limits will be utilized. Field instrumentation will be calibrated and utilized in accordance with the relevant SOPs presented in Appendix B.

10.2 Method QC Checks

Method QC checks monitor the precision and accuracy of both sample preparation and analysis; method QC checks may, in addition, provide information on intra-laboratory reproducibility of a method and of matrix effects. Laboratory QC protocols will consist of, where applicable, U.S. EPA CLP analytical protocols and U.S. EPA deliverables and, at a minimum, includes the following samples:

- Laboratory preparation blank (aqueous samples) and reagent blank (non-aqueous samples) - Consisting of a blank that is processed through all procedures, materials and labware used for sample preparation and analysis. Blanks are analyzed a minimum of once per analytical batch of 20 or fewer samples per matrix. Blank analysis results are used to determine the existence and magnitude of contamination resulting from laboratory activities;
- Laboratory control sample - Clean matrices spiked with a known amount of target analyte. One LCS is used for every analytical batch of 20 or fewer samples per matrix. The LCS serves as a monitor of the overall performance of each step during the analysis, including sample preparation;

- Laboratory matrix duplicate - Non-spiked duplicate prepared in the laboratory with each aliquot treated the same throughout the analytical method. One sample is analyzed for every sample delivery group of 20 or fewer samples of a given matrix. The duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis;
- Matrix spike - Prepared by adding a known amount of a pure compound to the environmental sample before digestion or extraction. One sample is prepared for every sample delivery group of 20 or fewer samples of a given matrix. The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology; and
- Interference check sample - A sample analyzed by ICP spectroscopy consisting of interfering elements at elevated levels to assess inter-element interference and correction factors. A sample will be run at the beginning and at the end of an analysis sequence.

All laboratory QC objectives will be met as specified in method requirements.

10.3 Field QC Checks

Field QC checks monitor sampling by itself and the overall process of sampling, sample preparation and analysis. Field QC is a qualitative process that is dependent on the decisions made by personnel while performing individual tasks. Because field QC has no EPA statistical control limits, the professional opinion of the data validator is required to estimate the influence of field QC on the quality and usability of the data. Specific field QC procedures include completion of appropriate SOPs (Appendix B), including:

- Field Document Control;
- Decontamination of Sample Equipment; and
- Sample Custody Procedures.

Field quality control samples that are relevant to AOC work are described in SOP-3. SOP-3 describes the preparation and recommended collection frequency for the following samples:

- Blind decontamination rinsate blank - Used to assess the effectiveness of the decontamination procedures (SOP-6) utilized by the field sampling team;
- Field external contamination blank - Used to assess if aqueous sample filtering equipment and/or filters are introducing constituents into the sample;
- Blind bottle blank - Used to assess the "cleanliness" of the bottles utilized for aqueous sample collection. A blind bottle blank will only be submitted if certified bottles from the analytical laboratory are not utilized for sample collection; and
- Blind field duplicate - Used to assess field sampling and analysis precision as described in Section 4.2.1.2.

As stated previously in Section 4, EPA has not established "required" review criteria for field QC checks and the results for the above listed samples are to be utilized in data review by the data validator for providing a professional opinion on the quality and usability of the data.

11. PERFORMANCE AND SYSTEM AUDITS

Performance and systems audits are performed to assure and document that QC measures are used to provide data of acceptable quality and that subsequent calculations, interpretation, and other project outputs are checked and validated. Ongoing performance evaluations include duplicates, matrix spikes and QC check samples as described in Section 10, Internal Quality Control.

USEPA Contract Laboratory performance is continually monitored through on-going QA evaluations conducted by the Environmental Monitoring Systems Laboratory. The evaluations consist of periodic reviews of analytical data and supporting documentation complemented by on-site laboratory inspections. Performance sample results are also included in the evaluation of analytical performance.

Performance evaluations and system and data audits performed by the laboratory are presented in the laboratory QAP presented in Appendix C. The laboratory will provide CMC with the results of the internal and external performance evaluations and audits, upon request. Laboratory audits will be performed by CMC as needed and the results of the audit will be documented.

12. PREVENTIVE MAINTENANCE

Preventive maintenance tasks will be carried out on both field and laboratory equipment to minimize downtime. Preventive maintenance of field equipment will proceed routinely before each sampling event; more extensive maintenance will be performed on the basis of hours in use. Laboratory equipment will be maintained on a regular and scheduled basis. This maintenance is documented in the laboratory records logbook for each instrument as stated in Section 7, Calibration Procedures.

13. RECONCILIATION WITH DATA QUALITY OBJECTIVES

An assessment of data quality will be performed to determine whether data generated are consistent with the investigation DQOs. DQOs have or will be established for each AOC investigation. Data will be reconciled with DQOs by initially completing a quantitative and qualitative analysis of data results. The data will then be assessed for overall data usability.

The DQO process is iterative. QA objectives which were anticipated to be adequate when the work plan was developed may not be adequate after data are collected and evaluated. Concise discussions of these occurrences will be included in the deliverable QA assessments.

Specific routine procedures have been established for AOC-related data to complete the quantitative analysis (i.e., accuracy, precision and completeness). Section 4 presents the calculations for determining accuracy, precision and completeness and Table 4-2 summarizes typical quantitative QA objectives. The current RI work plans and future investigations may require different QA objectives; however, the calculations for quantitative analysis will remain the same. An addendum to this QAP will be submitted if there is a change in the approach to reconciliation with DQOs.

Qualitative analyses (i.e., comparability and representativeness), discussed in Section 4, are also part of the data validation process. Comparability and representativeness, however, are addressed as part of the DQO process. If data are found to deviate sharply (i.e., several orders of magnitude) from previous analyses or surrounding conditions upon which the sampling program was based, the data may be qualified (e.g., rejected) based on the validator's assessment of the usability of the data for the intended end uses.

The data validation process, outlined in Section 9, will utilize qualifiers to identify quality control problems and potential limitations on the use of the data, if any. In addition, as discussed in Section 4, data will be assigned to one of the following data usability categories:

- Acceptable;
- Acceptable with qualification; or
- Unusable/rejected.

The IU QA Officer will review and finalize each interim Data Quality Assessment Report prepared by the Project QAO based on IU-specific DQOs. Data quality will be based on a reconciliation with DQOs. The RI Proposals present the DQOs and specifically quantify the statistical confidence level that must be met to make certain decisions. Data quality and quantity will be compared to DQOs to determine whether decisions can adequately be answered (e.g., whether decisions can be made with the desired level of statistical confidence as defined in the DQOs).

The data quality assessment will be a written record of the reconciliation with DQOs and data deficiencies will be noted. If data are not adequate, in either quality or quantity, the IU QA Officer will initiate a corrective action. Corrective action is discussed in Section 14.

14. CORRECTIVE ACTION

Corrective action is required when potential or existing conditions are identified that may have an adverse impact on data quality. Corrective action applies to both the field and laboratory environment. In general, any member of the project team who identifies a condition adversely affecting quality can initiate corrective action. Written evidence (i.e. field or laboratory logbook) will document and identify the condition and explain the way it may affect data quality.

An important part of any QA program is a well-defined and effective policy for correcting quality problems. While the entire QA program is designed to avoid problems, it also serves to identify and correct those that exist. A system has been put in place to ensure that the condition is reported to a person who is part of the corrective action and follow-up plan. The corrective action system will include the following:

- The problem will be identified;
- Responsibility for investigating the problem will be assigned;
- The cause of the problem will be investigated and determined;
- A corrective action to eliminate the problem will be determined;
- Responsibility for implementing the corrective action will be established, and the corrective action will be implemented;
- The fact that the corrective action has eliminated the problem will be verified; and
- The complete process of establishing and implementing the corrective action will be documented in a project memorandum or QA report that specifies the problem areas requiring corrective action and how they were detected, the individual initiating corrective action, the samples concerned, the acceptable data range, the measures undertaken to correct the problems and the individual approving corrective action.

Documentation of corrective action will be reviewed by the IU QA Officer and the Project QA Officer. The IU QA Officer has the authority to approve and enforce necessary corrective measures.

15. QUALITY ASSURANCE REPORTS

Quality assurance reports for AOC work are summarized in Table 15-1. The reports range from modifications to this QAP based on project needs to deliverable QA assessments for each AOC deliverable. The Deliverable QA Assessment will include the following:

- Discussion of the data quality assessment used in each AOC deliverable (including field data);
- Recommendations for data use and limitations;
- Discussion of usability of data for intended end uses;
- Description of precision, accuracy and completeness relative to QAP objectives;
- Documentation of any corrective actions; and
- Identification of all cases where DQOs were not met and summary of the significance of these deviations.

TABLE 4-1
LABORATORY METHODS AND REPORTING LIMITS

SOIL/SEDIMENT ANALYSES

Metals (CLP)	Analytical Method	Maximum Reporting Limit (mg/Kg)	CRDL [a] (ug/L)
Aluminum (Al)	CLP SOW (ILMO 4.0)	40	200
Antimony (Sb)	CLP SOW (ILMO 4.0)	12	60
Arsenic (As)	CLP SOW (ILMO 4.0)	0.43	10
Barium (Ba)	CLP SOW (ILMO 4.0)	40	200
Beryllium (Be)	CLP SOW (ILMO 4.0)	0.15	5
Boron (B)	EPA 200.7	7,000	*
Cadmium (Cd)	CLP SOW (ILMO 4.0)	1	5
Calcium (Ca)	CLP SOW (ILMO 4.0)	1000	5000
Chromium (Cr)	CLP SOW (ILMO 4.0)	2	10
Cobalt (Co)	CLP SOW (ILMO 4.0)	10	50
Copper (Cu)	CLP SOW (ILMO 4.0)	20	25
Iron (Fe)	CLP SOW (ILMO 4.0)	20	100
Lead (Pb)	CLP SOW (ILMO 4.0)	0.6	3
Magnesium (Mg)	CLP SOW (ILMO 4.0)	1000	5000
Manganese (Mn)	CLP SOW (ILMO 4.0)	3	15
Mercury (Hg)	CLP SOW (ILMO 4.0)	0.1	0.2
Molybdenum (Mo)	EPA 200.7	390	*
Nickel (Ni)	CLP SOW (ILMO 4.0)	8	40
Potassium (K)	CLP SOW (ILMO 4.0)	1000	5000
Selenium (Se)	CLP SOW (ILMO 4.0)	1	5
Silver (Ag)	CLP SOW (ILMO 4.0)	2	10
Sodium (Na)	CLP SOW (ILMO 4.0)	1000	5000
Thallium (Tl)	CLP SOW (ILMO 4.0)	2	10
Vanadium (V)	CLP SOW (ILMO 4.0)	10	50
Zinc (Zn)	CLP SOW (ILMO 4.0)	4	20

General Chemistry (Non-CLP)		Estimated Quantitation Limit (mg/Kg) [b]
Cation Exchange	9081	NA
pH	9045B	NA
Sulfate	300.0	3.0
Chloride	300.0	2.0
Nitrate	300.0	1.0
Total Organic Carbon	9060	0.10%
Oxidation-Reduction Potential	TBD	NA

TABLE 4-1
LABORATORY METHODS AND REPORTING LIMITS
(continued)

AQUEOUS ANALYSES

Metals (CLP)	Analytical Method	Maximum Reporting Limit (ug/L)	CRDL [a] (ug/L)
Aluminum (Al)	CLP SOW (ILMO 4.0)	200	200
Antimony (Sb)	CLP SOW (ILMO 4.0)	60	60
Arsenic (As)	CLP SOW (ILMO 4.0)	10	10
Barium (Ba)	CLP SOW (ILMO 4.0)	200	200
Beryllium (Be)	CLP SOW (ILMO 4.0)	5	5
Boron (B)	EPA 200.7	750	*
Cadmium (Cd)	CLP SOW (ILMO 4.0)	5	5
Calcium (Ca)	CLP SOW (ILMO 4.0)	5000	5000
Chromium (Cr)	CLP SOW (ILMO 4.0)	10	10
Cobalt (Co)	CLP SOW (ILMO 4.0)	50	50
Copper (Cu)	CLP SOW (ILMO 4.0)	25	25
Iron (Fe)	CLP SOW (ILMO 4.0)	100	100
Lead (Pb)	CLP SOW (ILMO 4.0)	3	3
Magnesium (Mg)	CLP SOW (ILMO 4.0)	5000	5000
Manganese (Mn)	CLP SOW (ILMO 4.0)	15	15
Mercury (Hg)	CLP SOW (ILMO 4.0)	0.2	0.2
Molybdenum (Mo)	EPA 200.7	1,000	*
Nickel (Ni)	CLP SOW (ILMO 4.0)	40	40
Potassium (K)	CLP SOW (ILMO 4.0)	5000	5000
Selenium (Se)	CLP SOW (ILMO 4.0)	5	5
Silver (Ag)	CLP SOW (ILMO 4.0)	10	10
Sodium (Na)	CLP SOW (ILMO 4.0)	5000	5000
Thallium (Tl)	CLP SOW (ILMO 4.0)	10	10
Vanadium (V)	CLP SOW (ILMO 4.0)	50	50
Zinc (Zn)	CLP SOW (ILMO 4.0)	20	20

General Chemistry (Non-CLP)		Estimated Quantitation Limit (mg/L) [b]
pH	150.1	NA
Conductance	120.1	NA
Total Dissolved Solids	160.1	10
Total Suspended Solids	160.2	0.1
Alkalinity (Carbonate/Bicarbonate	2320	1.0
Anion Scan (Cl, Br, F, SO_4, PO_4, PO_4-ortho, NO_2, NO_3)	300.0	0.05 - 0.3
Chloride	300.0	0.20
Fluoride	300.0	0.10
Sulfate	300.0	0.3

TABLE 4-1
LABORATORY METHODS AND REPORTING LIMITS
(concluded)

NOTES:
(a) CRDL = Contract Required Detection Limit for Contract Laboratory Program work.

(b) The quantitation limits listed are the instrument detection limits for the analytical methods on clean matrices. Specific detection limits are highly matrix dependent and the limits listed are provided for guidance and may not always be achievable. Estimated detection limits provided by CMC contract laboratory.

CLP SOW = Contract Laboratory Program Scope of Work
* = No CRDL for these constituents.

TABLE 4-2
SUMMARY OF TYPICAL QUANTITATIVE QUALITY ASSURANCE OBJECTIVES [a]

Analysis	Matrix	Precision	Accuracy		Completeness
			LCS	MS	(c)
Laborator Inorganics	Soil/Sediment	S and D > 5x RL, RPD + 35% S or D ≤ 5x RL, S - D + 2x RL	(b)	75%-125%	80%
	Aqueous	S and D > 5x RL, RPD + 20% S or D ≤ 5x RL, S - D + 1x RL	80%-120%	75%-125%	80%
Field Inorganics	Soil/Sediment	S and D > 5x RL, RPD + 50% S or D ≤ 5x RL, S - D + 3x RL	NA	NA	80%
	Aqueous	S and D > 5x RL, RPD + 30% S or D ≤ 5x RL, S - D + 3x RL	NA	NA	80%
XRF	Soil	Relative Standard Deviation +/- 20%	Correlation Coefficient >= 0.7 (20% of XRF samples for lab analysis)		80%

NOTES:

(a) The QA objectives provided are anticipated to be adequate for AOC-related work. However, the quantitative QA objectives for each investigation will be finalized through the DQO process and will be presented in the RI Proposals (and future submittals, if necessary).

(b) Accuracy control limits for soil matrix are determined by the supplier of the laboratory control sample.

(c) The analytical completeness objective is 80% for all combined sample matrices.

1. Precision of laboratory inorganics will be assessed by comparison of sample and associated laboratory matrix duplicate results.
2. Precision of field sampling and analyses will be assessed by comparison of sample and associated blind field duplicate results. Criteria listed are not "required" and are to be utilized by the independent data validator in forming a professional opinion of data quality and usability.

S = Sample result (first measured value)
D = Duplicate sample result (second measured value)
RL = Laboratory Reporting Limit
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
MS = Matrix Spike
XRF = X-Ray Fluorescence
Lab = CMC contract laboratory - used for confirmatory sample analysis.
NA = Not Applicable

TABLE 9-1
DATA VALIDATION QUALIFIERS

Inorganic CLP SOW Laboratory Result Qualifiers

Concentration qualifiers

B - the reported value is less than the CRDL but greater than IDL.
U - the analyte was analyzed for but not detected

Quality Control Qualifiers

E - The reported value is estimated because of the presence of interference(s).
M - Duplicate injection precision not met for GFAA.
N - Spike sample recovery not within control limits.
S - The reported value was determined by the method of standard additions (MSA).
W- Post digestion spike for furnace AA analysis is out of control limits.
* - Duplicate analysis not within control limits
+ - Correlation coefficient for MSA is less than 0.995.

Method Qualifiers

P - ICP
A - Flame AA
F - Furnace AA
CV - Manual Cold Vapor AA
AV - Automated Cold Vapor AA
AS - Semi-Automated Spectrophotometric
C - Manual Spectrophotometric
T - Titrimetric
NR - Analyte not required to be analyzed

Independent Data Qualifier Definitions

U The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

J The associated value is an estimated quantity.

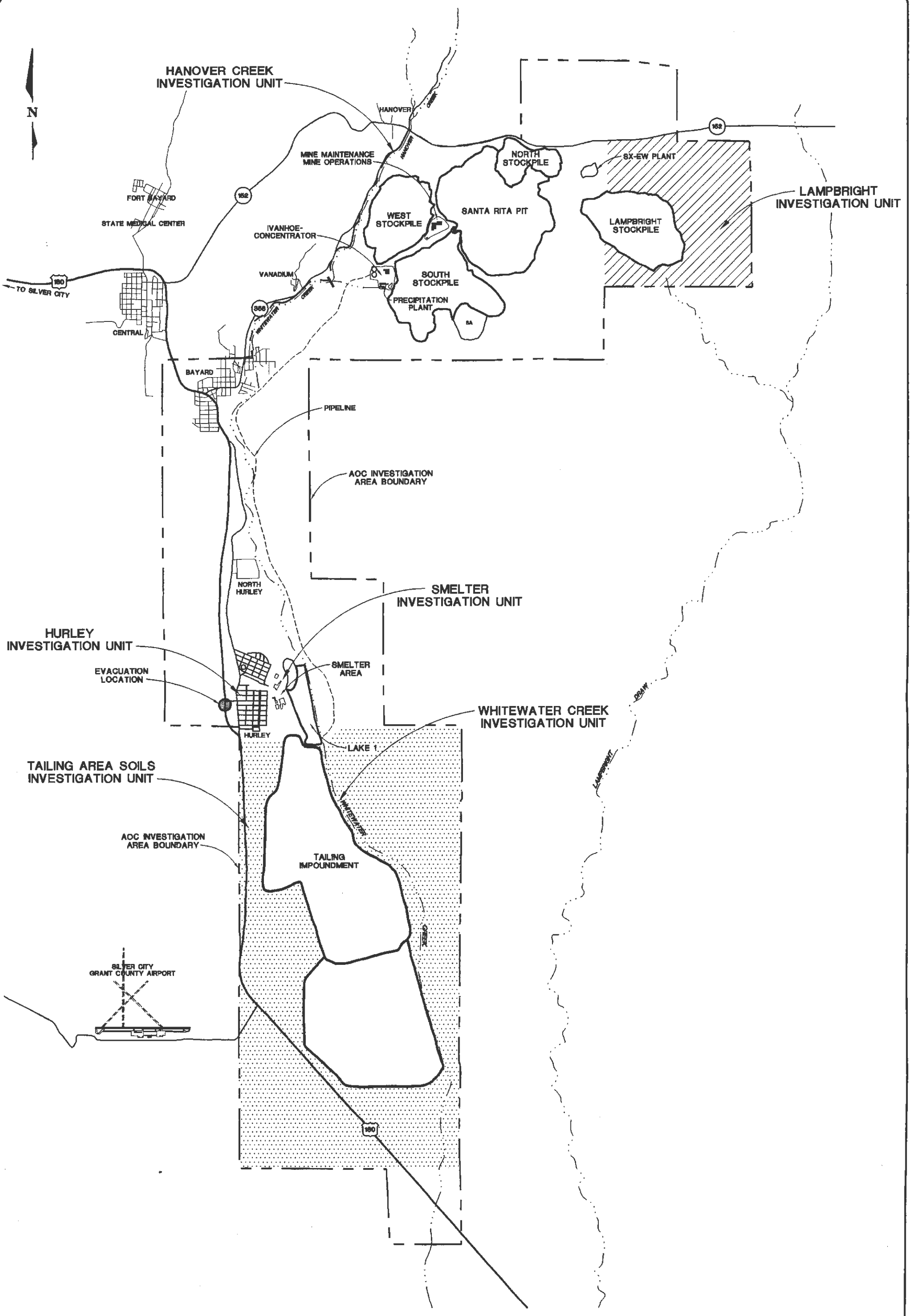
R The data are unusable (Note: Analyte may or may not be present).

UJ The material was analyzed for, but was not detected. The associated value as an estimate and may be inaccurate or imprecise.

NJ The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification and the associated numerical value represents its approximate concentration.

Table 15-1
Quality Assurance Reports

QA Report	Content	Prepared By	to Whom	Frequency
QAP Update Draft	Controlled Document Modifications	CMC	NMED AOC Project Manager	As Needed
QAP Update Final	Controlled Document Modifications approved by NMED	CMC	All Controlled Document Copies	As Needed
QA Corrective Action Report	Problems, Recommended Solutions, & Corrective Actions	All AOC Personnel	CMC AOC Project Manager	As Needed
Lab QA/QC Assessment/ Case Narrative	See Section 9.1.1	Lab QA Officer	CMC AOC Data Administrator	Each Sample Delivery Group
Data Validation Report	See Sections 9.2 & 9.3	Data Validation Contractor	CMC AOC Data Administrator	Each Sample Delivery Group
Deliverable QA Assessment	See Section 15	IU QA Officer	Appendix to Deliverable	Each Deliverable

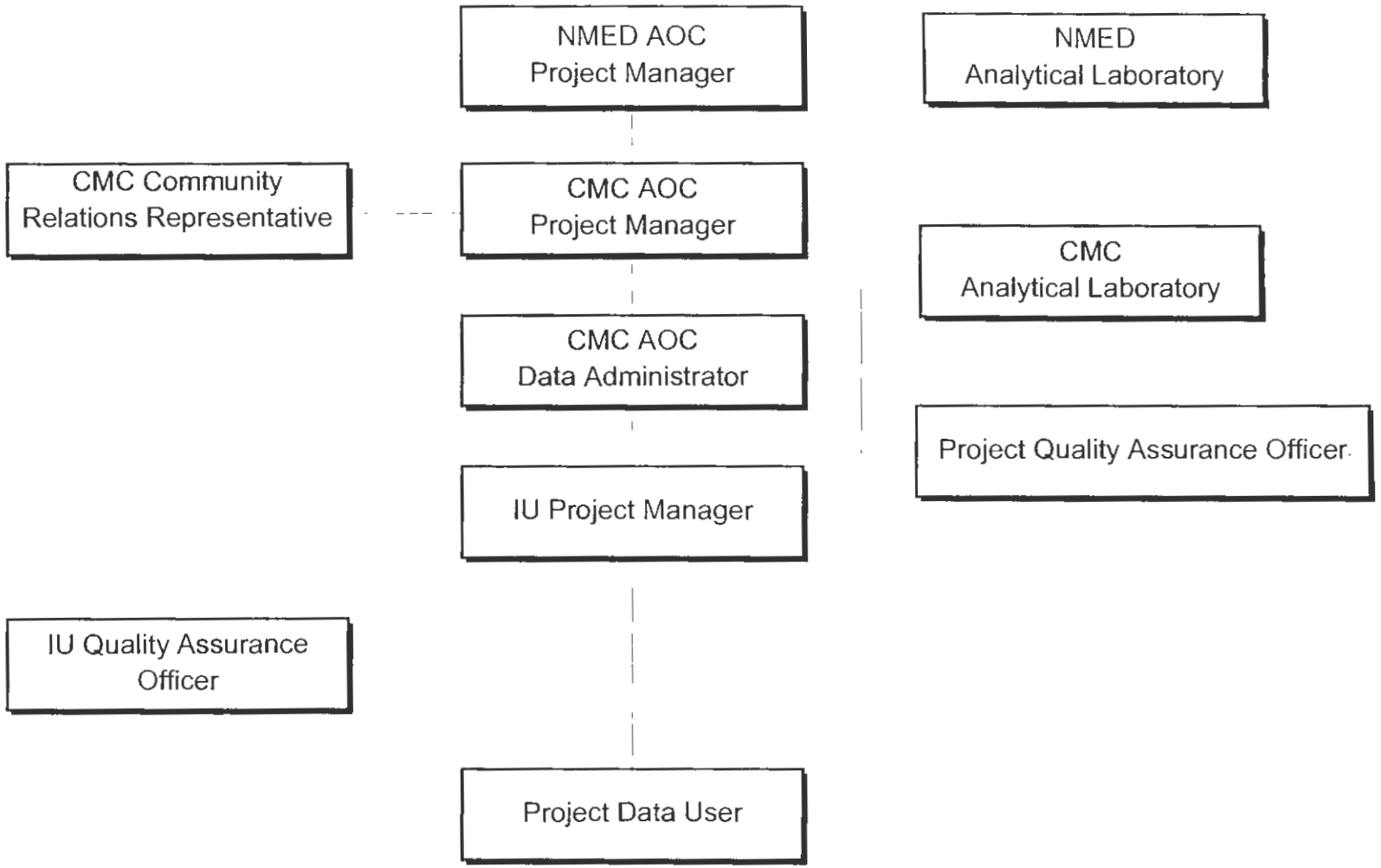


SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
74601.01.0401	05/95	A

FIGURE 1

SITE MAP



SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
74601.05.0101	01/97	A

FIGURE 2

PROJECT ORGANIZATION CHART

REFERENCES

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EPA (1994). Guidance for the Data Quality Objectives Process, Final Guidance. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., EPA QA/G-4.

NMED (1995). Letter of Approval for the Remedial Investigation Background Report, Ms. Maura Hanning (Superfund Program Manager), New Mexico Environment Department, Santa Fe, New Mexico, October 27.

APPENDIX A

DATA MANAGEMENT PLAN

ACKNOWLEDGMENT

Steffen Robertson and Kirsten (U.S.), Inc. acknowledges the key contributions of Woodward Clyde Consultants (WCC) in the preparation of this document.

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LIST OF ATTACHMENTS - DATA MANAGEMENT FORMS/CHECKLISTS

1. INTRODUCTION

This Data Management Plan (DMP) describes the operating strategy for data management associated with Administrative Order on Consent (AOC) project activities. The DMP describes the procedures that will be used to record, store, analyze, validate (i.e., verify accuracy of data import) and transmit data used in the AOC investigation. This document will be used in conjunction with the site-wide Quality Assurance Plan (QAP).

Environmental data related to the AOC will include historic data and data generated during completion of Remedial Investigation (RI) activities. Historic data consist of electronic files and/or paper copies of monitoring records maintained by CMC. Historic data will be integrated into the electronic database system at the discretion of CMC based on designated data uses.

RI data consist of present and future data collected in support of the AOC. Throughout the course of the AOC project, environmental data will be collected and incorporated into the data management system and/or preserved in their original format. Examples of these types of data include photographs, field books and field forms and other project generated data. Field forms may include, but are not limited to, Chain-of-Custody forms, water level measurements and field instrument calibration forms. The QAP includes the standard operating procedures for maintaining these documents in a defensible and retrievable format.

1.1 Project Organization

Several distinct roles of project staff will be involved in AOC data management and use. More than one role may be assigned to a project team member. Typical data access/handling privileges for the centralized environmental database are assigned based on these roles.

Figure 1 presents the project organization for the electronic data management system. The recommended roles and associated responsibilities for this DMP are listed below:

- CMC AOC Project Manager (CMC PM);
- Project Quality Assurance Officer (Project QAO);
- CMC AOC Data Administrator (CMC Data Administrator)
- Investigation Unit Project Manager (PM);
- Investigation Unit Quality Assurance Officer (QAO);

- Analytical Laboratory (AL); and
- Project Data Users (PDU).

Section 3 of the AOC QAP describes the responsibilities of each role. In general, the CMC Data Administrator, or designee, will maintain read-access and write-access to the electronic Database Management System (DBMS). Modifications or additions to the electronic DBMS will be facilitated through the CMC Data Administrator. CMC will provide read-only access to designated parties.

1.2 Principal Producers, Handlers and Recipients of AOC Data

Figure 2 illustrates the principal producers, handlers or recipients of AOC data. In general, the following parties are identified:

- Sampling crews;
- Analytical laboratory;
- CMC AOC Project Manager and Data Administrator (i.e., Chino Mines Company);
- Project QAO;
- IU Project Manager and QAO; and
- New Mexico Environment Department.

Further discussion on the transfer of information between each party is presented below.

Sampling crews perform field data collection in accordance with the IU-specific Field Sampling Plans (FSPs) and the AOC QAP. Original sample documentation associated with field activities and the packaged environmental samples (e.g., Chain-of-Custody) are transmitted via the CMC Data Administrator, or designee, to the analytical laboratory.

Environmental samples are analyzed by the laboratory. Following completion of laboratory analyses, paper copies of the laboratory results and associated quality control documentation are transmitted to the CMC Data Administrator, or designee. The CMC Data Administrator, or designee, verifies that the laboratory package corresponds to a requested sample set for an IU. The hard copy laboratory package is then forwarded to the IU Project Manager responsible for the sampling event. The IU Project Manager is responsible for performing an initial quality control check (e.g., completeness) on the hard copy laboratory package.

The IU Project Manager will notify the CMC Data Administrator, or designee, of the results of the initial quality control check. The CMC Data Administrator, or designee, will notify the analytical laboratory of acceptance of the data package with necessary corrections, if required. If corrections are required, the analytical laboratory will re-issue the hard copy data package. In addition, at this time the laboratory will issue an electronic file of the laboratory data to CMC.

The CMC Data Administrator, or designee, will load the electronic file from the laboratory into the electronic database system. The final hard copy data package will be forwarded to the Project Quality Assurance Officer for data validation. Data validation procedures for AOC data are described in Section 9 of the QAP.

In accordance with the provisions of the QAP, the Project QAO will assign appropriate data validation qualifiers to each hard copy data package. Following completion of data validation activities, the Project QAO will transmit the annotated data validation package and validation report to CMC. The CMC Data Administrator, or designee, will load the data validation qualifiers into the electronic DBMS. The Project QAO will verify that the data validation qualifiers were transcribed correctly.

Validated data and the data validation report will be transferred from the CMC Data Administrator to the IU Project Manager who is responsible for obtaining a final data quality assessment from the IU QAO. The IU QAO will review the validated data and the data validation report and will prepare a final, written data quality assessment. Limitations on data use, if any, will be noted. The data quality assessment will be forwarded to the CMC Data Administrator for entry in the DBMS.

Validated electronic data, including the data quality assessment, will be available for use by CMC designated parties. In accordance with the AOC, CMC will transmit quarterly data summary reports to NMED. Original hard copy documentation will be filed and maintained by CMC at the AOC building.

2. MANAGEMENT OF EXISTING/HISTORIC DATA

Figure 3 illustrates the principal data flows associated with existing/historic data. These data may be integrated with the electronic database management system (DBMS) at the discretion of CMC. Existing/historic records include, but are not limited to, the following:

- Groundwater quality data collected as part of the ongoing groundwater discharge permit program for the site. These data are currently archived in electronic form;
- Air quality data including SO_2 emissions from the smelter. These data are maintained in an electronic archive file by the CMC Environmental Department;
- Climate data including average wind speed, wind direction, temperature, and precipitation records from various monitoring stations. These data are currently maintained as electronic and/or paper files in the CMC Environmental Department;
- Well completion and production details for various water quality monitoring wells and water supply well fields. These data exist as paper documentation stored on-site;
- Surface water quality and quantity measurements at various sample locations. These data exist as paper documentation stored on-site;
- Vegetation and biota distribution maintained as maps and tabular data;
- Soil type distribution and surficial geology maintained as map information;
- Land mineral and water rights leasing and ownership maintained as maps and tabular information;
- Physical and chemical analyses of soil and sediment. These data may stored as electronic or paper documentation on-site;
- Resident notification database. CMC maintains an active electronic file of property owners and residents near the CMC site; and
- Groundwater elevations and pumping records maintained primarily as paper documentation.

As shown in Figure 3, existing/historic data that are intended for use in the AOC project will likely require conversion prior to loading into the electronic DBMS. Data conversion consists of formatting an existing record into a compatible file structure which is consistent with other database records in the system. The type of data conversion will vary based on the format of the existing data set. Conversion and verification procedures of historic paper records and electronic files are provided below.

2.1 Data Conversion

Data conversion consists of formatting an existing record into a compatible file structure which is consistent with other database records in the system. The primary goal of data conversion is to minimize data handling or alteration of file content. The type of data conversion will vary based on the format of the existing data. Paper record and electronic file formats are discussed below.

2.1.1 Paper Records

Paper records may be manually input into an electronic file or scanned into an electronic file. Selection of manual input or scanning technology will vary based on the format and content of the paper documentation. Use of manual input or scanning technology will be at the discretion of CMC and each IU Project Manager.

Manual data entry may be preferred if a limited number of fields on the paper record are needed rather than the contents of the entire paper record. Scanning of paper documentation may be preferred if the data are presented in tabular form and if the paper records are in good condition.

2.1.2 Electronic Files

Electronic files may be converted via generic data import utilities (e.g., conventional spreadsheet applications, ASCII text editors, commercial database programs). Depending on the format of the electronic file, customized import utilities may be required. Selection of a suitable data import utility will be at the discretion of CMC and each IU Project Manager. The preferred data import utility will minimize data handling and the need for manual data input.

2.2 Verifying Data Quality in the Database

Following conversion of the existing data records, the CMC Data Administrator is responsible for ensuring that the imported data are checked against the original records. Verification procedures will vary depending on whether the existing data were available in paper records or electronic format.

2.2.1 Electronic Files

The following data QC procedure will be followed for checking the imported database against hard copy records:

- If possible, a hard copy file of the complete original electronic file and the imported electronic file will be generated. Alternatively, in the event that multiple files were imported, hard copy files of representative portions of the electronic file may be used;
- Clearly mark corrections to the hard copy of the imported report in red ink;
- Check values at a frequency of approximately 10 percent. If errors are found, an additional 10 percent of values will be checked for similar errors. If errors are found in the second 10 percent, then all values will be checked, or the data conversion method may be modified;
- Keep a copy of the marked up database hard copy;
- Make the required changes to the database; and
- Print a new database hard copy and check the corrected copy of the database to verify that corrections have been completed.

2.2.2 Paper Records

Manual input will be proofed and corrected at a frequency of 100%. Scanned images will be verified after Optical Character Recognition (OCR) verification on a decreasing percentage scale. For example, if there are 10 pages of data to be scanned, the first page or the page with the poorest print quality will be 100% verified. Subsequent pages in the same batch will be verified at 20% record verification rate. If an error is found on a page, that page will be 100% verified. The QC procedures described for electronic files apply to the paper records with the exception noted above.

2.3 Corrections and Changes to Converted Data

Changes or corrections may be required to the converted data. In the event that changes are required after verification, a Data Correction/Change form will detail the changes to be made. This form serves as documentation that the changes were completed. The CMC Data Administrator, or designee, will review and initial all change forms. The Notification of Data Operation Form, No. F1.2 (Attachment A) will be used for this purpose.

The person requesting the change will complete the form and sign the "completed by" box. The form will be sent to the CMC Data Administrator who will sign the "sent to" box. The person entering the changes will sign the "entered by" box. All corrections, addition of data qualifiers, and other required changes to the database, will be proofed by the CMC Data Administrator, or designee, for potential entry errors at 100 percent. The person checking the data will sign the "checked by" box on the form.

2.4 Data Validation Procedures for Existing/Historic Data

Data validation and assessment consists of verifying the data quality of existing data prior to exportation from the database system. Data quality is assessed based on specific data validation criteria. Criteria for existing data will vary based on the supporting QA/QC documentation associated with a particular existing data set and the purpose or use anticipated for the data set.

2.5 Database Auditing Procedures

The auditing procedure for data management involves the Project QAO and the CMC Data Administrator. The Project QAO, or designee, is responsible for implementing the data auditing procedures. The purpose of data auditing is to provide a QA/QC check on the data validation and the general quality of the environmental data in the database.

At the discretion of the Project QAO, random data quality checks on database records will be conducted to ascertain if the data contains the correct standard values and meets other data quality standards. Examples of database record requests subject to random data quality checks may include, but not be limited to:

- Electronic Chain-of-Custody;
- Validated laboratory data;
- Field sampling information; and
- Historic groundwater sampling data.

The Project QAO will compare the database records with source documentation to verify data quality. The Project QAO will notify the CMC Data Administrator of the results of each audit. If significant departures from the source documentation are detected, the appropriate IU Project Manager will be notified.

3. MANAGEMENT OF AOC DATA

Figure 4 illustrates the principal data flows associated with AOC data. Primary components of the data flow diagram can be categorized in the following processes and procedures:

- Project setup;
- Field data collection and documentation procedures;
- Entering Chain-of-Custody and field data;
- Laboratory data procedures;
- Loading analytical results into database management software;
- Verifying data quality in the database;
- Corrections and changes to sample data;
- Electronic data validation procedures for AOC data; and
- Data transfer between AOC consultants.

Note that the specific processes and procedures listed above are not shown on Figure 4. Figure 4 is a generalized data flow diagram and specific processes and procedures are discussed below.

3.1 Project Setup

AOC data are collected in accordance with the AOC QAP and IU-specific FSPs. Each IU-specific FSP will be set up as a "project" in the database. Therefore, the term "project" will be synonymous with each IU-specific FSP.

The CMC Data Administrator, or designee, will establish new projects. The CMC Data Administrator, or designee, is responsible for ensuring that new projects are established correctly. Establishing a new project comprises four types of activities:

- Assigning specific roles to project team members;
- Establishing new accounts and setting up default information in the database;
- Notifying parties who will be involved in the further processes described in this DMP; and
- Documenting the above.

The first three types of activities are described below, and documentation procedures are described throughout this section.

The CMC Data Administrator will use Form C1.0 (Attachment A) which provides an overall tracking of the documentation process covered in detail in the other forms in Attachment A. Attachment A includes two checklists for setting up each new project (Form Nos. C1.1 and F1.1). The CMC Data Administrator will use Form C1.1 (Attachment A) for tracking tasks associated with setup of each new project. The first step in establishing a new project is for the IU Project Manager to request establishment of the new project using form F1.1. This form will specify the assignment of environmental data management roles and responsibilities to each team member.

Following assignment of roles, a new project name must be generated and essential information entered into the database. The project identification will be a unique name which will be assigned by the IU-specific FSP. The project name will be entered into the database by the CMC Data Administrator, or designee, at the request of the IU Project Manager. Form Nos. C1.1 and F1.1, included in Attachment A, will be used to notify the CMC Data Administrator, or designee, of each new project.

Other required data that will be entered on this form by the IU Project Manager prior to acceptance by the CMC Data Administrator, or designee, (and establishing a new project on the database) are:

- Project name;
- Project Manager (PM); and
- Project location and FSP name.

The form will be sent to the CMC Data Administrator who will set up the project in the database using the checklist provided on Form C1.1 as described in detail in the section below.

It is the responsibility of the IU Project Manager, or designee, to notify formally recognized role-holders in the DMP that they have been appointed to their position or positions. The notification shall be by facsimile or other written method. A copy of the notification will be made to the project file.

In particular, the following parties which are associated with each IU shall be formally notified of their future participation in the new project:

- Project Manager (PM);
- IU Quality Assurance Officer (QAO);
- Project Data User (PDU), if known;
- Analytical Laboratory (AL); and
- Project Quality Assurance Officer (Project QAO).

Responsibility for data quality and ensuring that data in the database is consistent with requirements, including lookups, rests with the IU Project Manager or designee. Procedures for data quality checking and related issues are discussed in following subsections (Section 3.1.1 and Section 3.1.2).

3.1.1 Providing Access to the Database

Once the new project has been established in the database, access to the database for proposed users will be agreed upon by the CMC Data Administrator, or designee. The CMC Data Administrator will enter the users' access. "Users" in this context includes:

- Data users (PDUs);
- Data validator (Project QAO); and
- Data query and reporting persons (PDUs).

When the data access list has been determined, the IU Project Manager, or designee, will use a database access request form (F1.2) to specify to the CMC Data Administrator user access privileges. This form will also be used for requesting change of database access privileges (changes shall be approved by the initials of the CMC Project Manager on the form).

3.1.2 Establishing Lookup Tables for the Database

In conjunction with establishment of database access, the CMC Data Administrator, or designee, will maintain the project data lookups for the database. Project data lookups are special tables within the database system that are used for:

- Reducing data entry time by providing pre-entered information fields; and

- Providing QA/QC controls on certain aspects of data entry, validation and data reporting which will ensure that the correct values are contained in certain database fields.

Standard values for the project data lookup tables are established prior to loading data and are loaded by the CMC Data Administrator.

The primary lookup table will be the project chemical list. This table summarizes the list of chemicals (i.e., those for which analyses will be performed) for the project. The project chemical list is drawn from a Master Chemical List that will be set up by the CMC Data Administrator.

3.2 Field Data Collection and Documentation Procedures

Each IU Project Manager oversees field data collection and documentation procedures. The IU Project Manager, or designee, is responsible for coordinating input of field data into the database management software. Attachment A has a checklist for this procedure entitled "Checklist: Chain-of-Custody and Field Data Collection" (Form C1.2).

The following field data types will be input in the database management software:

- Field notes relating to the in-field parameters of the samples or other important data, including the Field Sampling Data Sheet;
- The minimum required information from the Chain-of-Custody (COC) forms used to confirm passage of the samples to the laboratory; and
- Results from field analyses.

Each AOC consultant is responsible for generation of field documentation associated with a sampling event. The QAP specifies the standard operating procedures for field documentation.

3.2.1 Chain-of-Custody

In accordance with the QAP, Chain-of-Custody (COC) forms are used to document the transport and receipt of samples from the field to the laboratory.

3.2.2 Field Sample Identification/Numbers

The following sample numbering scheme for aqueous and non-aqueous samples has been developed:

Uxx-NNNN

"U" represents AOC work and "xx" represents the investigation unit (i.e., Lampbright - 01, Hanover Creek - 02, Whitewater Creek - 03, Smelter - 04, Hurley Soils - 05 and Tailing Area Soils - 06, Ecological - 07, Miscellaneous - 08).

CMC will assign blocks of unique sequential numeric strings (i.e., NNNN) to each designated AOC consultant. Each AOC consultant is responsible for assigning unique sample numbers from their range of available numbers during field data collection. Standard Operating Procedure (SOP)-1 of the QAP (Appendix B) provides additional information on the anticipated sample numbering scheme.

3.2.3 Field Forms

Procedures for recording data in field log books and data sheets are provided in SOP-2 of the QAP (Appendix B). To track the number of samples and analyses requested, it is imperative that all samples be entered into the field logbooks or field sample data sheets (whether they are being analyzed for chemical or geotechnical parameters, or not at all).

3.2.4 Sample Receipt Confirmation

In accordance with the QAP, laboratories receiving samples from the field will be required to provide sample receipt confirmation. The confirmation will include a copy of each COC form updated to include the following information:

- Signature of the receiving agent for the laboratory;
- Date and time of sample receipt; and
- Laboratory ID.

The confirmation will be faxed to the CMC Data Administrator. The CMC Data Administrator will forward a copy of the sample receipt confirmation to the appropriate IU Project Manager or designee. The IU Project Manager, or designee, is responsible for

checking the confirmation received from the laboratory against the original COC form(s) to ensure that the samples were received by the laboratory.

The CMC Data Administrator will also be responsible for checking the updated COC forms sent by the laboratory to ensure:

- All samples and analyses were correctly entered into the laboratory's data management system; and
- Laboratory IDs were assigned to each sample.

It is the responsibility of the IU Project Manager, or designee, to resolve issues regarding missing samples (i.e., samples sent but not confirmed as received by the laboratory).

The IU Project Manager, or designee, will notify the CMC Data Administrator and the laboratory by phone and/or fax of discrepancies observed during the sample receipt confirmation.

3.3 Entering Chain-of-Custody and Field Data

COC and field information will be entered into the database under the supervision of the CMC Data Administrator. The location description of sampling stations will be recorded by techniques which provide redundancy in geographic 'pinpointing' so that location errors or problems may be corrected in the office. Redundancy is mandatory as: a) an invalid location can potentially invalidate other data collected; and b) the sampling station can potentially be destroyed over extended time and thus prevent relocation by field means. Examples of positional redundancy include the following:

- A station's coordinates (New Mexico State Plane (NMSP) Coordinate System, west zone) recorded to the nearest reasonable foot multiple, horizontally and vertically, and a consistent and unique symbol marked on a copy of the base map issued from the GIS database (where the map copy is extensive enough to show annotated NMSP grid lines) or on a current USGS 7.5 minute map;
- A collection point's position based upon a verifiable measure from a known reference point, such as along a stream in reach units, along a stable linear feature discernible on the AOC base map (or rectified aerial photograph or image), and a consistent and unique symbol marked on a copy of the standard issue base map; and/or

- An activity point's street address and a verifiable sketch of the major structures in measured relation to the activity point and an approximate NMSP coordinate.

In all cases of recording coordinates, the coordinate set must have its reference datum stated, for example, North American Datum of 1927 (NAD27), NAD83, etc.

After completion of the loading of COC information and field data, the completed Form C1.2 will be sent to the IU Project Manager, or designee. The IU Project Manager, or designee, will be responsible for ensuring that the field data are correctly entered to the database. The procedure described in Section 3.6 shall be used for checking the accuracy of data entered manually to the database. After the check is completed, Form C1.2 will be signed and returned to the CMC Data Administrator.

3.4 Laboratory Data Procedures

The IU Project Manager, Project QAO and AL are involved in the laboratory data procedure process. The AL is responsible for implementing the laboratory data procedure. Implementing the laboratory data procedure comprises four main tasks:

- Confirming receipt of the sample delivery package from the field;
- Accurately recording all procedures relating to the analytical process;
- Transmitting the data results to the nominated recipients; and
- Documenting the above.

Documentation procedures are described throughout this section. Specific criteria for validation of chemical data are described in the QAP.

3.4.1 Standard Laboratory Data Management Procedures

The analytical laboratory must adhere to minimum environmental data management standards that ensure quality and use of the data to most effectively utilize the results of field and laboratory analyses. In particular, the data management procedure depends on the following functions being performed at every level of the procedure:

- Use of standard data transmittal formats;
- Use of standard values for key fields in the data gathering, analysis and storage; and

- Use of continuous monitoring of the process and strict adherence to QA/QC control points so that the process can be audited.

Analytical laboratories are required to adhere to the procedures described below.

3.4.2 Electronic and Hard Copy Deliverables to the CMC Data Administrator

Following completion of analysis of a batch of samples, the laboratory shall send a hard copy of the analytical data and associated QA/QC deliverables to the CMC Data Administrator. The CMC Data Administrator will notify the laboratory of acceptance of the hard copy data package following verification that the data package is complete. If corrections to the data package are required, the CMC Data Administrator, or designee, will provide written notification to the laboratory regarding the corrections. The laboratory will complete the necessary corrections and re-issue the final data package to CMC. The electronic file deliverable will be issued by the laboratory following acceptance of the hard copy data package by the CMC Data Administrator, or designee.

3.4.2.1 Data Certification

The sender is responsible for ensuring the integrity of the data transmitted. For the electronic transmission, the sender is responsible for verifying accuracy of not only the data field contents, but also ensuring adherence to the agreed upon reporting format, mentioned in the next section.

3.4.2.2 Record Structure

The electronic records shall be consistent with the format agreed upon by contract with CMC. If there are required fields that the laboratory does not typically provide a value for or if there is uncertainty as to the valid values for a field, the person responsible for data transmittal should immediately contact the CMC Data Administrator, or designee, for clarification.

3.4.2.3 Transfer Media

Files must be transferred on IBM/MS-DOS formatted diskettes.

3.4.2.4 Character Style

The written style for characters in a field should be applied as standard database values (i.e., upper case letters for field sample numbers).

3.4.2.5 Laboratory Results Data

Only final results shall be included in the data set. The sample detection limit shall be provided for all analyses, regardless of the validation flag.

3.4.2.6 Analyte Naming Conventions

The laboratory results should be provided with the analyte spelling corresponding to the list maintained by the CMC Data Administrator. This list will relate to the only acceptable spelling for each analyte, method number/name and CAS number.

3.4.2.7 Standard Sample Identifiers

As discussed in Section 3.2.2, a unique field sample identifier shall be assigned to each sample collected and listed on the COC form that accompanied the sample to the laboratory. It should be noted that the database will not accept duplicate sample identifications, even if the sample collection date is different.

The laboratory shall assign a unique Laboratory Sample ID to each Field Sample ID. The laboratory shall also provide a value for the field Sample Delivery Groups (SDG) provided on the COC in the data deliverable. If the laboratory does not use SDG (or Lab Batch IDs) for grouping analytical tests, the CMC Data Administrator will assign a unique number corresponding to the data package deliverable.

3.4.2.8 White Space

No extraneous white space characters (e.g., spaces, tabs, blanks) shall be included in the data file. All data fields must be trimmed to remove leading and trailing white space.

3.4.2.9 Diskette Label

The diskette label will contain the following information:

- CMC project name;

- Laboratory name;
- Laboratory job;
- File names contained on diskette;
- Date of submittal; and
- Number of diskette if there are more than one diskette per submittal.

3.4.2.10 Transfer of Data Diskettes

The following guidelines should be followed for the shipping of data diskettes:

- Diskettes should be scanned and determined free of viruses;
- Diskettes should be shipped in appropriate protective packaging; and
- The package should be addressed to the CMC Data Administrator.

3.5 Loading Analytical Results into Database Management Software

The CMC Data Administrator, or designee, is responsible for loading analytical results into the database management software. As described in Section 1.2, loading of analytical data is contingent on acceptance of the hard copy data package by the CMC Data Administrator and the appropriate IU Project Manager. Form C1.3 will be used to document that all laboratory data were received.

Loading analytical data to the database comprises four main tasks:

- If electronic files are available, coping the files to the correct directory on the CMC local-area-network (LAN);
- Loading or manually entering the data to the database;
- Verifying the load or entry was performed correctly; and
- Documenting the above.

The first and third tasks listed above are described in this section. The task of loading the data is described in a separate documentation available on-line and is taught in a training class. Documentation procedures are described throughout this section. Attachment A contains a checklist for this section entitled "Check List - Loading/Validating Analytical Data" (Form C1.3).

After receiving the electronic data from the laboratory and before loading the data into database, the CMC Data Administrator, or designee, is responsible for verifying the following:

- A laboratory SDG number is assigned for each sample;
- Required samples/analyses were performed as specified in the COCs and sampling plan;
- Required electronic format was provided;
- Data for which standard values are to be used in the database are correct according to the provided list; and
- Standard nomenclatures have been adhered to (including Sample ID, Method Number and Analyte Names).

The pre-load data check will be documented by checking the appropriate box on Form C1.3. The CMC Data Administrator is responsible for the accuracy of the data being entered into the database management software, regardless of who actually loads or enters the data. The CMC Data Administrator shall be responsible for the accuracy of the data and for assuring that all fields which are subject to standard values contain only values that are in the approved standard value lists.

At the discretion of the Project QAO, data quality checks will be performed on the database. Data records that are found to contain unapproved values (i.e., not in the approved lookup lists) will be marked for attention. The persons responsible for this data entry or loading will be responsible for rectifying the incorrect values.

The Project QAO also performs a random data quality check on electronic data deliverables that are received from the analytical laboratories. If unacceptable data are found, the CMC Data Administrator, or designee, may refuse to accept the data and notify the laboratory and the IU Project Manager that this exception has occurred.

3.5.1 Definition of Analytical Data Types

Analytical data comprise data generated by the laboratory during the analysis of the environmental samples. Laboratory data will include, but not be limited to:

- Lab sample ID;
- Sample delivery group;
- QA/QC type;

- Method number;
- Received date;
- Analysis date;
- Extracted date;
- Analyte name;
- Value (result);
- Value qualifiers; and
- Units.

Field data that should accompany the laboratory information include, but are not limited to, field sample ID, identification of blind field duplicates, matrix, sample date and sample time.

3.5.2 Entering Analytical Data into the Database

The CMC Data Administrator may load analytical data to the database by one of three methods (in order of most preferable):

- Transferring a file to the CMC LAN and loading the file;
- Transferring a file to the CMC LAN and requesting assistance with loading the data; or
- Connecting to a docking station PC connected to the CMC Local Area Network (LAN) and entering the data manually to the database.

The completion of data loading will be documented by checking the appropriate box on Form C1.3. The CMC Data Administrator will immediately notify the relevant parties that the data has been loaded and verified using Notification of Data Operation, Form No. F1.2 and marking the appropriate box on Form C1.3. Form F1.2 will be "completed by" the CMC Data Administrator and "sent to" the relevant parties. It is the CMC Data Administrator's, or designee's, responsibility to ensure that all members of the team follow these procedures for data loaded to the database by these methods.

3.6 Verifying Data Quality in the Database

Once the AOC data have been electronically or manually loaded to the database, the CMC Data Administrator, or designee, is responsible for ensuring that the data are checked against the hard copy records delivered from the analytical laboratory.

The following data QC procedure will be followed for checking the database against the hardcopy data:

- The analytical database QC review will be completed on a data deliverable basis (from the analytical laboratory). A hard copy of the loaded data, organized by lab batch number (or SDG), will be checked by the CMC Data Administrator, or designee, against the data deliverable hard copy, as described below;
- Clearly mark corrections to the hard copy database report in red ink;
- Using the COC forms returned to the CMC Data Administrator from the field and the laboratory data sheets, check that the field sample numbers are correctly listed on the database hard copy, and that all samples for the data package are reported on the database hard copy;
- Using the COC forms and laboratory data sheets (Lab Sheets), check that all the analyses requested for each sample are reported on the database hard copy;
- Using the Lab Sheets, check that the units reported on the database hard copy are correctly reported [i.e., check that the analytical matrix is reported correctly], as liters (L) for aqueous samples, and kilograms (kg) for solids, and that the power of the unit is correct for the analytical method [i.e., micrograms (µg) or milligrams (mg)];
- Using the Lab Sheets as a basis, check values (results and reporting limits) for all analytes for a given sample, at a frequency of approximately 10 percent of the samples for each data package. For data packages with results reported for more than 10 analytes for all samples, check the values and reporting limits for a minimum of one analyte per sample. If errors are found, an additional 10 percent of results and reporting limits will be checked for similar errors. If errors are found in the second 10 percent, then all results and reporting limits will be checked, or a new data deliverable will be requested;
- For each data package, note any questions concerning the reporting of the data and review systematic problems (if any) with the Project QAO and CMC Project Manager;
- Keep a copy of the marked up database hard copy;
- Make the required changes to the database;
- Print a new database hard copy and check the corrected copy of the database to determine that corrections have been completed;
- After completing the QC check of approximately 10 percent of the data package, discuss the general findings of the review procedure with the Project QAO and the CMC Project Manager. Depending upon the review findings, appropriate modifications to the review procedure may be put into effect; and

For manually entered data, 100% of the data shall be proofed and corrected. Otherwise, all procedures mentioned above will be followed.

Documentation of completion of the verification will be accomplished by marking the appropriate box on Form C1.3.

3.7 Corrections and Changes to Sample Data

It is expected that changes or corrections may be required to be made to the data entered into the database (e.g., error corrections as described above, cancellation of sample analyses, additions of qualifiers to non-validated data, field logbook error corrections).

In instances where changes are required to the database after the data have validated, all changes must be accompanied by a Data Correction/Change form that will detail the changes to be made, and document that the changes were completed. The Notification of Data Operation Form, No. F1.2 (Attachment A) will be used for this purpose. The name of the person requesting the change will be entered into the "Form Completed by" box and sent to the CMC Data Administrator. After the changes have been made and verified, Section 3.0 procedures will be followed for notification. Completion of entry of validation qualifiers and changes for a given sample digestion group shall also be documented using Form F1.2.

For all corrections, addition of data qualifiers, and other required changes to the database, 100 percent of the changes will be proofed by the CMC Data Administrator, or designee, for potential entry errors.

3.8 Data Validation Procedures for AOC Data

Implementation of the Data Validation Procedure comprises four main tasks:

- Receipt of the laboratory validation package and analytical results and confirmation thereof;
- Accurately recording all procedures relating to the data validation;
- Transmitting the validation qualifiers and changes to the nominated recipients; and
- Documenting the above.

Specific criteria for laboratory data validation and data validation by CMC's designated contractor are presented in the QAP. This section describes the minimum requirements for

performing items 1 through 3 in the list above according to this DMP. Documentation procedures are described throughout this section.

3.8.1 Data Delivery and Receipt Confirmation

The laboratory is responsible for delivering data necessary for the validation of the analytical results to the CMC Data Administrator, or designee.

The validation data package will be in hard copy format only (unless by prior agreement with CMC). As listed in the laboratory's contract with CMC, analytical parameters and equipment calibration information shall be included, as necessary, to allow the validation to proceed.

The Project QAO will notify the laboratory of any departures from the standard requirements for hard copy data that are permitted or required. The Project QAO will receive analytical results for validation in hard copy form directly from the CMC Data Administrator, or designee. Electronic data deliverables shall only be provided to the validator by prior arrangement with the CMC PM.

Other relevant QA/QC data may be provided to the Project QAO by the following methods:

- Copies of the field notes may be sent to the Project QAO;
- Information may be summarized in a memorandum to the Project QAO;
- Data may be queried directly from the database software by the CMC Data Administrator, or designee, and sent electronically or in hard copy form to the Project QAO; or
- The Project QAO may connect to the database management software using the provided PC work station and query the required data directly.

Data shall be sent to the validator in batches that match those sent as electronic deliverables to the CMC Data Administrator. It is imperative the Project QAO ensure that the data received from the lab is the correct data to be validated. This can be accomplished by communicating with the CMC PM or CMC Data Administrator immediately after receiving data packages from CMC.

3.8.2 Delivery of Validation Qualifiers

On completion of validation of a batch of samples, the Project QAO shall send hard copy of the validation qualifiers and changes to the data to the CMC Data Administrator. Electronic data deliverables from the Project QAO shall not be accepted for the purpose of loading data. Validation changes will be entered directly into the database. Completion of validation will be documented by marking the appropriate box on Form C1.3.

3.8.3 Loading Data Validation Qualifiers Management Process

Data validation qualifiers and changes shall be entered to the database by the CMC Data Administrator, or designee, using a PC connected to the CMC database. The changes and qualifiers will be checked in accordance with the procedures outlined in Section 3.6, where applicable. Completion of loading qualifiers and verifying entry will be documented by marking the appropriate boxes on Form C1.3. Form F1.2 will be used to notify the IUPM and the project QAO of completion of the entry.

3.9 Data QA/QC Auditing Procedures

The Project QAO and CMC Data Administrator are involved in the data QA/QC auditing procedures. The Project QAO is responsible for implementing the data auditing procedures for all investigation units. The IU QAO is responsible for a given IU. The purpose of data auditing is to provide a QA/QC check on the data validation and the quality of the environmental data in the database in general. This section describes the procedures for checking the data quality in the database management software.

3.9.1 Responsibilities of the Project QAO

The Project QAO's responsibilities include:

- Provide peer review of the analytical data validation process;
- Develop and/or endorse and uphold standard values for the database (where appropriate); and
- Provide other assistance needed for users of the system to meet the quality requirements for the database.

The Project QAO will perform these duties by:

- Auditing the data validation qualifiers and changes provided by the validators;
- Liaising with the CMC Data Administrator to coordinate occasional and random data quality checks on the data in the database; and
- Advising the CMC PM and CMC Data Administrator of any problems that are observed in the process or data quality in the database, so that the CMC Data Administrator can rectify the problems.

3.9.2 Procedure for Data Quality Auditing

Once the validation qualifiers and changes are received and entered into the software, the Project QAO will perform a data quality check on approximately 10 percent of the validated data.

The check will comprise:

- Evaluation of the data to ensure scientifically realistic results (i.e. within reasonable bounds for the project); and
- A check to confirm that the validation qualifiers entered into the database are correct according to the hard copy records in the project file.

If errors are found in the database as a result of the 10 percent check, the errors will be brought to the attention of the CMC Data Administrator and other concerned parties (e.g. the Project QAO). The CMC Data Administrator will coordinate efforts to correct the data in the database.

Documentation of the completion of this QA/QC audit check will be accomplished by marking the appropriate box on Form C1.3.

3.9.3 Random Data Quality Checks

From time to time, the Project QAO will request data quality checks on the records in the database to ascertain if the data contains the correct standard values and meets other data quality standards. In turn, the Project QAO will communicate the results of these checks to the CMC PM and CMC Data Administrator if any significant departures from the standards are found.

3.10 Data Transfer Between AOC Consultants

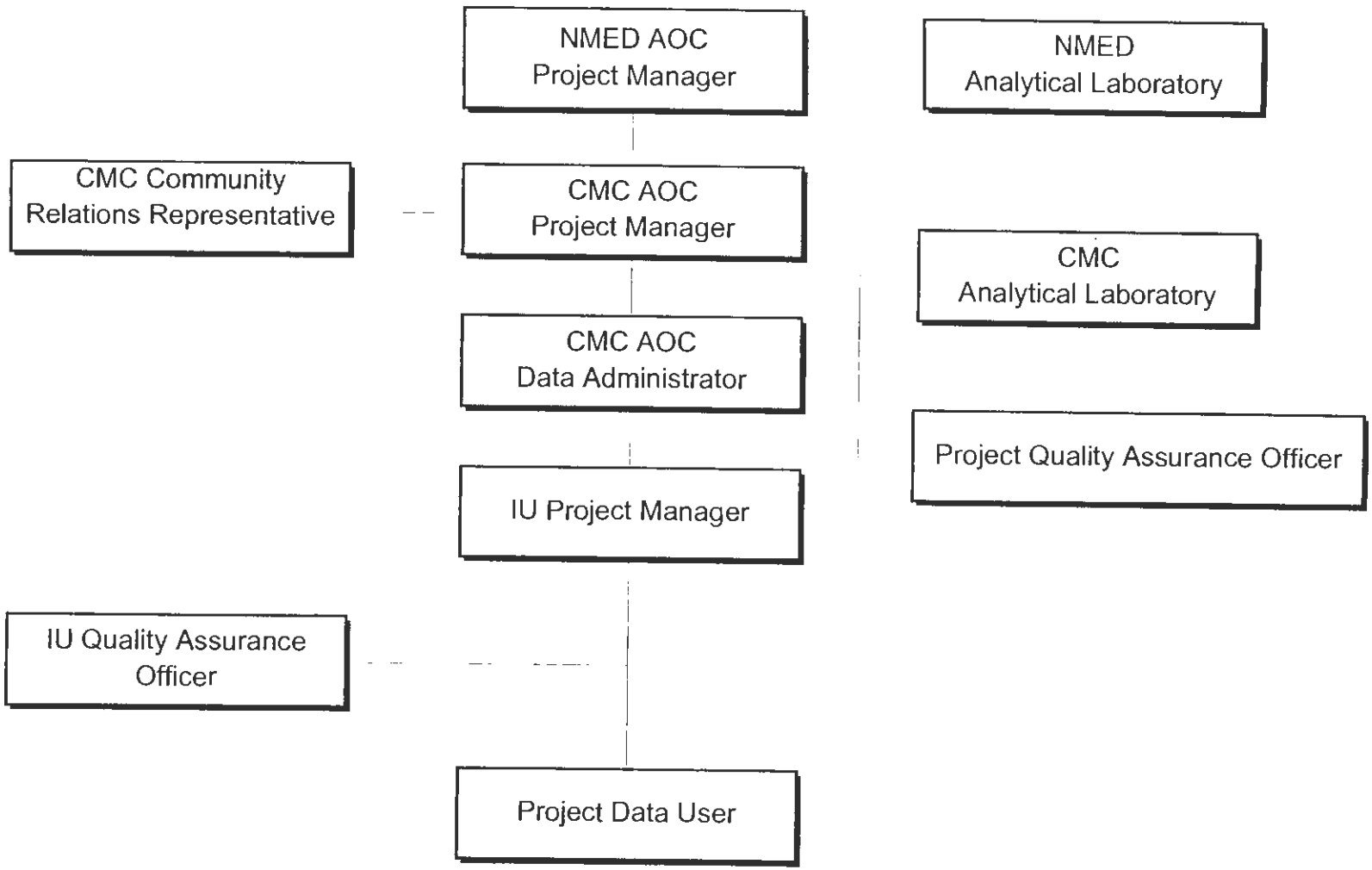
Read-only access will be provided to CMC designated parties. Data transfer will consist of exported query reports from the database system. CMC and the AOC consultants may modify the exported query data in accordance with reporting requirements; however, modified data may only be imported back into the database system by the CMC Data Administrator, or designee.

4. DATA SECURITY AND STORAGE

Data stored in the database will be archived on a regular basis to ensure data recovery. CMC personnel will backup the computer system and files/tapes will be stored in the CMC AOC Building in a secure location. In addition, monthly backups will be stored off-site in a fireproof safe or filing cabinet.

5. CLOSING REMARKS

The DMP and the QAP are intended to meet the overall data management requirements stated in the AOC. These documents may be amended or modified as the AOC project proceeds.



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Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
74601.05.0101	01/97	A

FIGURE 1

PROJECT ORGANIZATION CHART

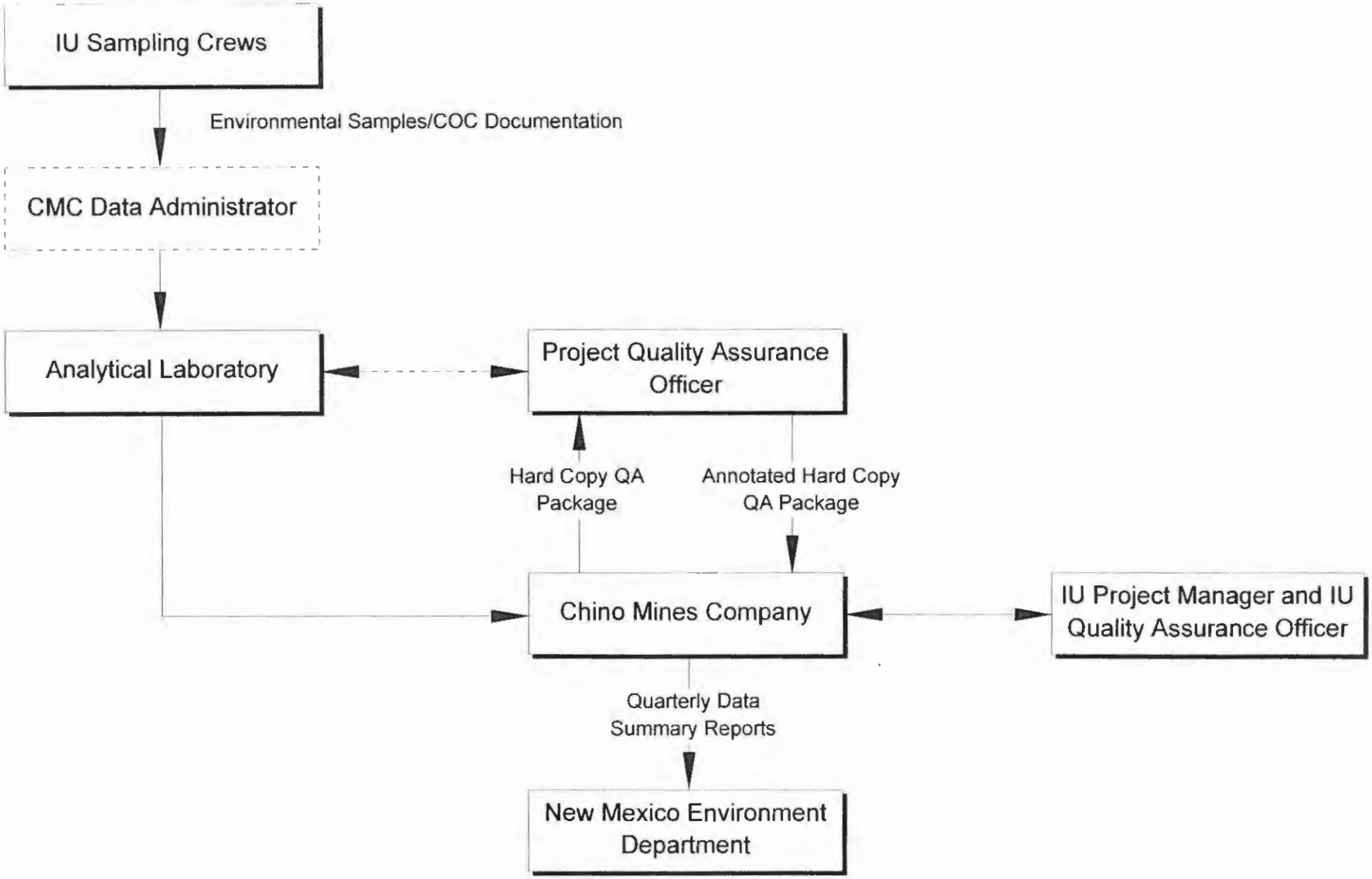

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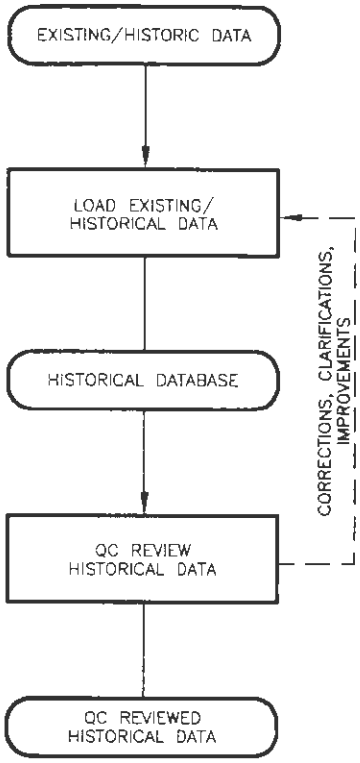
FIGURE 2

PRINCIPAL PRODUCERS, HANDLERS AND RECIPIENTS OF AOC DATA



LEGEND:

ACTIVITY

DATA SET

INFORMATION TRANSFER OR PRODUCT

INFORMATION FEEDBACK OR REWORK

SRK

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FIGURE 3

PROJECT DATA FLOW DIAGRAM
FOR EXISTING/HISTORIC DATA

* STA.#2 * M:\CHINO\74601\05-0101\06-96\FIG03.DWG * JUN 07, 1996 * 1:22:21 PM *

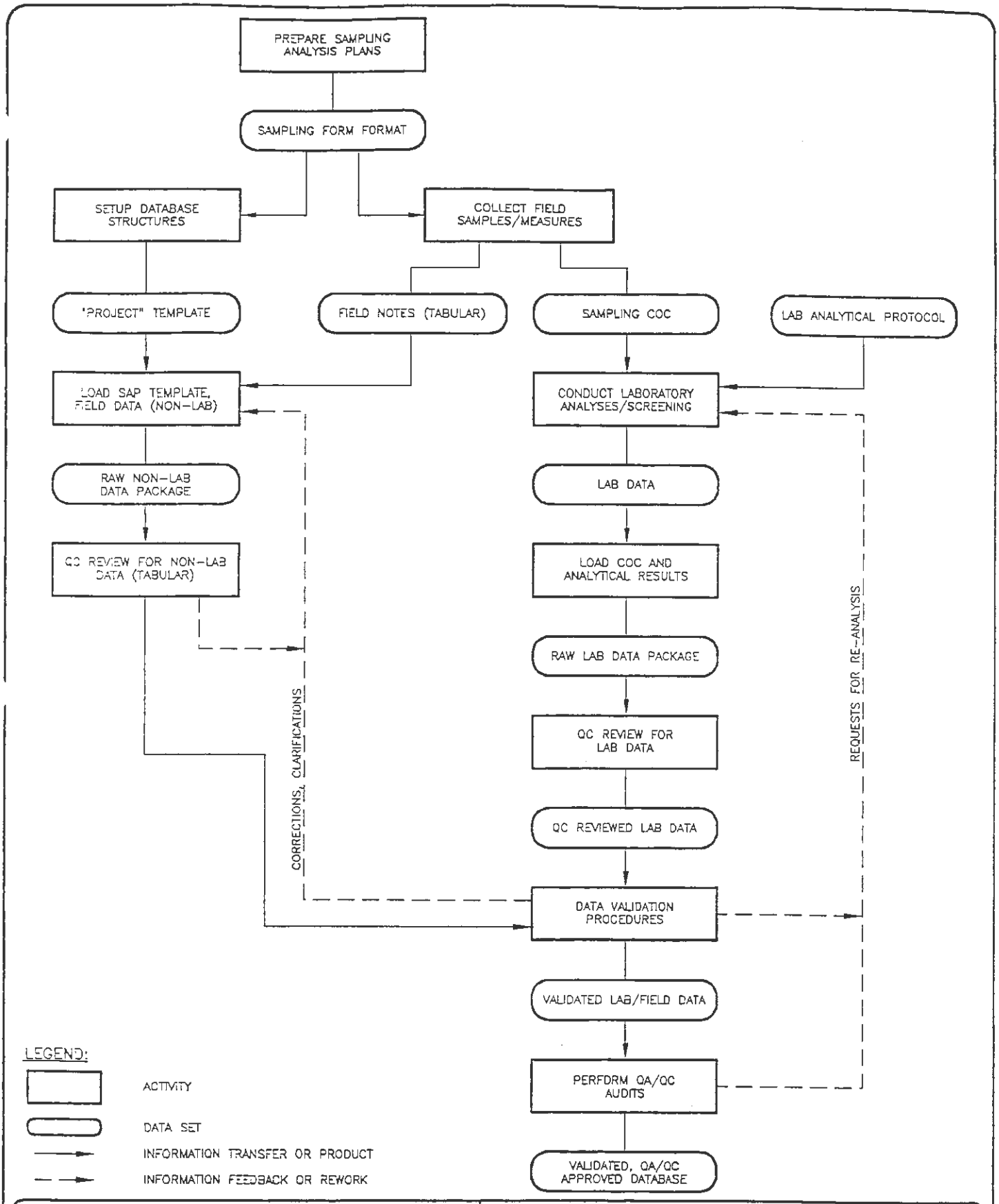

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FIGURE 4

PROJECT DATA FLOW DIAGRAM FOR AOC DATA

ATTACHMENT A
DATA MANAGEMENT FORMS/CHECKLISTS

FORM C1.0 - MASTER CHECKLIST

Project Name: _____

Project Location: _____

	Inititals	Date
☐ If Pertinent, Attach Copy of Project Authorization		
☐ Project Checklist Completed and Checked (Form C1.1), if New Project		
☐ Field Data Collection Completed and Checked (Form C1.2)		
☐ Loading Analytical Data Completed and Checked (Form C1.3)		
☐ Validation Completed and Checked (Form C1.3)		

Comments or Special Instructions

Signature	Date
Form Completed by:	
Sent to:	
Entered by:	
Checked by:	

FORM C1.1 - CHECKLIST: PROJECT SETUP

Project Name: _____

Project Location: _____

	Inititals	Date
☐ Assign Project Roles (Form F1.1)		
☐ Open Project and Establish Database Access (Form F1.1)		
☐ Establish Lookup Tables (Provide Attachment of the Data Management Plan)		
☐ Establish and Verify Project Chemical List (Provide Attachment of the Data Management Plan)		
☐ Establish Library of Definitions for Abbreviations Used in Fields (Provide Attachment)		
☐ Notify All Parties of Their Roles by Fax		

Comments or Special Instructions

Signature	Date
Form Completed by:	
Sent to:	
Entered by:	
Checked by:	

FORM C1.2 - CHECKLIST: CHAIN-OF-CUSTODY AND FIELD DATA COLLECTION

Project Name: _____

Project Location: _____

	Inititals	Date
In Field Procedures		
☐ All Chain-of-Custody (COC) Forms Sent to Laboratory (Attach Copy of COCs)		
☐ All Sample Receipts Returned		
Data Loading/Transer Procedures		
☐ All COCs Loaded by CMC Administrator		
☐ Data Notification of COCs Loaded (Form F1.2)		
☐ All Loaded COCs Checked for 100% Accuracy by IUPM		
☐ All Field Notes Loaded by CMC		
☐ Data Notification of Field Notes Loaded (Form F1.2)		
☐ All Loaded Field Notes Checked for Accuracy by IUPM		

Comments or Special Instructions

Signature	Date
Form Completed by:	
Sent to:	
Entered by:	
Checked by:	

FORM C1.3 - CHECKLIST: LOADING/VALIDATING ANALYTICAL DATA

Project Name: _____

Project Location: _____

	Initials	Date
Data Loading/Transfer Procedures:		
☐ Check All Laboratory Data Received		
☐ Hardcopy		
☐ Electronic		
☐ Pre-Load Data Quality Check		
☐ Load Analytical Data		
☐ Verify Data Quality (Section 3.6)		
☐ Notify IUPM of Data Load		
Data Validation Procedure (Optional)		
☐ Confirm Validation Completed		
☐ Validation Codes and Changes Entered		
☐ Validation Entries Checked		
☐ Notify IUPM and Project QAO of Data Loaded Correctly (Form F1.2)		
☐ QA/QC Audit Check Performed		

Comments or Special Instructions

Signature	Date
Form Completed by:	
Sent to:	
Entered by:	
Checked by:	

FORM F1.1 - DATABASE ACCESS

Project Name: _____

Project Location: _____

Forward To:

Page ___ of ___

Role	Name	Company
Environmental Manager		
Project Manager		
Project Data Manager		
Database Administrator		
QA/QC Officer		

Company	Name	Logon ID

Project							Geological				Chemical			Production			Query		
Merge Project	Export to .DEF	Import from .DEF	Project Status	Chemical List	Site/Locations	Lookups	Edit	Query	Data Entry Forms	Electronic Load	Data Entry	Sampling Plan	Chain-of-Custody	Pre-QC	QC	Validated	Pre-QC	QC	Validated

Comments and Special Instructions

Signature	Date
Completed by:	
Sent to:	
Entered by:	
Checked by:	

FORM F1.2 - NOTIFICATION OF DATA OPERATION

Project Name: _____ Project Location: _____	Forward To: Distribution List	Page __ of __

Type of Information (Mark only one)	**Type of Operation** (Mark only one)
☐ Chain-of-Custody ☐ Field/Location ☐ Laboratory Path/Filenames _____	☐ Manual Data Entry ☐ Transfer of File to Load ☐ Electronic Data Load ☐ Edit/Changes ☐ Validation Codes/Changes ☐ Other _____ _____ _____ _____ _____ _____

COC Numbers, Location or Lab Batch Numbers:

_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____
_____ _____ _____ _____ _____ _____ _____

Comments or Instructions

Signature	**Date**
Completed by:	
Sent to:	
Entered by:	
Checked by:	

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPS)

STANDARD OPERATING PROCEDURES (SOPs)
FOR
CHINO MINES COMPANY
AOC REMEDIAL INVESTIGATION

Prepared by:

Steffen Robertson and Kirsten (U.S.), Inc.
7175 West Jefferson Avenue
Suite 3000
Lakewood, CO 80235

SRK Project No. 74601.05.0102
June, 1996

STANDARD OPERATING PROCEDURES
AOC REMEDIAL INVESTIGATION
CHINO MINES COMPANY

SOP-1	Field Document Control
SOP-2	Field Logbook
SOP-3	Field Quality Control
SOP-4	Sample Custody and Documentation Procedures
SOP-5	Packaging and Shipping of Environmental Sample Containers
SOP-6	Decontamination of Equipment Used to Sample Soil and Water
SOP-7	Requesting Environmental Laboratory Services
SOP-11	Field Measurement of pH, Specific Conductance and Temperature For Aqueous Samples
SOP-12	Redox-Potential (E_h) & Dissolved Oxygen Measurements
SOP-13	Field Sampling of Stream Channels, Springs and Seeps
SOP-14	Sampling, Preservation and Containerization
SOP-15	Water Table Elevation Measurement
SOP-16	Groundwater Sampling
SOP-17	Filtering of Water Samples
SOP-21	Sample Collection From Soil Borings, Excavations and Hand Dug Pits
SOP-22	Surface Soil Sampling
SOP-23	X-Ray Fluorescence On-Site Measurement
SOP-24	Sediment, Evaporite and Precipitate Sampling
SOP-25	Installation and Development of Shallow Groundwater Monitor Wells
SOP-26	Field Laboratory Determination of Soil pH
SOP-27	(Reference) ASTM Standard, D 5781-95, Guide for the Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
SOP-28	(Reference) ASTM Standard, D 5782-95, Guide for the Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
SOP-29	(Reference) ASTM Standard, D 5783-95, Guide for the Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

SOP-30	(Reference) ASTM Standard, D 5784-95, Guide for the Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
SOP-31	(Reference) ASTM Standard, D 5521-94, Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers

STANDARD OPERATING PROCEDURE NO. 1
FIELD DOCUMENT CONTROL

Information relevant to field operations must be recorded in various forms, including logbooks, photographs, chain-of-custody records and field sample data sheets. Field document control procedures will be implemented to ensure that documents are trackable and accounted for when the project is completed.

Field Documents Subject to Control:

1. Project logbooks;
2. Field logbooks;
3. Field sample data sheets;
4. Chain-of-custody records;
5. Sample logbooks; and
6. Photographs, drawings, and annotated maps used during field activities.

Sample Numbering Scheme

CMC's AOC Data Administrator will assign a block of sample numbers on a project-by-project basis to those required to complete any type of sampling for AOC work. These sample numbers will be used for all samples prepared in the field, including QA/QC samples. The following sample numbering scheme for aqueous and non-aqueous samples will be used:

Uxx-NNNN

Where "xx" represents each investigation unit as follows:

- Lampbright Draw - 01;
- Hanover Creek Channel - 02;
- Whitewater Creek Channel - 03;
- Smelter - 04;
- Hurley Soils - 05;
- Tailing Affected Soils - 06;

- Ecological - 07; and
- Miscellaneous -08.

NNNN represents a four-character numeric string assigned as follows:

Background Report Sampling	See Note Below
Remedial Investigation	0001 through 1000
Remedial Investigation	1100 through 2000
Feasibility Study	2500 through 3000
Remedial Design	3100 through 4000
Remedial Action (RA)	4100 through 5000
Post RA Monitoring	5100 through 6000

Note: The Background Report sample numbers consist of combinations of numbers which will not be duplicated using the blocks of numbers specified above.

Additional blocks of sample numbers can be developed as the need arises and this SOP will be updated in such cases.

Each consultant will maintain a logbook defining field activities (SOP-2). The logbook entries will be named after the specific site and project to be performed. Documents created to collect data or information should have the date and signature of the personnel who are responsible for the measurements or observations recorded.

When field forms or logbooks are completed, original versions will be provided to the CMC AOC Data Administrator in Hurley, N.M. for placement in the master field document control section of the master project file. Records of sample bottle certification will be kept with the field logbook for filing in the master project file.

STANDARD OPERATING PROCEDURE NO. 2
FIELD LOGBOOK

A separate field logbook shall be used for each field task. Each logbook shall have a unique document control number. The logbooks shall be bound and have consecutively numbered pages. The information recorded in these logbooks shall be written in indelible ink. Entries shall be initialed and dated at the end of each day by the author, and a line drawn through the remainder of the page. Pages shall be consecutively numbered. Corrections to logbook entries shall consist of a single line-out deletion in indelible ink followed by the author's initials and the date. No field logbooks shall be destroyed or thrown away, even if they are illegible or contain inaccuracies that require replacement or correction. These logbooks or data forms, at a minimum, shall include the following entries:

- Purpose and description of proposed field task;
- Time and date fieldwork started;
- Location and description of work area and, if possible, map reference and photographs and sketches of well construction details, soils, pits, etc.;
- Names and titles of field personnel;
- Name and address of any field contacts;
- Meteorological conditions at the initiation of fieldwork and any ensuing changes in these conditions;
- Details of the fieldwork performed, with special attention to any deviations from the Field Sampling Plan (FSP) or Standard Operating Procedures (SOPs);
- All field measurements made;
- Level of personnel protective equipment;
- Field instrument calibration data;
- Field laboratory analytical results; and
- Personnel and equipment decontamination procedures.

For field sampling work, at a minimum, the following entries should be made:

- Sample location and number;
- Sample type (e.g., groundwater) and amount collected;

- Date and time of sample collection;
- Split samples taken by other parties. Note the type of sample, sample location, time/date, name of person, person's company, and any other pertinent information;
- Sampling method, particularly any deviations from the SOP;
- Suspected waste composition, including an estimate of the hazard level as being low or medium;
- Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample (e.g., filters and preserving reagents); and
- Sample preservation, handling, packaging, labeling, shipping information (e.g., weight), the shipping agent, and the laboratory that will receive the samples.

PHOTOGRAPHS

Photographs shall be taken of field activities using a camera-lens system with a perspective similar to the naked eye. Photographs should include a measured scale in the picture, when practical. The following items shall be recorded in the field logbook for each photograph taken:

- The photographer's name, the date, the time of the photograph, and the general direction faced;
- A brief description of the subject and the fieldwork portrayed in the picture; and
- Roll number and sequential number containing the photograph.

The slides or prints and associated negatives shall be placed in the master project files in CMC's office following development of the film. Supporting documentation from the field logbooks shall also be photocopied and placed in the master project files to accompany the particular slides or prints. Figure 2-1 presents an example of a photograph label. These photograph labels are intended to be attached to the individual photo placed in the master project file.

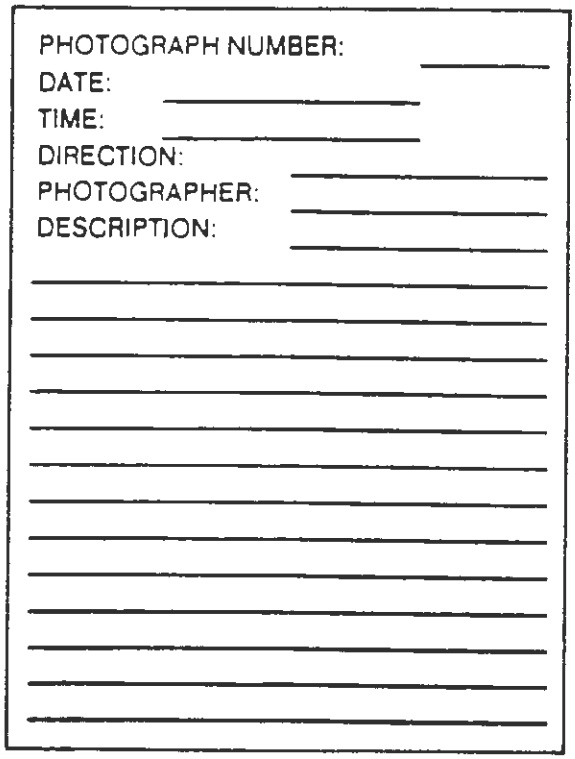

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FIGURE 2-1

PHOTOGRAPH LABEL

STANDARD OPERATING PROCEDURE NO. 3
FIELD QUALITY CONTROL

Field Quality Control (QC) is a part of the project Quality Assurance/Quality Control program. This Standard Operating Procedure (SOP) describes the preparation and recommended collection frequency of various field QC samples for aqueous and soil/sediment media. Table 3.1 lists the QC sample types, preparation methods, and recommended frequencies for the field sampling program.

At least one set of field QC samples shall be prepared for each sampling event. An event is defined by any of the following conditions:

1. An initiation of a new sampling round; or
2. A significant change in sample type or media.

If the number of field QC samples taken is not equal to an integer multiple of the interval specified in Table 3.1, then the next highest multiple shall be used. For example, if a frequency of 1 in 20 is indicated and 28 samples are taken, then two field QC samples shall be prepared.

All field QC samples shall be labeled and shipped with field samples to the laboratory according to SOP-5. Sample custody shall be maintained using the procedures described in SOP-4.

Description of Field QC Measures

Field QC measures shall be implemented during sample collection activities to preserve sample integrity. Sampling equipment shall be decontaminated according to the appropriate SOPs to minimize potential cross-contamination. In addition, new surgical type gloves shall be donned at each sample location and, when possible, the sampling program shall proceed from "clean" to "dirty" areas.

Description of Field QC Samples

General descriptions of potentially applicable field QC samples follow below. The sample collection frequency shall be established by the site-specific Field Sampling Plan.

Blind Decon Rinseate Blank (BDRB) - A BDRB is a sample bottle containing distilled/deionized (DS/DI) water and preservative and is prepared at the sample site. A BDRB is prepared for dissolved metals by processing a representative amount of DS/DI water through the decontaminated sample collection container and filtering apparatus (if appropriate) and adding the appropriate preservative. A BDRB is prepared by processing a representative amount of DS/DI water through the decontaminated sample collection container only and adding the appropriate preservative. The appropriate sample number shall be written on the sample label, and the label shall be placed on the bottle.

Field External Contamination Blank (FECB) - A FECB is a sample bottle containing DS/DI water that is "sampled" through an unused filter and is prepared at the sample site. A FECB is prepared by processing a representative amount of DS/DI water through the decontaminated filtering apparatus (if appropriate) using a clean, unused filter. The appropriate sample number shall be written on the sample label, and the label shall be placed on the bottle. The sampler shall record the filter name and lot number in the field logbook.

Blind Bottle Blank (BBB) - A BBB is a sample bottle containing DS/DI water and preservatives and is prepared in the field laboratory. A BBB is contained in a sample bottle randomly chosen from the lot of bottles received from the supplier. A BBB is prepared by the same protocols as a normal sample but is not exposed to any "field conditions" or sampling equipment. The appropriate sample number shall be written on the sample label, and the label shall be placed on the bottle.

Blind Field Duplicate (BFD) - A BFD consists of split samples taken at the same location and time but placed in different sample containers for separate analysis. Each duplicate shall be analyzed for identical chemical parameters. A BFD is prepared as follows:

1. Collect an adequate volume of sample to accommodate two sample containers;
2. Process the samples as per SOP-16, SOP-21, or SOP-22 for each duplicate;
3. Label the two sample containers with appropriate sample numbers; and
4. Record duplicate number, sample number, and sample location in the field book.

The chain of custody documentation for the BFD should reflect an arbitrary sampling time, which is consistent with the sample set.

Trip Blank (TB) Sample - A TB sample is only required when volatile organic analyses are requested. The TB sample is prepared by the laboratory and consists of a sample bottle filled with Type II reagent water, transported to the site, handled like a sample and returned unopened to the laboratory for analysis. One trip blank per day shall be prepared and shipped with samples taken that day (see SOP-4).

REFERENCES

APHA, AWWA, and WPCF, 1985. Standard methods for the examination of water and wastewater, 16th Ed. M.H. Franson (ed). American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D.C.

TABLE 3.1
RECOMMENDED FIELD QUALITY CONTROL SAMPLING PROGRAM

Quality Control Sample Name	Abbreviation	Applicable Sample Media	Preparation Location	Recommended Collection Frequency
Blind Decon Rinseate Blanks	BDRB	Aqueous Soil/Sediment	Sample Site	Once per 20 or Once per Sampling Event
Field External Contamination Blank	FECB	Aqueous	Sample Site	Once per Day per Matrix
Blind Bottle Blank[a]	BBB	Aqueous	Field Lab, Retained in Lab	Once per 20 or Once per Sampling Event
Blind Field Duplicates	BFD	Aqueous Soil/Sediment	Sample Site	Once per 10 or Once per Week
Trip Blank	TB	Aqueous (VOCs Only)	Laboratory	Once per Day

Note:

a. This QC sample is not required if pre-cleaned sample containers and certification are supplied by the analytical laboratory.

STANDARD OPERATING PROCEDURE NO. 4
SAMPLE CUSTODY AND DOCUMENTATION PROCEDURES

A stringent, established program of sample chain-of-custody procedures shall be followed during field sample collection and handling activities and transfer of the samples to the analytical laboratory. Whenever possible, preprinted labels should be used to ensure that all necessary information is retained with the sample. Shipping manifests shall be utilized to maintain control over access to the destination of samples after shipment from the sample collection site.

Figures 4-1, 4-2, 4-3, 4-4 and 4-5 (A and B) show examples of the sample label, field sample data sheet, chain-of-custody record, field sample data sheet for surface water and soil sampling data sheets, respectively. The use of each form is discussed below.

Sample Label

Each sample shall be labeled, and the following information recorded on the label:

1. Project number;
2. Laboratory analyses;
3. Sample type (grab or composite, media sampled);
4. Sample identification (well number for groundwater samples; soil boring number, sample number, and sample depth for soil samples, etc.);
5. Date and time sample was taken;
6. Sampler's name;
7. Sample ID number (in accordance with SOP-1, a unique serial number stamped or written on each sample label);
8. Preservative added; and
9. Remarks, including pertinent field observations.

Field Sample Data Sheet

The field sample data sheet is completed in the field and signed by the individual physically in charge of sample collection. The field sample data sheet correlates the assigned sample bottle designation to a specific well or sample location or other distinguishing feature or attribute (e.g., blank sample, replicate sample, purge evaluation sample, etc.)

Chain-of-Custody Record

Chain-of-custody (COC) records ensure that samples are traceable from the time of collection until they are received and analyzed by the analytical laboratory. The COC shall be sealed in the sample shipping container. The shipping agent or courier is not required to sign the COC. Upon arrival at the lab, the sample custodian checks the custody seals on the sample shipping container, opens the container and signs as receiving the sample and noting the condition of the custody seal (e.g., intact).

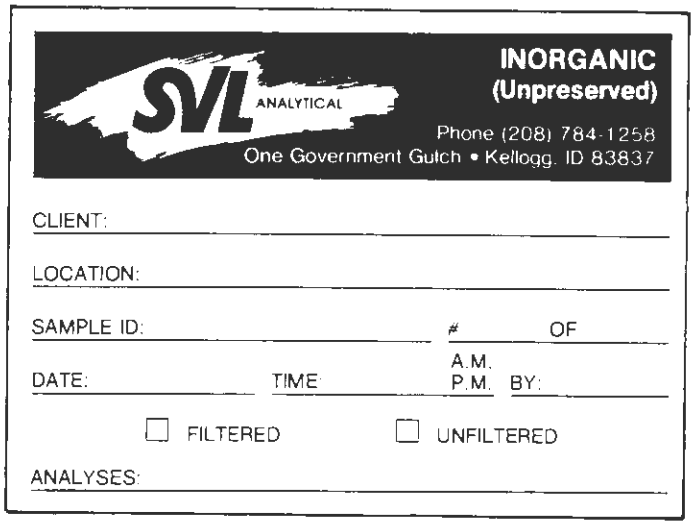
A sample is in a person's custody if one of the following criteria is met:

1. It is in the person's possession;
2. It is in the person's view after being in possession;
3. It has been locked up to prevent tampering after it was in the person's possession; or
4. It was in the person's possession and was then transferred to a designated secure area.

The COC record is completed and signed in the field by the individual physically in charge of its custody. The COC record should be completed concurrently with the field sample data sheet. The sampler is personally responsible for the care and custody of the sample until it is shipped.

When transferring possession of the samples, the individuals relinquishing and receiving the sample shall sign, date, and write the time of day on the COC record. Samples in separate coolers shall not be included in the same COC record. The COC record is enclosed with the samples in each given cooler after it has been signed by the sampler.

The COC record also serves as the laboratory request form. As shown on Figure 4-3, a space is included on the form to list the analyses requested for each sample.



LABEL COLOR IDENTIFICATION

Inorganics	-	white
Organics	-	blue
Metals	-	red

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FIGURE 4-1

SAMPLE LABEL

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Field Sample Data

PROJECT No. _____
PAGE __ OF _____

PROJECT NAME _____ SAMPLED BY _____
STATION NO./LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO./EXPOSURE NO._____

FIELD DATA

TIME _____ AIR TEMP. °F _____ WEATHER _____

WELL DEPTH _____ WATER DEPTH _____ SAMPLE DEPTH _____ SAMPLE METHOD _____

VOL. PURGED _____ SAMPLE TEMP. ____ °C ☐ IN SITU ☐ IN BOTTLE SP. COND. _____ /___ AT 25°C ☐ IN SITU ☐ IN BOTTLE

pH _____ ☐ IN SITU ☐ IN BOTTLE Eh _____ ☐ IN SITU ☐ IN BOTTLE DISSOLVED O_2 _____ ppm ☐ IN SITU ☐ IN BOTTLE

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

FIELD PARAMETERS:

_____ GALLON pH - _____ EH - _____ TEMP. _____

_____ GALLON pH - _____ EH - _____ TEMP. _____

_____ GALLON pH - _____ EH - _____ TEMP. _____

REMARKS: _____

_____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 _____ pH 7 _____ pH 10 _____
SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____
PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____
FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____
SAMPLER'S SIGNATURE _____

FIGURE 4-2

SVL ANALYTICAL

CHAIN OF CUSTODY RECORD

Page _____ of _____

Client: _____

Contact: _____

Address: _____

_____

Phone Number: _____

NOTES:

1) Specify QC samples if desired.

2) Ensure proper container packaging.

3) Ship samples promptly following collection.

Table 1. – Matrix Type

1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify)

FOR SVL USE ONLY

SVL JOB # _____

Lab Name: **SVL Analytical, Inc.** **(208) 784-1258** **FAX (208) 783-0891**

Address: **One Government Gulch, Kellogg, ID 83837-0929**

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)										
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						
10.																						

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received by:	Date:	Time:

Delivery Method _____

White: LAB COPY Yellow: CUSTOMER COPY

SVL-COC 5/93

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FIGURE 4-3

SAMPLE CHAIN OF CUSTODY RECORD

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Field Sample Data

PROJECT No. _____
PAGE __ OF _____

PROJECT NAME _____ SAMPLED BY _____
STATION NO./LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO./EXPOSURE NO._____

FIELD DATA

TIME _____ AIR TEMP. °F _____ WEATHER _____

TYPE: STREAM ☐ POND ☐ OTHER ☐ SAMPLE NAME _____ DEPTH _____ STREAM WIDTH _____ FLOW VELOCITY_____

DISTANCE FROM BANK _____ SAMPLE DEPTH ____ SAMPLE TEMP _____ ☐ IN SITU ☐ IN BOTTLE SP. COND. _____/_____ 25°C ☐ IN SITU ☐ IN BOTTLE

pH _____ ☐ IN SITU ☐ IN BOTTLE Eh _____ ☐ IN SITU ☐ IN BOTTLE DISSOLVED O_2 _____ ppm ☐ IN SITU ☐ IN BOTTLE

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

REMARKS: _____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 _____ pH 7 _____ pH 10 _____
SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____
PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____
FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____
SAMPLER'S SIGNATURE _____

FIGURE 4-4

SURFACE SOIL DATA COLLECTION FORM

Sample Number _____

Collection Date _____

Collection Time _____

Location Code _____

Chain of Custody No. _____

Coordinates North or Y _____ East of X _____

_____

Sample Location _____

Composite (Y/N) _____

Composite Description _____

Collection Method _____

Sample Team Leader _____

Sample Team Member _____

Sample Team Member _____

Sample Team Member _____

Container Size (OZ) _____ % Full _____

_____

Comments _____

_____

_____

_____

_____

_____

_____

_____

Completed By: _____

Print Name Signature Date

Subcontractor: _____

FIGURE 4-5A

SURFACE SOIL SAMPLING
FIELD ACTIVITIES REPORT FORM

Project Name _____

Site Identification _____ Date _____

Sampler _____

SAMPLE POINT	GRID LOCATION	TIME	COMMENT

Completed By: _____
Print name Signature Date

Subcontractor: _____

FIGURE 4-5B

STANDARD OPERATING PROCEDURE NO. 5
PACKAGING AND SHIPPING OF ENVIRONMENTAL SAMPLE CONTAINERS

Packaging of Sample Containers

1. Follow 40 CFR 261.1 (d) regulations for the shipment of samples, (copy attached).
2. Before packing the samples, check lids for tightness and tape them, if necessary. Do not use electrical tape or other tape with adhesive containing volatile organics if volatile organic sampling is requested.
3. Seal each sample container individually inside a single, 2-mil-thick (or thicker), zip-lock polyethylene bag. Position sample container so that the sample label can be read through the bag.
4. Place one or more bagged samples inside a strong shipping container, such as a metal picnic cooler or Department of Transportation (DOT)-approved fiberboard box, that has been lined with a large polyethylene bag. Surround all containers with non-combustible, cushioning material (e.g., vermiculite) to provide stability during transport. Use ice, Blue Ice or similar product for cooling the samples during shipment.
5. The chain-of-custody record and sample packing list shall be placed in an envelope and taped to the inside lid of the shipping container (DOT shipping papers are not required).
6. Close the shipping container and seal it with two or more custody seals placed across the container opening and tape the container shut using fiberglass tape (or equivalent). Be careful not to break the custody seals.

Marking/Labeling of Shipping Container

1. Clearly print in indelible ink the laboratory name and address and the return name and address in unabbreviated form on the shipping container.
2. Clearly print in indelible ink on top of the shipping container the following: "Environmental Samples," and "This End Up." Draw upward arrows on all four sides of the container.

Note:

Holding time begins on the date and time of sample collection. Be sure to ship samples with enough lead time to meet these holding times. Whenever possible, notify the analytical laboratory before sample collection, by an appropriate method, to ensure that analysis requirements can be met.

If samples are stored by the sampler, the preservation techniques implemented by the sampler must be documented. Samples must remain secure under a valid chain of custody.

CUSTODY SEAL

Person Collecting Sample _____ Sample No._____
(signature)

Date Collected _____ Time Collected_____

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FIGURE 5-1

SAMPLE CUSTODY SEAL

ATTACHMENT TO SOP 5

40 CRF 261.1 (d)
REGULATIONS FOR SAMPLE SHIPMENT

Code of Federal Regulations
Title 40: Protection of the Environment
Chapter I - Environmental Protection Agency, Part 261.4(d)

(d) Samples. (1) Except as provided in paragraph (d)(2) of this section, a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition, is not subject to any requirements of this part or Parts 262 through 268 or Part 270 or Part 124 of this chapter or to the notification requirements of section 3010 of RCRA, when:

(i) The sample is being transported to a laboratory for the purpose of testing; or

(ii) The sample is being transported back to the sample collector after testing; or

(iii) The sample is being stored by the sample collector before transport to a laboratory for testing; or

(iv) The sample is being stored in a laboratory before testing; or

(v) The sample is being stored in a laboratory after testing but before it is returned to the sample collector; or

(vi) The sample is being stored temporarily in the laboratory after testing for a specific purpose (for example, until conclusion of a court case or enforcement action where further testing of the sample may be necessary).

(2) In order to qualify for the exemption in paragraphs (d)(1) (i) and (ii) of this section, a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:

(i) Comply with U.S. Department of Transportation (DOT), U.S. Postal Service (USPS), or any other applicable shipping requirements; or

(ii) Comply with the following requirements if the sample collector determines that DOT, USPS, or other shipping requirements do not apply to the shipment of the sample:

(A) Assure that the following information accompanies the sample:

(1) The sample collector's name, mailing address, and telephone number;

(2) The laboratory's name, mailing address, and telephone number;

(3) The quantity of the sample;

(4) The date of shipment; and

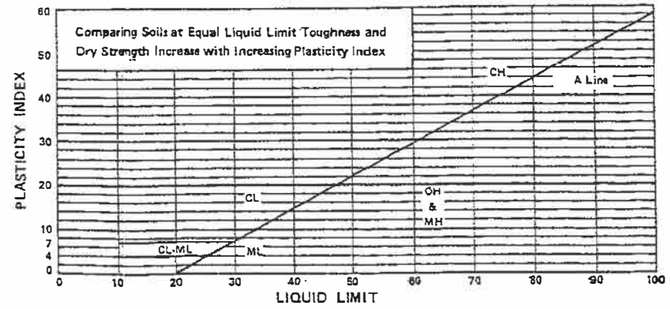
(5) A description of the sample.

(B) Package the sample so that it does not leak, spill, or vaporize from its packaging.

(3) This exemption does not apply if the laboratory determines that the waste is hazardous but the laboratory is no longer meeting any of the conditions stated in paragraph (d)(1) of this section.

Major Divisions			Graphic Symbols		Typical Name	Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Information Required for Describing Soils	Laboratory Classification Criteria
1	2		3	3a	4	5	6	7
Coarse-Grained Soils: More than half of material is larger than No. 200 sieve size. The No. 200 sieve size is about the smallest particle visible to the naked eye.	Gravels: More than half of coarse fraction is larger than No. 4 sieve size. (For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size)	Clean Gravels (Little or no fines)	GW	RED	Well-graded gravels, gravel-sand mixtures, little or no fines.	Wide range in grain size and substantial amounts of all intermediate particle sizes.	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions, and drainage characteristics. Give typical name; indicate approximate percentages of sand and gravel, maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbol in parentheses. Example: Silty sand, gravelly; about 20% hard, angular gravel particles 1/2-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM).	Determine percentages of gravel and sand from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse-grained soils are classified as follows: Less than 5% = GW, GP, SW, SP More than 12% = GM, GC, SM, SC 5% to 12% = Borderline cases requiring use of dual symbols
			GP	RED	Poorly graded gravels or gravel-sand mixtures, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.		
		Gravels with Fines (Appreciable amount of fines)	GM	YELLOW	Silty gravels, gravel-sand-silt mixture.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).		
			GC	YELLOW	Clayey gravels, gravel-sand-clay mixtures.	Plastic fines (for identification procedures see CL below).		
	Sands: More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classification, the 1/4-in. size may be used as equivalent to the No. 4 sieve size)	Clean Sands (Little or no fines)	SW	RED	Well-graded sands, gravelly sands, little or no fines.	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $\quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for GW Atterberg limits below "A" line or PI less than 4 Atterberg limits above "A" line with PI greater than 7 Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			SP	RED	Poorly graded sands or gravelly sands, little or no fines.	Predominantly one size or a range of sizes with some intermediate sizes missing.		
		Sands with Fines (Appreciable amount of fines)	SM	YELLOW	Silty sands, sand-silt mixtures.	Nonplastic fines or fines with low plasticity (for identification procedures see ML below).		
			SC	YELLOW	Clayey sands, sand-clay mixtures.	Plastic fines (for identification procedures see CL below).		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $\quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for SW Atterberg limits below "A" line or PI less than 4 Atterberg limits above "A" line with PI greater than 7 Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.

						Identification Procedures On Fraction Smaller than No. 40 Sieve Size				
						Dry Strength (Crushing Characteristics)	Dilatancy (Reaction to Shaking)	Toughness (Consistency near PL)		
Fine-Grained Soils: More than half of material is smaller than No. 200 sieve size. The No. 200 sieve size is about the smallest particle visible to the naked eye.	Silts and Clays: Liquid limit is less than 50		ML	GREEN	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	None to slight	Quick to slow	None	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions. Give typical name; indicate degree and character of plasticity; amount and maximum size of coarse grains; color in wet condition; odor, if any; local or geologic name and other pertinent descriptive information; end symbol in parentheses. Example: Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML).	Use grain-size curve in identifying the fractions as given under field identification.
			CL	GREEN	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Medium to high	None to very slow	Medium		
			OL	GREEN	Organic silts and organic silty clays of low plasticity.	Slight to medium	Slow	Slight		
	Silts and Clays: Liquid limit is greater than 50		MH	BLUE	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Slight to medium	Slow to none	Slight to medium		
			CH	BLUE	Inorganic clays of high plasticity, fat clays.	High to very high	None	High		
			OH	BLUE	Organic clays of medium to high plasticity, organic silts.	Medium to high	None to very slow	Slight to medium		
Highly Organic Soils			Pt	ORANGE	Peat and other highly organic soils.	Readily identified by color, odor, spongy feel and frequently by fibrous texture.				



PLASTICITY CHART

For laboratory classification of fine-grained soils

(1) Boundary classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder. (2) All sieve sizes on this chart are U.S. standard.

Unified Soil Classification System

STANDARD OPERATING PROCEDURE NO. 6
DECONTAMINATION OF EQUIPMENT USED TO SAMPLE SOIL AND WATER

The field hydrogeologist or geologist shall set up the area used to decontaminate soil and water sampling equipment in the manner shown on Figure 6-1. This area shall be located approximately 15 feet away from the specific sampling area. The personnel performing the decontamination procedures shall wear disposable surgical gloves.

Procedures Used to Decontaminate Soil Sampling Equipment

The following decontamination procedure shall be utilized for inorganically contaminated soil sampling equipment. If the sample will not be analyzed for trace metals, the nitric acid wash may be skipped.

Table 6.1 lists the equipment that shall be used to decontaminate the soil sampling equipment. The specific procedures for decontaminating soil sampling equipment include:

1. At Station No. 1, first wash the contaminated equipment in a tub containing tap water to remove the soil material. Follow with a second wash in a tub containing water mixed with a phosphate-free industrial strength soap such as Alconox.
2. Move the equipment to the wash tub in Station No. 2. Rinse the equipment with clean water, wash with 0.1 normal nitric acid (HNO_3) and then with distilled/deionized (DS/DI) water.
3. At Station No. 3, place the clean equipment on plastic sheeting until it is used again. Soil sampling equipment that will not be used immediately shall be wrapped in clean plastic.

Procedures Used to Decontaminate Water Sampling Equipment

The following decontamination procedure shall be utilized for inorganically contaminated water sampling equipment. If the sample will not be analyzed for trace metals, the nitric acid wash may be skipped.

Table 6.2 lists the equipment that shall be used to decontaminate water sampling equipment (To decontaminate pumps, see the following Section).

The specific procedures for decontaminating water sampling equipment include:

1. At Station No. 1, wash the contaminated equipment in a tub containing water mixed with a phosphate-free industrial strength soap such as Alconox.
2. Move the equipment to the wash tub in Station No. 2. First, rinse the equipment with DS/DI water. Then rinse the equipment with dilute (0.1 normal) nitric acid and follow with a second rinse using DS/DI water.
3. At Station No. 3, place the clean equipment on plastic sheeting until it is used again. Water sampling equipment that will not be used immediately shall be wrapped in clean plastic.

Disposal of Decontamination Materials

Based on the sample data results from the RI Background Report, disposal of investigation-derived waste shall consist of the following:

1. Following the decontamination of all water sampling equipment, the disposable gloves and used plastic from Station No.3 shall be placed in garbage bags and disposed of in a trash collection facility.
2. The wash and rinse water from Station No.1 and No.2 shall be disposed of on the ground surface at the sample location.

Decontamination of Sampling Pumps

When samples are collected by sampling pumps, sampling shall begin with the well containing the lowest anticipated analyte concentration. Successive samples should be obtained from wells anticipated to have increasing analyte concentrations. Use of dedicated pump equipment is preferable when feasible. Table 6.3 lists the decontamination equipment required.

When pumps (e.g., submersible or bladder) are submerged below the water surface to collect water samples, they should be cleaned and flushed between uses. This cleaning process consists of an external detergent wash and high-pressure tap water rinse, or steam cleaning, of the pump casing, tubing, and cables, followed by a flush of potable water through the pump. This flushing can be accomplished by pouring clean tap water from a carboy into the end of the discharge tube and working it down to the inside of the pump. The procedure should be repeated; then the tubing and inside of the pump should be rinsed with DS/DI water. Alternatively, the sampling pump may be

flushed by pumping a volume of potable water equal to two times the total capacity of the pump. This may be followed by pumping the same volume of DS/DI through the pump.

Surface pumps (e.g., peristaltic or diaphragm) used for well evacuation shall be cleaned between well locations. However, a new length of polyethylene tubing must be used for each well and discarded after use. The pump and hose should always be placed on clean polyethylene sheeting to avoid contact with the ground surface.

TABLE 6.1
DECONTAMINATION EQUIPMENT FOR SOIL SAMPLING

Equipment List for Decontamination

Item	Quantity
3-gallon plastic tubs	3
5-gallon plastic container, tap water	a
5-gallon carboy, DS/DI water	a
Alconox	a
Hard-bristle brushes	2
Plastic sheeting or garbage bags	a
Latex gloves	a
Kimwipes	a
0.1 Normal Nitric Acid	a
55-gallon drum(s)	a
Spray Paint	a

Equipment at Decontamination Stations

Station No. 1

Alconox, tap water, two 3-gallon plastic washtubs, scrub brush, DS/DI water

Station No. 2

3-gallon plastic washtub, DS/DI water, 0.1 Normal nitric acid

Station No. 3

Plastic sheeting or garbage bag

Note:

a. Quantity is dependent on the size of the sampling effort and is, therefore, left to the discretion of the field hydrogeologist or geologist.

TABLE 6.2
DECONTAMINATION EQUIPMENT FOR WATER SAMPLING

Equipment List for Decontamination

Item	Quantity
3-gallon plastic tubs	2
5-gallon plastic container, tap water	a
5-gallon carboy, DS/DI water	a
Alconox	a
Dilute (1 to 1) nitric acid[b]	a
Hard-bristle brushes	2
Plastic sheeting or garbage bags	a
Latex gloves	a
Kimwipes	a
0.1 Normal Nitric Acid	a
55-gallon drum(s)	a
Spray Paint	a

Equipment at Decontamination Stations

Station No. 1

Alconox, tap water, two 3-gallon plastic washtub, scrub brush, DS/DI water

Station No. 2

3-gallon plastic washtub, DS/DI water, dilute (1 to 1) nitric acid[b]

Station No. 3

Plastic sheeting or garbage bag

Note:

a. Quantity is dependent on the size of the sampling effort and is, therefore, left to the discretion of the field hydrogeologist or geologist.

b. Mix equal volumes of concentrated nitric acid with DS/DI water.

TABLE 6.3
DECONTAMINATION EQUIPMENT FOR SAMPLING PUMPS
EQUIPMENT LIST FOR DECONTAMINATION OF SUBMERSIBLE PUMPS

Equipment List for Decontamination

Item	Quantity
Alconox	a
Tap water	a
5-gallon carboy, DS/DI water	a
Hard-bristle brushes	1
Plastic sheeting or garbage bags	a
Personal protective equipment	a,b
30-gallon plastic trash can or plastic overpack drum	1
55-gallon drum(s)	a
Drum labels	a
Spray paint	a
Steam cleaner	optional

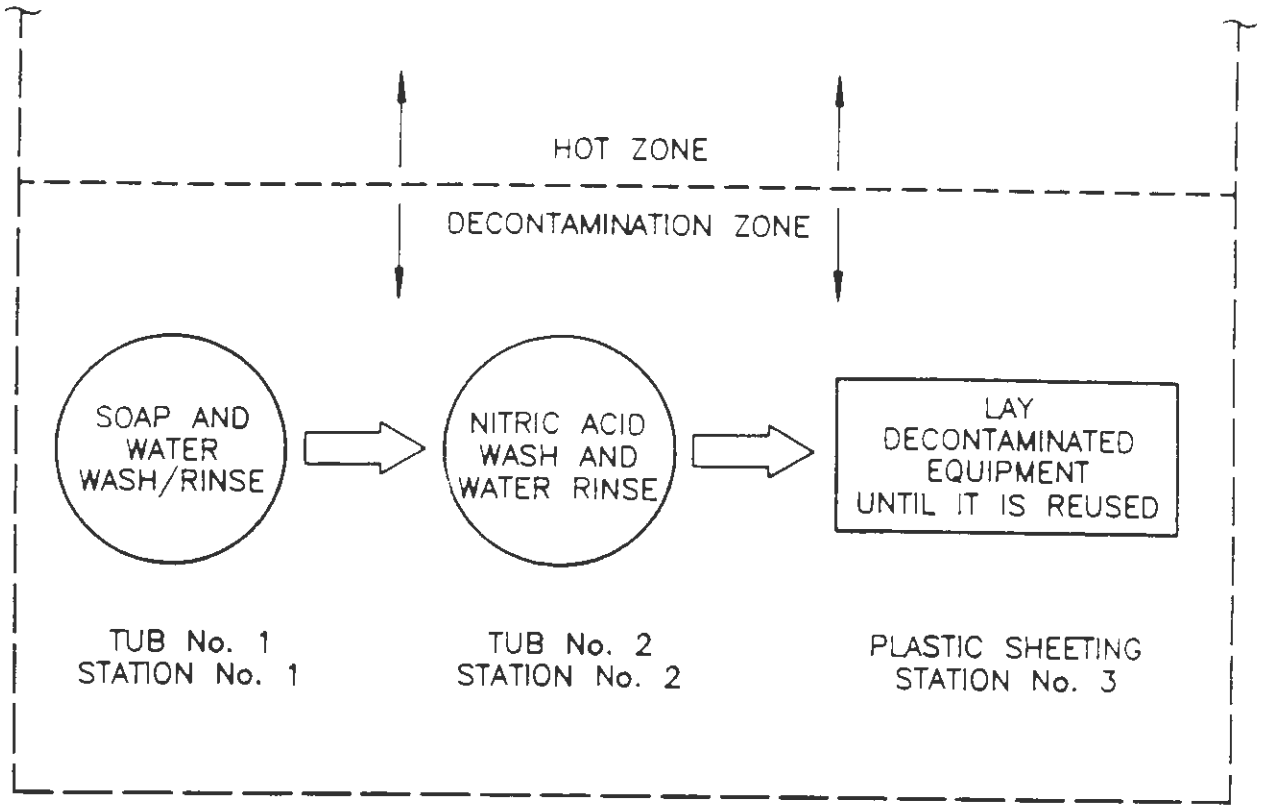
Equipment at Decontamination Stations

Item	Quantity
Polyethylene tubing	a
Plastic sheeting or garbage bags	a

Note:

a. Quantity is dependent on the size of the sampling effort and is, therefore, left to the discretion of the field hydrogeologist or geologist.

b. Type of protective equipment as specified in the site-specific Health and Safety Plan.



STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
74601	04/95	A

FIGURE 6-1

TYPICAL DECONTAMINATION STATIONS LAYOUT

STANDARD OPERATING PROCEDURE NO. 7
REQUESTING ENVIRONMENTAL LABORATORY SERVICES

The standardized form to be used for requesting environmental laboratory services from the contracted laboratories is presented. This form serves two main purposes: (1) to request bottles and other sampling materials for a planned sampling program and (2) to provide advance notification to the laboratory of future laboratory analyses requirements.

FAX

CHINO MINES COMPANY - AOC

REQUEST FOR ENVIRONMENTAL LABORATORY SERVICES

Date: _____

Fax to: _____

From: _____

Attention: _____

_____

_____

_____

Phone:_____

Fax:_____

Ship to: _____

Attention:_____

_____

_____

_____

Phone:_____

Fax:_____

Request for
Environmental Laboratory Services

Analysis	Number of Samples		Remarks
	Water	Solid	
PHYSICAL/CHEMICAL			
pH			
Specific Conductance			
TOC			
TOX			
GENERAL INORGANIC CHEMISTRY			
Chloride			
Iron			
Manganese			
Sulfate			
Fluoride			
Nitrate/Nitrite			
GENERAL ORGANIC CHEMISTRY			
BTEX/MTBE			
Oil & Grease			
ORGANIC			
PCB			
Phenols			
Volatiles			
Semi-volatiles			
Pesticides/Herbicides			
RADIOCHEMISTRY (Specify)			
METALS - GRAPHITE FURNACE			
METALS - ICP or FLAME			
RCRA CHARACTERISTICS			
TCLP			
OTHER			

Request for
Environmental Laboratory Services

Date Bottles Required: _____

Anticipated Date Samples to be Shipped for Analysis: _____

Special Instructions: _____
_____
_____
_____
_____
_____

STANDARD OPERATING PROCEDURE NO. 11
FIELD MEASUREMENT OF pH, SPECIFIC CONDUCTANCE AND TEMPERATURE FOR AQUEOUS SAMPLES

The following are detailed procedures for specific field instrumentation meters. Maintenance of field instrumentation shall be in accordance with manufacturer's specifications. In the event other meters are used, follow manufacturer instructions for use and calibration. Record procedure in the field log book.

INTRODUCTION TO pH

The pH scale is from 0.0 standard units (SU) to 14.0 SU, with 7.0 SU being neutral. Because pH is a negative logarithm of the hydrogen ion activity, a change of one SU equals an order of magnitude change in concentration. Combination electrodes may be used in field determination of pH due to the convenience of a single electrode system. The combination electrode contains both the glass and the reference electrode in a single housing. This electrode is generally not affected by color, turbidity, colloidal matter, high salinity, oxidants, or reductants. Factors that cause interference in pH measurements include the following:

Temperature

Temperature compensation must be applied if the sample temperature is not within 2°C of the calibration buffer temperature. If the pH meter is not equipped with automatic temperature compensation (ATC), the calibration is conducted by manual adjustment of the electrode response (temperature offset) as described in the manufacturer's instructions. Temperature of the solution at the time of pH measurement must be reported together with the pH value.

Sodium Content

Errors in pH measurement will occur for samples of high sodium content and pH above 10. This error can be eliminated by using a low sodium error electrode.

Oily and Organic Samples

The following method is not suitable for oily or organic samples, because the electrode response can be impaired by coatings from these materials. Electrodes can be easily cleaned as described in the manufacturer's instructions.

PROCEDURE

Follow instructions in the owner's manual supplied by the manufacturer to stabilize system and to operate the pH meter. Use the owner's manual to select recommended solutions to maintain electrodes in good condition during long-term or short-term storage. If required, keep electrodes wet by returning them to storage solutions when not in use.

1. Equipment Calibration

    1.1. Equipment must be calibrated daily and prior to use each time the instrument is turned on. The pH meter and the electrode must be calibrated together. The pH meter should be calibrated with two buffer solutions that most approximate the sample pH.

    1.2. Thoroughly rinse a container three times with deionized water. Discard the rinse water and dry the container. Then rinse the container with a small amount of the appropriate buffer solution and discard the rinse. Fill the container approximately 2 inches above the working part of the electrode with the appropriate buffer solution.

    1.3. Standardize both buffer solutions with the meter in accordance with the owner's manual.

    1.4. If the instrument does not calibrate for both buffers, that is the instrument reads 4.0 for the 4.0 buffer and 9.9 for the 10 buffer, repeat measurements until both readings are within 0.05 pH units of the buffer solution value. If the calibration error is more significant, see the owner's manual for troubleshooting.

2. pH Measurement

2.1. Keep electrodes immersed in buffer solution. Before use, remove the electrodes from the buffer solution and rinse with distilled water over a "wash" beaker. Dry electrode gently with soft tissue. If the electrode has just been cleaned, it may need to be conditioned. Dip the electrode into the sample for one minute, then blot dry and immerse it into a fresh portion of the sample.

2.2. Rinse the sample container three times with deionized water then wipe the container dry. Rinse the container with a small amount of the sample and throw the rinse-out. Collect a sufficient amount of sample to fill the container approximately 2 inches above the working part of the electrode.

2.3. Immerse the electrode approximately 1 inch below the surface level of the sample and keep it approximately 1 inch away from the container wall. Using the electrode, stir the sample for a minimum of one minute to ensure sample homogeneity. Gentle stirring will minimize carbon dioxide entrapment. Take the reading when equilibrium is obtained.

2.4. Note and record pH and temperature. pH values should be measured to the nearest tenth of a pH value and temperature should be recorded to the nearest degree centigrade. Samples may be discarded following pH measurement.

QUALITY CONTROL

1. Between measurements, clean the electrode with deionized water; throw the rinse-out.

2. Duplicate measurements should be made after every ten samples, at a minimum, or after each set of samples, whichever comes first.

3. Verify the calibration of the electrode and meter after every ten samples or at the end of each set, whichever comes first. The verification is conducted with the pH 7.0 buffer solution to assure the calibration of the system is maintained.

INTRODUCTION TO SPECIFIC CONDUCTANCE (SC)

Specific conductance or electrical conductivity is a convenient, rapid method of estimating the amount of dissolved solids in an aqueous solution. The property is related to the total concentration of ionized substances and their respective concentrations, mobility, and valence, and to the temperature at which the measurement is made. Total dissolved solids (mg/L) is equal to the conductivity multiplied by a factor between 0.55 and 0.9, depending on the soluble constituents in a specific water.

Specific conductance is customarily reported as micromhos per centimeter ($m\Omega^{-1}/cm$). In the International System of Units (SI), the reciprocal of the ohm (Ω) is the Siemens, and conductivity is reported as milliSiemens per meter (mS/m). (1 mS/m=10 $m\Omega^{-1}/cm$)

The field SC sample is never stored for field analysis and is discarded following the analysis. Factors that cause interference in SC measurements include the following:

Temperature

Errors can result if sample temperature is not corrected or compensated for. Conductivity increases about 2 percent per degree centigrade.

Potassium Chloride Temperature Coefficient

Because the potassium chloride solution used for calibration requires slightly different temperature correction than most waters, the more the temperature of measurement deviates from 25°C, the greater the uncertainty in applying temperature correction will be.

Atmospheric Exposure

Exposure of the sample to the atmosphere can cause changes in the SC due to loss or gain of dissolved gases. This is very important in the case of water with low SC. Carbon dioxide normally present in air can change the conductivity of pure waters.

PROCEDURE

Follow instructions in the owner's manual supplied by the manufacturer to stabilize system and to operate the SC meter. Use the owner's manual to select recommended solutions to maintain electrode in good condition during long-term or short-term storage. If required, keep electrode wet by returning to storage solutions when not in use.

1. Equipment Calibration

1.1 Equipment must be calibrated daily and prior to taking measurement at a given site. The calibration standards are routinely prepared to have SC of 100, 1000, 10,000 and 100,000 mS/cm at 25°C.

1.2 Clean the conductivity probe with deionized or distilled water. Rinse the probe in a small amount of the standard. After rinsing, throw the rinse-out.

1.3 Select a plastic or glass container several inches taller than the working part of the probe and at least two inches greater in diameter. Clean and dry the container. Choose a standard nearest the expected concentrations of the samples to be measured. Fill the container with a small amount of the calibration standard, swirl the solution around the sides of the container to thoroughly rinse the container, and discard the rinse solution. Fill the container with the calibration standard to a depth of at least two inches greater than the height of the working part of the probe.

1.4 Immerse the probe in the calibration standard. For approximately one minute, gently stir the solution with the conductivity probe, while moving the probe up and down in the center of the solution and at least one inch from the container wall and the top surface of the solution. For the SC meters equipped with the ATC function, set the conductivity instrument to the correct conductance while stirring. For SC meters without the ATC function, the temperature and SC of the standard are recorded. Temperature correction of the SC shall be in accordance with the calculation section

presented herein. The measurement is corrected to 25°C through use of the probe constant.

2. SC Measurement

2.1 Clean the conductivity probe in deionized or distilled water. Rinse the probe in a small amount of the sample. After rinsing, discard the solution.

2.2 Clean the sample container by rinsing with deionized or distilled water and dry the container. Rinse the container with a small amount of the sample and throw the rinse-out. Rinse the conductivity probe several times with deionized water and then two or more times with the sample. Collect a sufficient amount of sample to fill the container approximately 2 inches above the submerged working part of the probe.

2.3 Immerse the probe approximately one inch below the surface level of the sample. For approximately one minute gently stir the sample with the conductivity probe, moving the probe up and down in the center of the solution and at least one inch from the container wall and the top surface of the sample.

2.4 Record the SC while stirring. For instruments with an ATC function, ensure that the ATC function is set on and record the reading. When a measurement is taken using an instrument without ATC function, record sample temperature and correct measurement to 25°C. Out-of-range values are reported as greater than (>) the upper limit of the specific meter. Repeat steps 2.1 and 2.2 between every sample measurement.

QUALITY CONTROL

1. Duplicate sample measurements shall be conducted every ten samples or after each set of samples, whichever comes first.

2. Reread the appropriate concentration of the KCl standard solution after each sample set. This measurement is used as a data point to normalize recorded measurement if any drift occurs during the sampling period.

CALCULATIONS

1. Displayed values for conductivity measurement must be multiplied by the range setting at the time of the reading.

2. Measurements are reported at 25°C. Instruments with the ATC function, once calibrated, are automatically corrected to 25°C and the measurement is recorded directly from the meter. All other instruments need to have the value of the SC multiplied by a temperature correction factor to normalize to 25°C.

3. The temperature coefficient (f) for SC at 25°C may be calculated using the following expression:

$$f = \frac{C}{(1 + 0.019 \times (t - 25))}$$

where, C = probe (cell) constant
t = temperature of measurement

The temperature corrected SC may be calculated using the following expression:

$$SC = (SC_m) \times f$$

where, SC_m = measured specific conductance

For convenience in the field, a table of temperature coefficients (Table 11-1) has been included to be used in reporting conductivity measurement at 25°C. Values shown in Table 11-1 assume a probe (cell) constant equal to 1.

PROCEDURE FOR TEMPERATURE MEASUREMENT

The following procedure applies to mercury thermometers. Many pH and conductivity meters available have electronic temperature probes that are not subject to this procedure.

1. Inspect thermometers for defects such as cracks or gaps in the mercury prior to their use.

2. Put a water sample of at least 200 milliliters into a beaker or sample bottle.

3. Place the thermometer in the sample and allow the instrument to equilibrate for about one minute. Do not allow the thermometer bulb to touch the sides of the container.

4. Read the temperature to the nearest one degree Centigrade (°C) and then record this value in the field logbook or on a field data sheet.

5. The thermometer should be checked against the NIST-calibrated field laboratory thermometer on a quarterly basis. They should agree within 0.5°C.

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Table 11-1

Temperature Factors (f_t) for Correcting SC Data

°C	°F	f_t	°C	°F	f_t	°C	°F	f_t
3.0	37.4	1.709	18.2	64.8	1.157	21.4	70.5	1.078
4.0	39.2	1.660	18.4	65.1	1.152	21.6	70.9	1.073
5.0	41.0	1.613	18.6	65.5	1.147	21.8	71.2	1.068
6.0	42.8	1.569	18.8	65.8	1.142	22.0	71.0	1.064
7.0	44.6	1.528	19.0	66.2	1.136	22.2	72.3	1.060
8.0	46.4	1.488	19.2	66.6	1.131	22.4	72.3	1.055
9.0	48.2	1.448	19.4	66.9	1.127	22.6	72.7	1.051
10.0	50.0	1.411	19.6	67.3	1.122	22.8	73.0	1.047
11.0	51.8	1.375	19.8	67.6	1.117	23.0	73.4	1.043
12.0	53.6	1.341	20.0	68.0	1.112	23.2	73.8	1.038
13.0	55.4	1.309	20.2	68.4	1.107	23.4	74.1	1.034
14.0	57.2	1.277	20.4	68.7	1.102	23.6	74.5	1.029
15.0	59.0	1.247	20.6	69.1	1.097	23.8	74.8	1.025
16.0	60.8	1.218	20.8	69.4	1.092	24.0	75.2	1.020
17.0	62.6	1.189	21.0	69.8	1.087	24.2	75.6	1.016
18.0	64.4	1.163	21.2	70.2	1.082	24.4	75.9	1.012

Table 11-1

°C	°F	f_t	°C	°F	f_t	°C	°F	f_t
24.6	76.3	1.008	28.2	82.8	.940	31.8	89.2	.877
24.8	76.6	1.004	28.4	83.1	.936	32.0	89.6	.873
25.0	77.0	1.000	28.6	83.5	.932	32.2	90.0	.870
25.2	77.4	.996	28.8	83.8	.929	32.4	90.3	.867
25.4	77.7	.992	29.0	84.2	.925	32.6	90.7	.864
25.6	78.1	.988	29.2	84.6	.921	32.8	91.0	.861
25.8	78.5	.983	29.4	84.9	.918	33.0	91.4	.858
26.0	78.8	.979	29.6	85.3	.914	34.0	93.2	.843
26.2	79.2	.975	29.8	85.6	.911	35.0	95.0	.829
26.4	79.5	.971	30.0	86.0	.907	36.0	96.8	.815
26.6	79.9	.967	30.2	86.4	.904	37.0	98.6	.801
26.8	80.2	.964	30.4	86.7	.901	38.0	100.2	.788
27.0	80.6	.960	30.6	87.1	.897	39.0	102.2	.775
27.2	81.0	.956	30.8	87.4	.894	40.0	104.0	.763
27.4	81.3	.953	31.0	87.8	.890	41.0	105.8	.750
27.6	81.7	.950	31.2	88.2	.887	42.0	107.6	.739
27.8	82.0	.947	31.4	88.5	.884	43.0	109.4	.727
28.0	82.4	.943	31.6	88.9	.880	44.0	111.2	.716

STANDARD OPERATING PROCEDURE NO. 12
REDOX-POTENTIAL (E_h) & DISSOLVED OXYGEN MEASUREMENTS

E_h measurements are conducted using an ORION model 96-78 redox electrode and ORION SA-210 portable meter (or equivalent devices) set to the millivolt (mV) mode. In the event other meters are used, follow manufacturer instructions for use and calibration. Maintenance of field instrumentation shall be in accordance with manufacturer specifications. Record procedure in field logbook.

Filling Electrode

The electrode shall be filled with one of the two solutions selected to best match the ionic strength of the sample solution to minimize junction potentials. The following solutions shall be used:

1. Dilute solution [total ionic strength less than 0.2 molar (M)]. Use ORION dilute filling solution (Cat No. 900001), which will match the potential of a conventional calomel electrode.

2. Concentrated solution (total ionic strength greater than 0.2M). Use ORION concentrated filling solution (Cat No. 900011), which is 4M KCl saturated with Ag/AgCl.

   When filling the electrode, the solution level in the electrode should always be at least 1 inch above the level of the solution being measured.

Connect the Electrode to the Meter

Insert the platinum redox connector (large diameter) in the pH or sensing electrode input jack on the Orion SA-210 meter and the referenced electrode connector (small diameter) into the referenced electrode input jack.

Calibration Procedure

The meter shall be calibrated daily using a two-stage process that checks the operation and accuracy of the meter. To check the meter operation:

1. Connect the electrodes to the meter, place the electrodes in a beaker of tap water, and turn on the meter.

2. Add a drop of dilute NaOH to the beaker and mix it with tap water.

3. If the reading on the meter decreases sharply, then the electrodes are sensitive and operating properly.

4. If little or no change in the reading is observed, then the electrodes are not functioning properly and must be cleaned. The electrode cleaning procedures are summarized as follows:

    - Drain filling solution from outer portion of electrode body and refill with fresh solution (see Filling Electrode).
    - If response is poor, gently polish the platinum end of the electrode with a piece of crocus cloth (fine iron oxide grit polishing cloth) or with alumina paste (grain size = 0.05 μm) on a felt pad, rinse thoroughly and recheck the reading.
    - If the electrode still does not function properly, remove the sleeve from the inner electrode, rinse all the parts of the electrode with distilled/deionized (DS/DI) water, and allow to air dry.
    - Reassemble electrode and refill with filling solution.

Accuracy Checks of Meter and E_h Electrode

1. Use a standard solution consisting of ZoBell's ferrous/ferric solution.
2. Rinse electrodes with DS/DI water.
3. Pour the standard solution into a small beaker and place electrode into the beaker. Measure the temperature of the ZoBell solution in the beaker. The redox potential of the ZoBell solution

should match the potential in Table 12.1 plus or minus 15 mV. If the reading deviates from this range, then the electrodes must be drained or cleaned (see Step 4).

Measurement Procedure

1. Set the mode switch to the mV position, and place the electrode in the sample solution. The filling hole should be above the solution and not covered by the rubber sleeve. The filling solution should always be at least 1 inch above the level of the solution being measured. Make sure all air bubbles are removed from the system. When the reading stabilizes, record the potential (E) as a positive or negative value.

2. For some applications, redox-potential readings are reported relative to the normal hydrogen electrode (NHE). To do this, select the electrode potential (C) value in Table 12.2 that corresponds to the filling solution used and the temperature of the solution measured. Substitute the table value for C in the following equation and solve for E_h:

   $E_h = E + C$

   where,

   E_h = oxidation reduction potential of the sample relative to the standard hydrogen electrode
   E = the observed potential read on the meter
   C = the correction factor listed in Table 12.2

Dissolved Oxygen Measurements

Dissolved oxygen measurements are taken using the ORION Model 97-08 oxygen electrode shown on Figure HG-8-2 and ORION SA-210 meter set to the pH mode. The reading is displayed in parts per million (ppm).

Calibration Procedure

1. Connect electrode to Orion SA-210 meter.

2. Assemble the components for the test setup, shown on Figure 12-1, as follows:

- Insert the funnel into a Biological Oxygen Demand (BOD) sample bottle containing enough sample water to just cover the bottom.
- Insert the electrode into the BOD funnel, making sure that the electrode tip is not immersed in the water and does not have water droplets clinging to the outside of the membrane.
- Use this bottle for storing the electrode between measurements.

3. With the electrode mode switch in the OFF position, switch the meter to the pH mode. Set the meter's slope control to 25°C. Set the reading to 7.00 with the meter's calibration (standardization) control knob.

4. Turn the mode switch on the electrode to BT CK (battery check) position. Good battery operation is indicated by a reading of 13.40 or greater on the meter.

5. Turn the mode switch on the electrode to the ZERO position. Use the ZERO calibration control knob to set the meter to read 0.00.

6. Turn the electrode mode switch to the AIR position. If measurements are being made at sea level, use the AIR calibration control knob to set the pH meter reading to the prevailing barometric pressure, in millimeters of mercury. The barometric pressure at sea level is unknown or if the elevation is above sea level, refer to Tables 12.3 and 12.4 to obtain the correct AIR setting.

7. Turn electrode mode switch to the H_2O position for sample analysis.

Measurement Procedure

1. Insert the funnel into the sample bottle. Slowly immerse the standardized electrode into the funnel. Sample displaced by the electrode will collect in the funnel. (For in-situ samples, immerse the electrode into the surface water, or lower into the well for ground water.) If available, use a flow-through cell. Proceed with Step No. 3.

2. Place a bottle on a magnetic stirrer and stir gently.

3. Turn the mode switch of the electrode to HO position and set the meter to the pH mode.

4. Obtain and record stable reading. The result is displayed in ppm of dissolved oxygen.

5. Remove electrode from the funnel. Rinse electrode and funnel with distilled water, then dry electrode. Gently blot the electrode membrane dry.

6. Place funnel and electrode in storage bottle.

TABLE 12.1
POTENTIALS OF THE ZOBELL SOLUTION FOR CALIBRATION[(a)]

	Electrode Potential in mV	
Temperature °C	900001 Solution	900011 Solution
10	210	250
20	193	238
25	185	231
30	177	224

(a) Langmuir, Donald, Procedures in Sedimentary Petrology, "E_h-pH Determination," Ed. R.E. Carver, New York, John Wiley & Sons, Inc., 1971, p. 597-633, Chapter 26.

TABLE 12.2
POTENTIALS DEVELOPED BY THE REFERENCE ELECTRODE RELATIVE TO THE STANDARD HYDROGEN ELECTRODE FOR THE FILLING SOLUTIONS[a]

	"C" Electrode Potential in mV	
Temperature °C	900001 Solution	900011 Solution
10	251	214
20	244	204
25	241	199
30	238	194

(a) Orion Research, 1991, Instruction manual, platinum redox electrodes, model 96-78-00, model 97-78-00.

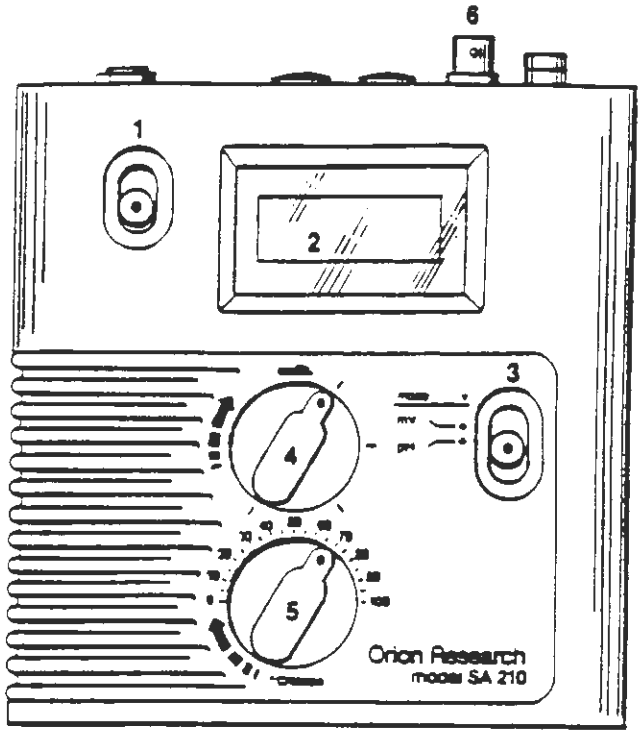
TABLE 12.3
AIR CALIBRATION SETTING FOR CORRECT STANDARDIZATION

	Condition	AIR Calibration Setting
1.	Sea level barometric pressure is known.	Barometric Pressure (mm) ¸ 100
2.	Sea level barometric pressure is unknown	7.60
3.	Elevation above sea level.	7.60 x elevation correction factor[(a)]

(a) Values for elevation correction factor are listed in Table 12.4.

TABLE 12.4
CORRECTION FOR ELEVATION

Elevation (feet)	Elevation Correction Factor (cf)	AIR Setting (cf x 7.60)
0 (sea level)	1.000	7.60
500	0.982	7.46
1,000	0.965	7.33
1,500	0.948	7.20
2,000	0.931	7.08
2,500	0.915	6.95
3,000	0.899	6.83
3,500	0.883	6.71
4,000	0.867	6.59
4,500	0.851	6.47
5,000	0.836	6.35
5,500	0.821	6.24
6,000	0.806	6.13
6,500	0.791	6.01
7,000	0.777	5.90
7,500	0.762	5.79
8,000	0.748	5.68
8,500	0.735	5.59
9,000	0.721	5.48
9,500	0.708	5.38
10,000	0.694	5.27
10,500	0.680	5.17
11,000	0.666	5.06



Instrument Description

1 **ON/OFF Switch** Controls power to meter.

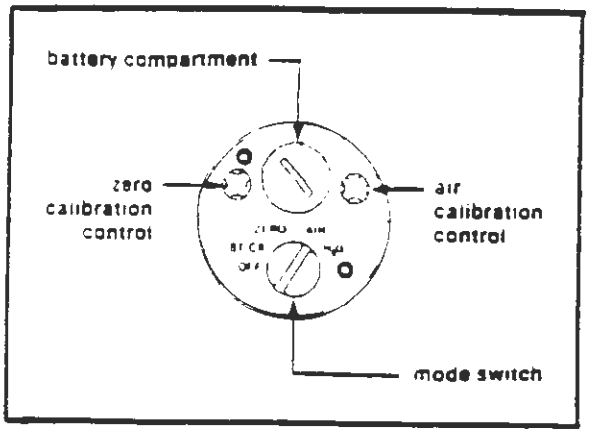
2 **LCD Display** Automatically displays data in large numerals with negative polarity sign and decimal point. pH values are displayed from 0 to 14 with 0.01 pH unit resolution. Millivolt range is −1999 to + 1999. Dissolved oxygen is measured from 0 to 14 ppm when meter is used with Model 97-08 Oxygen Electrode.

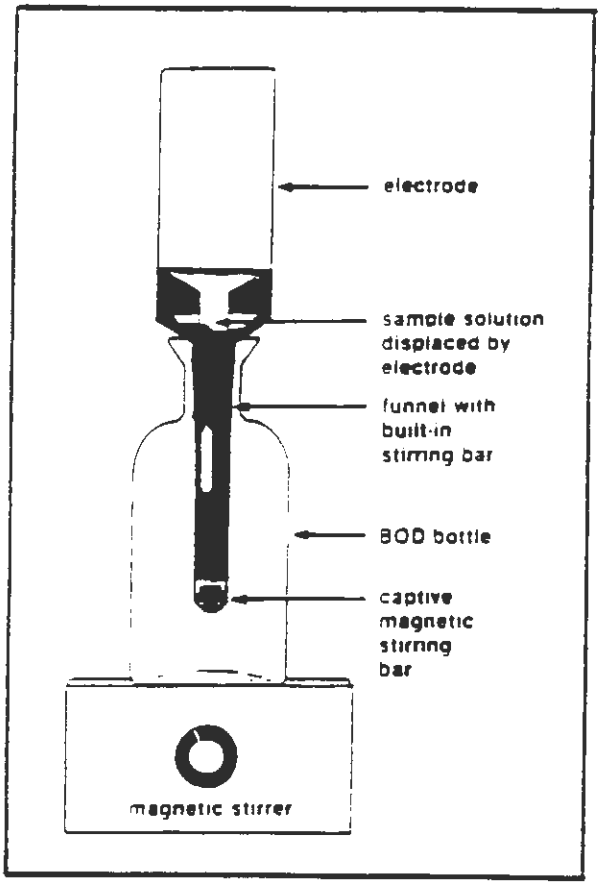
3 **Mode Control** Provides operator with choice of measuring sample in either pH or mV mode.

4 **Calibration Control** Used to standardize the meter/electrode system in buffers of known pH.

5 **Temperature/Slope Control** Compensates for variation in electrode slope or solution temperature.

6 **Electrode Connection** Accepts BNC connector from combination electrodes and pin tip jack available for use with separate half-cell reference electrodes.





Operating Controls Description

Mode Switch – A five-position switch used to select the operation mode. The positions are:

OFF – Used when the electrode is not operating. In the **OFF** position the electronic amplifiers are not operating, but the electrode polarizing voltage is maintained so that stable readings will be obtained the moment the electrode is switched to the standardization and operating modes.

BT CK – Battery check. Good battery operation is indicated by a reading of 13.4 or greater on the pH scale of the meter.

ZERO – Used to electronically zero the electrode. This mode simplifies the standardization of the electrode by electronically simulating the output of the electrode in the presence of a zero oxygen level.

AIR – Used to standardize the electrode on air.

H_2O – Used for sample analysis.

Zero Calibration Control – Knob is used to obtain a zero reading on the pH scale of the meter.

Air Calibration Control – Knob is used to set barometric pressure of air on the pH scale of the meter.

SRK
STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
74601	04/95	A

FIGURE 12-2

ORION DISSOLVED OXYGEN ELECTRODE (MODEL 97-08) TEST SETUP

STANDARD OPERATING PROCEDURE NO. 13
FIELD SAMPLING OF STREAM CHANNELS, SPRINGS AND SEEPS

This sampling procedure shall be utilized to collect aqueous samples from stream channels, drainage ditches, and springs or seeps. The samples collected will be composite or grab samples depending upon the sampling site. A sample Field Data Sheet is presented in Figure 13-1.

Sampling Procedure:

1. Wearing disposable surgical gloves and proper eye protection, rinse a clean 1- or 2-liter plastic bottle or decontaminated sampling beaker three times with stream water.

2. Rinse a set or clean sample bottles (for unfiltered samples) three times with stream water. See SOP-14 for correct sample bottle size and composition.

3. If the channel width is less than 5 feet across, collect grab sample from the center of the channel. If channel width is greater than 5 feet, divide channel into 5-foot sections and collect a composite sample at the center of each section to obtain a channel-integrated sample.

4. Submerse sampling container in water, mouth pointing upstream and below the water surface. Samples shall be collected from the approximate midpoint between the stream bed and the stream surface. Take care not to collect any stream bed solids. If collecting a grab sample, fill a sample bottle, and add required preservatives according to SOP-14. Secure the bottle cap tightly, then skip to step No. 10. If collecting a composite sample, pour full container into the bucket and take another sample from the next section of the stream. Collect 4 to 5 liters if a split is required.

   Note: If needed, a pond sampler may be used to collect samples as far as 15 feet from the edge of the ditch or channel

5. Stir or swirl the contents of the bucket gently. Using the sampling container, fill a set or sets of sample bottles (unfiltered samples).

6. Dipping from the bucket, filter a requisite volume of sample according to SOP-17.

7. Add preservatives to metals' samples according to SOP-14. Secure the sample bottle cap tightly.

8. Empty bucket and repeat steps 3 through 7 for each required field replicate.

9. Label the sample bottles with an appropriate sample tag. Label the tag carefully and clearly, addressing all the categories or parameters. Be sure to record the information in the field log-book and complete the chain-of-custody documents.

10. Collect sample field parameters according to procedures in SOP-11 and SOP-12.

11. Properly clean and decontaminate the sampling equipment prior to reuse or storage according to SOP-6.

STEFFEN ROBERTSON AND KIRSTEN

Field Sample Data

PROJECT No. _____
PAGE __ OF _____

PROJECT NAME _____ SAMPLED BY _____
STATION NO./LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO./EXPOSURE NO._____

FIELD DATA

TIME _____ AIR TEMP. °F _____ WEATHER _____

TYPE: STREAM ☐ POND ☐ OTHER ☐ SAMPLE NAME _____ DEPTH _____ STREAM WIDTH _____ FLOW VELOCITY_____

DISTANCE FROM BANK _____ SAMPLE DEPTH _____ SAMPLE TEMP _____ ☐ IN SITU ☐ IN BOTTLE SP. COND. _____/_____ 25°C ☐ IN SITU ☐ IN BOTTLE

pH _____ ☐ IN SITU ☐ IN BOTTLE Eh _____ ☐ IN SITU ☐ IN BOTTLE DISSOLVED O_2 _____ ppm ☐ IN SITU ☐ IN BOTTLE

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

REMARKS: _____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 _____ pH 7 _____ pH 10 _____
SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____
PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____
FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____
SAMPLER'S SIGNATURE _____

FIGURE 13-1

STANDARD OPERATING PROCEDURE NO. 14
SAMPLING, PRESERVATION AND CONTAINERIZATION

This Standard Operating Procedure (SOP) describes the techniques and quality control measures used to sample, prepare, and handle water subject to the analyses listed below. Tables 14.1 through 14.3 summarize the information in this SOP. In addition, Tables 14.1 and 14.3 summarize information for sampling, preservation and containerization of solid samples subject to specified analyses.

1. Acidity and Alkalinity;
2. Bicarbonate/Carbonate;
3. Chloride;
4. Fluoride;
5. Hardness;
6. Metals (Al, As, Ba, Cd, Ca, Co, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Ag, Na, Sr, Zn);
7. Nitrate;
8. Silica;
9. Semi-volatile Organic Compounds;
10. Solids {Total dissolved solids (TDS), total suspended solids (TSS)};
11. Sulfate;
12. Total Organic Carbon in Water; and
13. Volatile Organic Compounds.

All sample containers are assumed to be pre-cleaned by the laboratory prior to shipment to the site. If pre-cleaned sample containers are not available at the time of sampling, follow additional container preparation procedures below.

Acidity and Alkalinity

Apparatus and Materials

1. Polyethylene or borosilicate glass (pyrex or equivalent) bottles.

Sample Collection, Preservation and Handling:

1. Fill sample bottles completely, leaving no headspace, then cap tightly.

2. Store samples at 4 degrees Centigrade (°C)

3. All samples should be analyzed within 14 days of collection.

Quality Control:

1. Dissolved gases contributing to acidity or alkalinity, such as carbon dioxide, hydrogen sulfide, or ammonia, may be lost or gained during sampling or storage. To prevent this, sample bottles should be filled completely, leaving no headspace, then cap tightly.

Bicarbonate/Carbonate

Apparatus and Materials:

1. Polyethylene or glass bottles.

Sample Collection, Preservation, and Handling:

1. Completely fill the sample bottle, leaving no headspace, and cap tightly.

2. Store sample at 4°C until analyzed.

3. All samples should be analyzed within 14 days of collection.

Quality Control:

1. Carbon dioxide may be lost or gained during sampling and storage. To prevent this, sample bottles must be filled completely, leaving no headspace, then capped tightly.

Chloride

Apparatus and Materials:

1. Polyethylene or glass bottles.

Sample Collection, Preservation, and Handling:

1. All samples must be analyzed within 28 days of collection.

Quality Control:

1. No special precautions.

Fluoride

Apparatus and Materials:

1. Polyethylene bottles.

Samples Collection, Preservation, and Handling:

1. Polyethylene bottles are required for collecting and storing samples for fluoride analysis. Always rinse the bottle with a portion of the sample.

2. All samples must be analyzed within 28 days of collection.

Quality Control:

1. Sample bottle must be rinsed with a portion of the sample prior to collecting the sample.

2. Only polyethylene bottles may be used.

Hardness

Apparatus and Materials:

1. Polyethylene or glass bottles.

2. Dilute nitric acid (1 to 1): Mix equal volumes of concentrated nitric acid, HNO_3, with distilled/deionized (DS/DI) water.

Sample Collection, Preservation, and Handling:

1. Acidify with HNO_3 to pH 2 or lower.

2. Samples should be analyzed within 6 months of collection.

Quality Control:

1. Errors may be introduced during sampling and storage by failure to remove residues of previous samples from the sample container; therefore, all containers and sampling equipment should be thoroughly cleaned before use.

Metals

Apparatus and Materials:

1. Polyethylene or glass bottles.

2. Dilute nitric acid (1 to 1): Mix equal volumes of concentrated nitric acid, HNO_3, with distilled/deionized (DS/DI) water.

3. DS/DI water.

Sample Collection, Preservation, and Handling:

1. Wash and rinse sample container thoroughly with dilute nitric acid (1 to 1), then with DS/DI water before use.

2. Acidify sample with dilute nitric acid (1 to 1) to a pH of 2 or less. Normally, 3 milliliters (ml) of dilute nitric acid per liter should be sufficient to preserve each sample. This will keep the metals in solution and minimize their adsorption on the container wall. Preservatives should be added sparingly to meet the requirements for the analytical method. The sample pH should be re-checked after a short time to ensure that the acid has not been buffered out of the sample.

3. All samples should be analyzed within 6 months of collection. An exception is mercury analysis, which must be completed within 28 days.

4. Samples filtered for dissolved metals analysis should be preserved after filtration rather than prior to filtration.

Quality Control:

1. Serious errors may be introduced during sampling and storage by failure to remove residues of previous samples from the sample container; therefore, follow the described rinsing procedure for all containers and sampling equipment.

Nitrate

Apparatus and Materials:

1. Polyethylene or glass bottles.

Sample Collection, Preservation, and Handling:

1. Store samples at 4°C.

2. All samples should be analyzed within 48 hours of collection.

Quality Control:

1. Nitrate determinations should be made promptly after sampling.

Semi-volatile Organic Compounds

Apparatus and Materials:

1. Threaded amber glass bottles, 1-liter size, French or Boston Round design or equivalent is required.

2. Bottle caps - threaded, screw on, and lined with Teflon.

Sample Collection, Preservation, and Handling

1. Bottles must not be pre-rinsed with sample before collection.

2. Fill bottle approximately 90% full, leaving headspace, then cap tightly.

Quality Control:

1. Sample must be maintained at 4°C ±2°C and protected from light.

2. Extract within 7 days of collection (aqueous samples) or 14 days (solid samples), analyze within 40 days of extraction.

Silica

Apparatus and Materials:

1. Polyethylene bottles.

Sample Collection, Preservation, and Handling:

1. Collect samples in bottles of polyethylene plastic only; do not use glassware for any sample handling.

2. Store samples at 4°C.

3. All samples must be analyzed within 28 days of collection.

Quality Control:

1. If samples are stored in glass, silica may leach into the sample and raise concentrations; therefore, glassware cannot be used.

Solids (TDS, TSS)

Apparatus and Materials:

1. Polyethylene or glass bottles.

Sample Collection, Preservation, and Handling:

1. Store samples at 4°C.

2. Samples must be analyzed within seven days following collection,

Quality Control:

1. Sample should be analyzed as soon as possible after collection for best results.

2. Exclude unrepresentative particles such as leaves, sticks, or large solids.

3. Glass bottles are desirable. Plastic bottles are satisfactory provided that the material in suspension in the sample does not adhere to the walls of the container. Store samples that are likely to contain iron or manganese so that oxygen will not come into contact with the water. Analyze these samples promptly to minimize the possibility of chemical or physical change during storage.

Sulfate

Apparatus and Materials:

1. Polyethylene or glass bottles.

Sample Collection, Preservation, and Handling:

1. Store samples at 4°C.

2. All samples must be analyzed within 28 days of collection.

Quality Control:

1. In the presence of organic matter, certain bacteria may reduce sulfate to sulfide. To avoid this, samples should be stored at or below 4°C.

Total Organic Carbon in Water

Apparatus and Materials:

1. Amber glass or polyethylene bottles, with Teflon-lined caps.

2. Concentrated, reagent-grade, sulfuric acid (H_2SO_4) or hydrochloric acid (HCL).

Sample Collection, Preservation, and Handling:

1. Acidify samples with concentrated sulfuric acid or hydrochloric acid to a pH of 2 or less.

2. Fill bottle completely, leaving no headspace, then cap tightly.

3. Store samples at 4°C.

4. All samples should be analyzed within 28 days of collection.

Quality Control:

1. Avoid exposure of the sample to light and atmosphere; minimize storage time.

Volatile Organic Compounds

Apparatus and Materials:

1. Forty-ml amber glass vials with Teflon-faced, silicon screw caps.

Sample Collection, Preservation, and Handling:

1. Use two bottles per sample.

2. Completely fill sample vial, leaving no headspace, then cap tightly.

3. Sample must be maintained at 4°C, and protected from light.

4. Preserve sample with HCl, (pH of 2 or less), to minimize degradation by microbial action.

Quality Control:

1. Sample vials must be filled completely, leaving no headspace, and capped tightly.

2. Unpreserved VOC samples must be analyzed within 7 days of sample collection.

3. Do not use electrical tape or other tape with adhesive containing volatile organics such as toluene.

TABLE 14.1
RECOMMENDED SAMPLING AND PRESERVATION PROCEDURES

Parameter	Collection Technique	Container[a]	Preservation	Holding Time[b]	Minimum Required Volume (ml)
Acidity	Grab or composite	P, G	Cool, 4°C	14 days	100
Alkalinity	Grab or composite	P, G	Cool, 4°C	14 days	100
Bicarbonate	Grab only	P, G	Cool, 4°C	14 days	100
Carbonate	Grab only	P, G	Cool, 4°C	14 days	100
Chloride	Grab or composite	P, G	None required	28 days	50
Fluoride	Grab or composite	P	None required	28 days	300
Hardness	Grab or composite	P, G	HNO_3 to pH<2	6 months	100

TABLE 14.1
RECOMMENDED SAMPLING AND PRESERVATION PROCEDURES

Parameter	Collection Technique	Container[a]	Preservation	Holding Time[b]	Minimum Required Volume (ml)
METALS					
Dissolved	Grab or composite	P, G	Filter on-site, HNO_3 to pH<2	6 months, except Hg - 28 days	200
Suspended	Grab or composite	P, G	Filter on-site	6 months, expect Hg - 28 days	200
Total	Grab or composite	P, G	HNO_3 to pH <2	6 months, except Hg - 28 days	100
Nitrate	Grab or composite	P, G	Cool, 4°C,	48 hours	100
Semi-volatile Organic Compounds	Grab or composite	G, Teflon-lined cap	Cool, 4°C No preservative	7 days to extract 40 days to analysis	1,000

TABLE 14.1
RECOMMENDED SAMPLING AND PRESERVATION PROCEDURES

Parameter	Collection Technique	Container[a]	Preservation	Holding Time[b]	Minimum Required Volume (ml)
Silica	Grab or composite	P	Cool, 4°C	28 days	50
SOLIDS					
Dissolved (non-filterable)	Grab or composite	P, G	Cool, 4°C	7 days	100
Suspended (filterable)	Grab or composite	P, G	Cool, 4°C	7 days	100
Sulfate	Grab or composite	P, G	Cool, 4°C	28 days	50

TABLE 14.1
RECOMMENDED SAMPLING AND PRESERVATION PROCEDURES

Parameter	Collection Technique	Container[a]	Preservation	Holding Time[b]	Minimum Required Volume (ml)
TOC	Grab or composite	P,G, Teflon-lined cap	Cool, 4°C H_2SO_4 or HCL to pH<2	28 days	25
Volatile Organic Compounds	Grab only	G, Teflon-Faced silicone cap	Cool, 4°C HCL to pH<2	14 days	2 x 40

Source:"Characterization of Hazardous Waste Sites," A Method Manual EPA-600/4-84-076.
[a]P = Polyethylene, G = Glass

[b]The holding times are those listed in Technical Additions to Methods for Chemical Analysis of Water and Wastes, EPA-600/4-82-005 and Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057.

TABLE 14.2
SUMMARY OF ORGANIC SAMPLE CONTAINERS

WATER SAMPLE	REQUIRED VOL.	CONTAINER TYPE
ORGANIC ANALYSIS	1 GALLON	1 x 4-LITER AMBER GLASS BOTTLES OR 2 X 80-OZ. AMBER GLASS BOTTLES OR 4 X 1-LITER AMBER GLASS BOTTLES

TABLE 14.3
SUMMARY OF INORGANIC SAMPLE CONTAINERS

WATER SAMPLE	REQUIRED VOL.	CONTAINER TYPE	PRESERVATION	HOLDING TIME
INORGANIC ANALYSIS	1 LITER	1 x 1-LITER GLASS OR POLYETHYLENE BOTTLE OR 2 x 500 ML GLASS OR POLYETHYLENE BOTTLE	HNO3 pH <2 (CN sodium hydroxide pH >12)	METALS - 180 DAYS Hg - 28 DAYS CN - 14 DAYS

SOIL/SEDIMENT SAMPLE	REQUIRED VOL.	CONTAINER TYPE	PRESERVATION	HOLDING TIME[(a)]
INORGANIC ANALYSIS	8 0Z	1 x 8-OZ WIDE-MOUTH PLASTIC OR GLASS JAR OR 2 x 4-OZ WIDE-MOUTH PLASTIC OR GLASS JARS (AMBER OR POLY FOR TOC)	4°C +/- 2°C	METALS - 180 DAYS Hg - 28 DAYS CN - 14 DAYS TOC - 28 DAYS

Notes:

a. No technical holding time criteria, however, validator will use aqueous hold time to form professional opinion on data quality.

STANDARD OPERATING PROCEDURE NO. 15
WATER TABLE ELEVATION MEASUREMENT

Depth to water shall be measured using an electric water-level measuring device, Soiltest Model No. Dr-760A, or equivalent. A light on the water level measuring device illuminates when the weighted probe tip contacts the water surface in the well and completes the electronic circuit. The depth of water in the well is then measured by noting the point on the graduated probe cable that corresponds to the measuring point (MP) of the well or piezometer casing at the top when the electronic circuit is first completed. The accuracy of the probe is considered to be ±0.01 foot.

Water-level measurements shall be recorded in the field logbook (SOP-2). Entries in the logbook shall include, but are not limited to, the date and time the water-level measurements are taken, the individuals accomplishing the task, the well or piezometer identification number or designation, the elevation of the top of the casing, the serial number or other identification number of the water level measuring device being utilized, and the depth to water, recorded as the depth from the MP at the top of the casing to the water-level surface and as the elevation of the water level. The entries shall be signed by each person on the sampling crew.

Field Procedures

1. Check the operation of the meter by turning on the indicator signal switch. The buzzer should sound and, if present, the indicator light should illuminate. If the water-level indicator signal(s) is not functioning properly, check the batteries and/or use a different meter.

2. Holding the device atop the casing, lower the cable gradually into the well or piezometer until the indicator contacts the water surface. Stop lowering the cable.

3. Note the point on the graduated cable that corresponds to the MP at the top of the casing when the electronic circuit is first completed.
4. Record the value on the cable as the depth to water surface to the nearest 0.01 foot.

5. Draw the cable about halfway up the casing, then lower it and repeat steps 2 through 4. If these readings differ by more than 0.02 foot, repeat until measured readings stabilize.

6. If the bottom of the well or piezometer is to be measured, lower the cable slowly from the center of the casing. When the probe is felt to hit the bottom, or the cable slacks noticeably, draw the cable up very slowly until it is taut again.

7. Note the cable reading at the MP. Record this value as the well depth to the nearest 0.01 foot.

8. Repeat Steps 6 and 7.

9. Remove the cable from the well or piezometer.

10. Decontaminate the probe and graduated cable with distilled water. The cable should be decontaminated only if the bottom of the well or piezometer will be sounded. The length of cable to be decontaminated is determined by the distance between the water level and bottom of the well or piezometer. This can be estimated from the completion log.

Maintenance

1. Carry spare batteries for the water-level measuring device at all times. Check the operation in the field laboratory prior to use by dipping the probe into a beaker of clean water. If the indicator does not function properly when tested, the device shall either be repaired and retested prior to further use, or the device shall be returned to the manufacturer for repairs and another measuring device substituted.

2. Clean the cable at the end of each day of sampling by rinsing with DS/DI water and wiping dry with paper towels. In addition, clean the cable between measurements any time solids adhere to it.

3. Measure the cable monthly to determine if use of the instrument has caused the cable to stretch and, thereby, induce errors in measurements. The graduated cable shall be compared against a steel tape and discrepancies, if any, noted in the logbook.

Calculations

Water table elevation = elevation of MP (surveyed) - measured depth to water

STANDARD OPERATING PROCEDURE NO. 16
GROUNDWATER SAMPLING

FIELD MEASUREMENTS

Once a well has been located and properly identified, the following field measurements should be noted in the bound field notebook. (SOP-2) A cross reference should be made between the field measurements identifying the well and the measurements of the well to be sampled to ensure that the proper well has been selected. A sample field data sheet is presented as Figure 16-1.

Physical Measurements

1. Presence and diameter of protective casing,
2. Lock and serial number (if lock is present at the well),
3. Diameter and construction material of the casing proper,
4. Total depth of well from the top of casing (TOC), surveyor's mark, if present,
5. Depth from top of casing (TOC) to water. Static water level measurements are taken to the nearest hundredth of a foot (0.01) from the marked point or, if not marked, the highest point on the well casing (SOP-15).

Calculations

1. Calculate the linear feet of water in the well by subtracting depth to water from total depth of well.

2. Calculate the volume of water present in the well casing by multiplying the linear feet of water by the volume per linear foot for the diameter of the well as given in the following table.

WELL CASING DIAMETER/CAPACITY	
Inside Casing Diameter (inches)	Gallons/Linear Ft
2	.16
4	.65
6	1.47
8	2.61

Example:

Total depth of casing	100 ft.
Depth to water	- 20 ft.
Linear water column	80 ft.
2" casing	x .16
Amount of water in casing	12.80 gallons

Alternately, use this formula to determine the gallons in any size pipe:

$$\text{Volume} = \frac{3.1416 \times r^2 \times h \text{ (in inches)}}{231}$$

Physical-Chemical Parameters

In addition to the physical measurements taken above and other information that may identify the well, the following physical-chemical information should be recorded initially, during evacuation, and prior to sampling:

1. pH (SOP-11)
2. Temperature (SOP-11)
3. Specific conductance (SOP-11)

Well Purging and Evacuation Procedures

To obtain a representative sample of groundwater, the well should be purged or evacuated to allow fresh or formation groundwater to enter the well. The optimum or preferred method to ensure that fresh water representative of the aquifer in contact with the well screen is being sampled is to perform a controlled sampling experiment.

Wells will be presumed to be adequately flushed for a representative sample when indicator parameters such as pH, temperature and specific conductance are observed to vary less than +/-10 percent. Measurement of the field indicators will be recorded at a minimum frequency of once per casing volume removed. Evacuation of three to six well volumes may be necessary to meet the indicator parameter criterion, however, in wells with very low recoveries this amount may not be practical. In these instances, the well may be evacuated to near dryness and allowed to recover prior to sampling. Evacuation rates should be kept well below 10 gallons/minute and in most cases should be below 5 gallons/minute.

Evacuation Methods

The evacuation of monitoring wells prior to sampling will be accomplished using a bailer, hand-lift pump, a submersible pump, or other appropriate methods that will not impact the integrity of the sample. Prior to beginning evacuation, all equipment should be decontaminated according to pertinent decontamination procedures (SOP-6).

The selection of an evacuation method most often relies on the expected recharge. If the recharge is anticipated to be rapid, a submersible pump may be used. Care should be utilized to ensure this does not act as a route of cross contamination.

Hand-bailing may be utilized in any case, but in general is more efficient in wells with a low recharge rate. The bailer should also be washed, rinsed, and a sample of the rinseate collected. A new length of either nylon or PVC cord should be used for each well and for each evacuation event.

Sample Collection

Sampling can begin after evacuation of the required volume of water from the well. Sampling of the monitor well should occur as soon as possible after evacuation, preferably immediately. In most cases, the time lapse between evacuation and sampling should not exceed two hours. The bailer or pump should be cleaned in accordance with SOP-6. Field quality control samples shall be collected in accordance with SOP-3.

Samples collected for laboratory analysis of dissolved metals will be filtered in the field in accordance with SOP-17. The collected groundwater samples will be placed in the appropriate types of containers specified in SOP-14. Following collection, the samples should be prepared for shipping (SOP-5) and all necessary documentation completed (SOP-4).

Bailer

Bailers come in a variety of sizes and volumes to accommodate most well casing diameters. The preferable materials of construction are, in order of decreasing preference, Teflon, stainless steel, polypropylene, polyethylene, Vitron, PVC (low plastic content).

1. Bailers should be slowly lowered into the well, using caution not to aerate the water to be sampled. The bailer may be lowered by hand using a new length of nylon or PVC cord. Cords should be compatible with the material being sampled and dedicated to only one well. Lower the bailer opposite the well screen and pull up on the cord to set the check valve.

2. Retrieve the bailer and slowly transfer the sample to the appropriate sample containers, filling purgeable organic vials first (if required).

The bailer and any other equipment placed in the well must be clean (i.e., decontaminated) and handled with new surgical gloves to preclude any potential contamination. Nothing entering the well should be allowed to contact the ground or any other potentially contaminated surface. If an item is contaminated, it should not be placed in the well or utilized for sampling. It is always a good practice to have an extra clean bailer on hand in the case of emergency.

Sampling Pumps

Sampling pumps can be used for both the sampling and evacuation of the well. Wells may be purged with a submersible pump using a uniform rate of discharge. Any pump that causes excessive aeration or agitation of the water should not be used. The intake/discharge lines should be composed of polyethylene tubing lined with Teflon. Initially, the evacuation pump will be positioned just below the water level, and if necessary, lowered as the water level is drawn down in the well. All purged water will be discharged in accordance with the site specific Field Sampling Plan.

Only positive pressure pumps should be used for sampling purposes. Prior to field use, the sampling pump should be thoroughly cleaned in accordance with SOP-6. This procedure is followed before initial use and after the sampling of any well.

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Field Sample Data

PROJECT No. _____
PAGE __ OF _____

PROJECT NAME _____ SAMPLED BY _____
STATION NO./LOCATION _____ DATE _____

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO./EXPOSURE NO._____

FIELD DATA

TIME _____ AIR TEMP. °F _____ WEATHER _____

WELL DEPTH _____ WATER DEPTH _____ SAMPLE DEPTH _____ SAMPLE METHOD _____

VOL. PURGED _____ SAMPLE TEMP. _____ °C ☐ IN SITU ☐ IN BOTTLE SP. COND. _____ /___ AT 25°C ☐ IN SITU ☐ IN BOTTLE

pH _____ ☐ IN SITU ☐ IN BOTTLE Eh _____ ☐ IN SITU ☐ IN BOTTLE DISSOLVED O_2 _____ ppm ☐ IN SITU ☐ IN BOTTLE

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL.	ANALYSIS REQUESTED

FIELD PARAMETERS:

_____ GALLON pH - _____ EH - _____ TEMP. _____

_____ GALLON pH - _____ EH - _____ TEMP. _____

_____ GALLON pH - _____ EH - _____ TEMP. _____

REMARKS: _____

_____

FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 _____ pH 7 _____ pH 10 _____
SP. COND. METER STANDARDS CHECK _____ Eh PROBE _____
PUMP TUBING RINSED _____ CHANGED _____ SAMPLER BLANK _____
FILTRATION BLANK WITH PRES. _____ FILTERS ACID WASHED _____
SAMPLER'S SIGNATURE _____

FIGURE 16-1

STANDARD OPERATING PROCEDURE NO. 17
FILTERING OF WATER SAMPLES

Filtration requirements will be specified in the site-specific Field Sampling Plan (FSP). These samples will be prepared using either a peristaltic pump or a vacuum pump equipped with a 0.45 micron field filter. The filter flasks will be glass, stainless steel, or polypropylene. Refer to SOP-14 for guidance on appropriate flask material to be used with each sample parameter. Both the filtered and unfiltered samples will be placed in appropriate sample containers.

PROCEDURES

Use of Disposable Filters

1. In situations where the static level in the well allows use of a peristaltic pump, the groundwater sample shall be pumped directly from the well through an in-line filter.

    - A disposable, high capacity, 0.45 micron filter is an acceptable filter for most applications.
    - In field use, the filter must first be flushed with 30-50 mls of deionized water or an inert gas to remove atmospheric oxygen.
    - The filter must be inserted on the high pressure side (i.e., on the delivery side) of the peristaltic pump. VACUUM FILTRATION IS NOT ACCEPTABLE.
    - The sample delivery tube must be long enough (greater than 2 feet) such that back-diffusion of oxygen to the filter is negligible.
    - New or pre-cleaned Tygon tubing shall be installed in the pump at each monitor well.

2. In situations where the static water level in the well is too deep for a peristaltic pump to be used directly, there are several alternatives:

- Groundwater may be sampled with an appropriately constructed bailer. The intake tube of the peristaltic pump is inserted into the full bailer and water pumped through a filter as described above.
- Any submersible pump of appropriate construction for which the flow rate can be adjusted may be used for water levels below 20 to 25 feet.
- Pressurized HDPE and Teflon bailers may also be used.

3. It is important that this operation is carried out as rapidly as possible and in such a way that sample agitation and exposure to atmospheric oxygen are minimized. It is for this reason that pouring the sample into any intermediate vessel for subsequent filtration IS NOT allowed. This includes barrel or syringe filters. Once the sample is collected into a sample container, preservation and pH checks should be completed.

Vacuum Pump

The following procedures are applicable for the use of a filter apparatus for field filtration of water samples, which will be analyzed for dissolved analytes:

1. The filter apparatus will be decontaminated in accordance with SOP-6.

2. In the field, place a 0.45 micron filter in a filtration apparatus. Place 10 to 15 milliliters (ml) of 10 percent dilute nitric acid into the filter apparatus and apply vacuum. Discard the filtered solution.

3. Place 10 to 15 ml of sample water in the filtration apparatus, apply vacuum, swirl filtrate in the flask, and discard the filtered solution. Repeat two additional times for total of three pre-washes.

4. Fill the apparatus with well-mixed sample water from the collection container and apply vacuum. Filter a suitable volume of sample water to meet sample analytical needs.

5. If the filter becomes clogged, note the volume of filtrate, carefully release vacuum from the flask, and pour the unfiltered sample water back into the collection container. Replace the used filter with a clean filter and repeat Step 4 using a sample volume equal to the amount that was able to pass through the first filter.

6. If an extremely turbid water sample is encountered, repeat the procedures using a pre-filter (usually 3.0 micron) followed by 0.45 micron filtration.

7. If the sample bottles have been prepared by the analytical laboratory and necessary preservatives added, proceed to step 9.

8. Rinse the sample bottle with a small quantity of filtrate three times. Upon collection of the required volume of filtrate, fill the sample bottle and cap. Preservation requirements for water samples are detailed in SOP-14.

9. Label sample bottle as appropriate and place in a cooler (SOP-4). Ship with other samples in accordance with SOP-5.

Peristaltic Pump

This section describes the procedure for filtering field samples using the Geotech filtration holder and peristaltic pump, which is powered by a 12-volt battery. This procedure was developed to minimize the potential for contamination and to ensure that dissolved trace metal samples can be analyzed using analytical techniques with detection limits below conventional Contract Laboratory Program requirements (i.e., EPA 200 series).

Field Laboratory Procedures

1. Clean the polycarbonate filter holder, support screens and Tygon tubing by soaking in dilute HCL or HNO_3 (approximately 0.1 normal solution) for at least 24 hours. (Preferably use new Tygon tubing.)

2. Rinse thoroughly at least three times with distilled/deionized (DS/DI) water.

3. Dry and reassemble:

    a. Place the O-ring into the bottom plate O-ring groove;

    b. Insert the disbursement disc into the bottom plate with the center pin down, circular grooves up, and flush with the surface of the plate;

    c. Lay the filter support screen on the disbursement plate, nest inside the alignment pins, and stepped edge side down;

    d. Lay the filter media on the support screen and center;

    e. Lay the filter support screen on top of the filter media, stepped edge side up;

    f. If a pre-filter is used, center it on the filter support screen;

    g. Insert the disbursement disc into the top plate with the center pin up and circular grooves down;

    h. Place the top plate over the assembled filter parts and check to see that alignment pins are engaged;

    i. Swing clamping bolts into place;

j. Tighten the nuts directly opposite each other half way. Then, by hand following the same pattern, compete tightening. Following this pattern will assure a proper seal;

k. Connect the tubing to the top place hose barb fitting. It is recommended that a hose clamp be used for higher operating pressures; and

l. When you begin pressurizing the sample through the unit, the air trapped inside must be released for maximum filtration. There is a small ball valve located in the top plate for this purpose. Simply hold the ball down with a small object until all of the air is released.

The optimum pressure for filtration with a filter membrane of 0.45 mm pore size is 7 to 15 pounds per square inch (psi). Maximum operating pressure should not exceed 25 psi.

Field Procedures

1. Assemble pump and filtration apparatus (described above).

2. Place filter in the filtration apparatus (see Step 3 under Field Laboratory Procedures). Place Tygon tubing in the sample collection bottle. Filter a minimum sample volume of 20 ml and discard. Repeat three times to ensure that the filtration apparatus and tubing are well rinsed with the sample.

3. Place a 500-ml or a 1-liter sample bottle below the filter outlet and fill.

4. Rinse the filtration device and sampling terminus of Tygon tubing thoroughly between each sample. This can be done most easily by removing the filter and pumping DS/DI water through the system. Load a new filter for each new water sample to be filtered.

STANDARD OPERATING PROCEDURE NO. 21
SAMPLE COLLECTION FROM SOIL BORINGS, EXCAVATIONS AND HAND DUG PITS

Soil Boring Procedures

The following procedures are designed to be used during the operation of drill rigs during soil sampling operations. Health and safety procedures during sampling activities are described in the Administrative Order on Consent Health and Safety Plan. The procedures listed below may be modified in the field by the agreement of the lead site sampler and drill operators based on field and site conditions after appropriate annotations have been made in the appropriate bound field logbook (SOP-2).

All utilities (gas and electric, telephone, sewer, etc.) shall be located by the utilities (in some instances a utilities locator may be necessary) prior to drilling or excavating. Overhead line locations shall also be identified. Minimum clearance distances shall be maintained.

Sampling intervals and sampling devices shall be specified in each Field Sampling Plan (FSP). Field personnel shall be familiar with the content of the FSP and shall keep a field copy of the FSP on-site during sampling activities.

1. Locate the site as directed in the FSP.

2. Drillers prepare rig for operation. This includes but is not limited to decontamination of the drill rig tools and sampling equipment (SOP-6), leveling the rig, preparing the downhole tools, preparing the auger "flights" or drill bit, and establishing the drill over the location.

3. Boreholes shall be abandoned in accordance with state regulations.

Split Spoon Sample Collection

1. Line the split spoon sampler in accordance with the FSP.

2. Mount the split spoon sampler to the drive stem.

3. Prior to using the split spoon sampler, sample the surface increment to a specified depth in accordance with site-specific FSP.

4. Set the split spoon sampler on the bottom of the borehole and advance the sampler to the desired depth using the rig hammer. Record the number of blows required to advance the sampler through each 6 inch depth interval.

5. After driving the split spoon sampler its entire length or upon refusal of advancement, recover the split spoon sampler. Refusal is defined as 100 blows with the rig hammer with less than 6 inches advancement of the split spoon sampler. This decision shall be made at the discretion of the field sampler.

6. After recovery of the split spoon sampler, open sampler and place in a holding device, maintaining the intervals as sampled. If laboratory analyses are specified in the FSP, proceed with sample collection.

7. Sampling personnel will then describe the soil sample based on the site-specific FSP instructions and fill out the appropriate bound field logbooks (i.e., document site ID, rig type, sampler type and dimensions, weight of hammer, hammer drop, etc.), field boring logs, field site sheets and quality assurance/quality control documentation. An example of the standard boring log form is presented in Figure 21-1.

8. Decontaminate the split spoon sampler according to procedures presented in SOP-6.

9. Repeat Steps 1 to 8 until sampling is completed.

10. The drill rig tools and sampling equipment shall be decontaminated prior to moving onto the next site. The drill rig will be left in a safe and secure fashion at the end of each shift.

11. Sample locations shall be marked with a survey stake.

Core Barrel Sample Collection

1. Line the core barrel sample in accordance with the FSP and install basket retainer, if necessary.

2. Mount the core barrel sampler to the drive stem.

3. Place the core barrel sampler on the ground surface and advance sampler to desired depth by rotating the drive stem.

4. Recover the sampler, remove liner from sampler and record lithology on boring log shown on Figure 21-1. If laboratory analyses are specified in the FSP, proceed with sample collection.

5. Advance augers to bottom of sample interval.

6. Decontaminate sampler according to SOP-6 and repeat steps 1 to 6 until sampling is completed.

7. Decontaminate drill rig tools and sampling equipment prior to moving onto next site.

8. Sample locations shall be marked with a survey stake.

Backhoe Pit Excavations

The following procedures are designed to be used during the operation of backhoe equipment to excavate sites prior to soil sampling operations. The procedures listed below may be modified in the field by the agreement of the lead site sampler and backhoe operators based on field and site conditions after appropriate annotations have been made in the appropriate bound field logbook (SOP-2).

1. Locate the site as directed in the FSP. Identify locations of underground utilities.

2. Place the backhoe tractor in a safe position. This shall be based on the operator's judgment and site conditions.

3. Begin backhoe excavation. Topsoil shall be determined by the technical field support, removed, and segregated from the underlying soils. Place excavated materials a sufficient distance from the excavation to prevent it from sloughing back into the pit.

4. Continue excavation of the pit to the required depth. This depth shall not exceed 4 feet below ground surface unless the proper pit exit trenches, shoring, and slopes have been excavated to prevent accidental burials of sampling crew and to meet or exceed all OSHA Construction Standards (29 CFR 1926) for entrance by sampling personnel.

5. Sampling personnel may enter the pit after all excavation is complete and the excavation is deemed safe. The site safety officer or qualified designee shall be the oversight authority and shall determine what is safe. "Safe" for backhoe pit excavations is defined as meeting or exceeding all OSHA Construction Standards (29 CFR 1926), for entrance by sampling personnel.

6. Soil profile descriptions shall be made from a hand cleaned surface along the pit wall using the Unified Soil Classification System (Figure 21-2).

7. Soil sampling shall follow the soil profile description and the sampling intervals defined in the FSP. A sample collected from a depth increment shall be a representative composite of the entire interval and not biased by sample mass from the top or bottom of the sampling increment.

8. All pertinent field quality assurance/quality control documentation, bound field logbooks, sample labels, profile sheets, and field site sheets shall be completed prior to refilling the pit.

9. After items 1 through 8 have been completed to the satisfaction of the lead sampler, the site pit shall be backfilled with the previously excavated materials. The earthen materials are to be replaced in the reverse order they were excavated with topsoil placed on top of the filled pit. There shall be some unavoidable mixing of soil during the excavation. Compaction of the pit backfill shall be performed to minimize potential consolidation of the backfill material.

10. Decontaminate all sampling equipment (SOP-6).

11. Move to the next site. If the previous site was the last site of the day, decontaminate the backhoe bucket, secure and park the backhoe/tractor rig for the evening.

Hand Dug Pits

The following procedures are designed to be used during the operation of hand tools to excavate sites prior to soil sampling operations. The procedures listed below may be modified in the field by the agreement of the lead site sampler and field personnel based on field and site conditions after appropriate annotations have been made in the appropriate bound field logbook (SOP-2).

1. Locate the site as directed in the FSP. If appropriate, identify locations of underground utilities.

2. Select the appropriate orientation for the excavation. This shall be based on the lead field sampler's judgment and site conditions.

3. Begin pit excavation. Topsoil is to be placed separately from the underlying soils. Place excavated materials a sufficient distance from the excavation to prevent its return to the pit. Placement of excavated materials on a sheet of plastic is recommended to facilitate backfilling the pit.

4. Continue excavation to the pit to the required depth. This depth shall not exceed 24 inches from the ground surface.

5. Soil profile descriptions shall be made from hand cleaned surface along the pit wall using the Unified Soil Classification System (See Attachment).

6. Soil sampling shall follow soil profile description and sampling intervals, based on the FSP. A sample collected from a depth increment shall be a representative composite of the entire interval and not biased by sample mass from the top or bottom of the sampling increment.

7. All pertinent field quality assurance/quality control documentation, bound field logbooks, sample labels, profile sheets, and field site sheets shall be completed prior to refilling the pit.

8. After items 1 through 7 have been completed to the satisfaction of the lead sampler, the site pit shall be refilled with the previously excavated materials. The materials are to be backfilled in the reverse order they were removed with topsoil placed on top. There will be some unavoidable mixing of soil during excavation.

9. Decontaminate all sampling equipment (SOP-6).

10. Move to next site. If previous site was the last site of the day, decontaminate the field sampling equipment, secure equipment and exit the site.

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Consulting Engineers & Scientists

LOG OF BORING HOLE

PAGE ____ OF ____

PROJECT NAME: PROJECT NO.:	BORING NUMBER:	COORDINATES OR LOCATION:
LOGGED BY: CHECKED BY:	SURFACE ELEVATION:	GWL DEPTH: (ENCOUNTERED) DEPTH: (STATIC)
DRILLING METHOD:	HOLE DIAMETER: / FLUID USED:	DATE STARTED: COMPLETED:
CASING TYPE AND SIZE: SCREEN TYPE AND SIZE:	FROM _____ A.G.S. TO _____ B.G.S. FROM _____ TO _____	

DEPTH ( )	SAMPLE TYPE AND NUMBER	SAMPLE DEPTH INTERVAL	BLOW COUNT	RECOVERY LENGTH (%)	PROFILE	DESCRIPTION	WELL CONSTRUCTION SUMMARY
0							0
60							

NOTES

FIGURE 21–1

STANDARD OPERATING PROCEDURE NO. 22
SURFACE SOIL SAMPLING

The following procedures are to be used to collect a surface soil sample from the upper soil horizon. These procedures may be modified in the field, based on field and site conditions after appropriate annotations have been made in the bound field log book. These procedures are intended for sampling of surface soils for inorganic analyses.

Sampling with a Spade and Scoop

The following is a list of equipment for surface soil sampling:

- Spade (long handle);
- Mason trowel;
- Stainless steel scoop;
- Stainless steel bowls (optional);
- Sample labels;
- Sample containers;
- Wash/rinse tub(s);
- Phosphate-free, lab-grade detergent (e.g., Liquinox);
- Distilled water;
- Plastic sheeting;
- Locations (map and/or list);
- Appropriate health and safety equipment;
- Field logbook; and
- Ice chest.

The field sampling procedure is as follows:

1. Locate the site as directed in the Field Sampling Plan (FSP).

2. Dig an appropriate number of random 12-inch square pits to a depth specified in the FSP. If an organic layer is present, carefully remove vegetation to the desired sample depth.

3. Collect a sample by scraping the face of the pit sidewall from the desired depth interval with a stainless steel or plastic spoon and place the soil into a stainless steel bowl.

4. If composite sampling is specified in the FSP, place an equal volume of sample from each sample location into a clean container. Unless the analysis is for leachable metals or other analyses, which would require different types of coarse fragments per the FSP, remove coarse fragments greater than 0.5 inches from the bowl. Mix the remaining sample in the container with a stainless steel spoon.

5. Transfer the soil sample directly into the appropriate sample container according to Table 22-1 and store in a cooler at 4 °C or less. Minimum sample volumes are specified in Table 22-1. Each container shall be labeled and packaged according to procedures outlined in SOP-4 and SOP-3.

6. Record appropriate information concerning sample collection in the bound field logbook (SOP-2). Complete the field data sheet for soil/sediment samples illustrated in Figure 22-A. If the sample has been obtained at a location designated as a boring location, the sampling event shall also be recorded in the boring log.

7. Decontaminate sampling tools between sampling events and at completion of sampling according to procedures outlined in SOP-6.

8. Collect the recommended field QC sample in accordance with SOP-3.

TABLE 22-1
SURFACE SOIL SAMPLE COLLECTION REQUIREMENTS

TYPE OF SAMPLE	SAMPLE ANALYSIS	REQUIRED VOLUME	CONTAINER TYPE
Inorganic	Metals and Cyanide Analysis	6 oz	1 x 8 oz or 2 x 4 oz wide-mouth glass or plastic jar
Organic	Extractable Analysis	6 oz	1 x 8 oz or 2 x 4 oz wide-mouth glass jar
Organic	Volatile Analysis	240 ml	2 x 120-ml wide-mouth glass vials
Dioxin	2,3,7,8-TCDD Analysis	4 oz	1 x 4 oz wide-mouth glass jar
High Hazard	Organic and Inorganic Analysis	6 oz	1 x 8 oz wide-mouth glass jar

Note:

1. Sample volume and container may vary based on the FSP.

Source: EPA, 1988, "Users Guide to the Contract Laboratory Program"

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SURFACE SOIL DATA COLLECTION FORM

Sample Number _____

Collection Date _____

Collection Time _____

Location Code _____

Chain of Custody No. _____

Coordinates North or Y _____ East of X _____

_____

Sample Location _____

Composite (Y/N) _____

Composite Description _____

Collection Method _____

Sample Team Leader _____

Sample Team Member _____

Sample Team Member _____

Sample Team Member _____

Container Size (OZ) _____ % Full _____

_____

Comments _____

_____

_____

_____

_____

_____

_____

_____

_____

Completed By: _____

Print Name Signature Date

Subcontractor: _____

FIGURE 22A

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SURFACE SOIL SAMPLING FIELD ACTIVITIES REPORT FORM

Project Name _____

Site Identification _____ Date _____

Sampler _____

SAMPLE POINT	GRID LOCATION	TIME	COMMENT

Completed By: _____

Print name Signature Date

Subcontractor: _____

FIGURE 22B

STANDARD OEPERATING PROCEDURE 23

X-RAY FLUORESENCE ON-SITE MEASUREMENT

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to serve as a guide to the start-up, check-out operation, calibration, and routine use of X-Ray Fluorescence (XRF) instruments for on-site measurement (OM) or fixed facility analysis of hazardous or potentially hazardous metals. It is not intended to replace or diminish the use of the specific manufacturer's operating instructions which contain additional information for optimizing instrument performance and for utilizing it for different applications.

The procedures contained in this SOP are general operating procedures which may be changed as required depending on site conditions, equipment limitations, limitations imposed by the Quality Assurance and/or Quality Control procedure or other protocol limitations. In all instances, the procedures finally employed should be documented and included in any or all final reports.

1.1 Principles of Operation

XRF is a non-destructive simultaneous method providing qualitative and quantitative elemental analysis for a variety of sample types with little or no sample preparation. The basis for the method is detection of fluoresced X-rays characteristic of the elements present in a sample following excitation by a radiation source. Primary X-rays from a sealed radioisotope source contained in the XRF instrument are impinged on the sample resulting in emission of fluorescence secondary X-rays characteristic of the elements present in the sample. A microprocessor-based detector provides the spectral resolution and sensitivity to quantitate metals in soil samples in the 10 - 500 mg/kg range depending on the matrix makeup and the analytes of interest.

2. APPLICABILITY

Solid and liquid samples can be analyzed for the elements aluminum (Al) through uranium (U) with proper X-ray source selection and instrument calibration. Typical environmental applications are:

- Heavy metals in soil (in-situ or samples collected from the surface or from bore hole drillings, etc.), sludges and liquids (e.g., lead (Pb) in gasoline).
- Light elements in liquids (e.g., phosphorus (P), sulfur (S), and chlorine (Cl) in organic solutions.
- Heavy metals in industrial waste stream effluents.
- PCB in transformer oil by analysis for chlorine atoms.

- Heavy metal air particulates collected on membrane filters, either from personnel samplers or from high volume samplers.
- Lead in paint

3. SUMMARY

The XRF analyzer employs radioactive isotopes for the production of primary X-rays. Each source emits a specific energy range of primary X-rays that cause a corresponding range of elements in a sample to emit fluorescent X-rays. When more than one source can excite the element of interest, the appropriate source(s) is selected according to its excitation efficiency for the element of interest.

The sample is positioned in front of the source-detector window, and sample measurement is initiated which exposes the sample to primary radiation from the source. Fluorescent and backscattered X-rays from the sample enter through the detector window and are counted in the detector.

4. INTERFERENCES AND POTENTIAL PROBLEMS

The total method error for XRF analysis is defined as the square root of the sum of squares of both instrument precision and user or application related error. Generally, the instrument precision is the least significant source of error in XRF analysis. User or application related error is generally more significant and will vary with each site and method used. The components of the user or application related error are the following.

4.1 Sample Placement

This is a potential source of error because the X-ray signal decreases as the distance from the radioactive source is increased. However, this error is minimized by maintaining the same distance for each sample, therefore operation in stationary mode is recommended.

4.2 Sample Representivity

This can be a major source of error if the sample does not represent the site. Representivity is affected by the soil macro- and micro-heterogeneity. For example, a site contaminated with pieces of slag dumped by a smelting operation will be more heterogenous than a site contaminated by liquid plating waste. This error can be minimized by either mixing a large volume of sample prior to analyzing an aliquot or by analyzing several locations (in-situ) at each sampling point and averaging the results.

4.3 Reference Analysis

Soil chemical and physical matrix effects may be corrected by using Inductively-Coupled Plasma (ICP) or Atomic Absorption (AA) spectroscopy analyzed site-specific soil samples as calibration or calibration check samples. A major source of error can result if the samples analyzed are not representative of the site and/or if the analytical error is large. Additionally, when comparing XRF results with reference analyses results, the efficiency of the sample digestion reference analysis should be considered. Some digestion methods may breakdown different sample matrices more efficiently than others total hydrofluoric (HF) digestion is recommended when fixed laboratory methods are used to compare to OM XRF results.

4.4 Chemical Matrix Effects

Chemical matrix effects (due to the chemical composition of the sample) result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, Fe tends to absorb copper (Cu) X-rays, reducing the intensity of Cu measured by the detector, however this effect can be corrected mathematically. Laboratory analysis using ICP or AA is essential if background contaminant levels are unknown. Soils application software accounts for high iron in soil samples, but the user should consult with the manufacture applications chemist or project chemist about possible effects due to background levels of major constituents.

4.5 Physical Matrix Effects

Physical matrix effects (due to sample morphology) are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, consider a sample in which the analyte exists in the form of very fine particles within a matrix composed of much coarser material. If two separate aliquots of the sample are prepared in such a way that the matrix particles in one are much larger than in the other, then the relative volume of analyte occupied by the analyte-containing particles will be different in each. When measured, a larger amount of the analyte will be exposed to the source X-rays in the sample containing finer matrix particles; this results in a higher intensity reading for that sample, and consequently, an apparently higher measured concentration for that element. Sample preparation (Section 8.3) can be designed to minimize error introduced by sample morphology.

4.6 Application Error

XRF instruments have the ability to operate in different modes or applications. Generally, the error in the application calibration is insignificant (relative to the other sources of error) if the instrument's application operating instructions are followed correctly. However, if the sample matrix varies significantly from the design of the application (e.g., using the soils application to analyze a 50% iron mine tailing sample) the application error may become significant.

4.7 Moisture Content

Sample moisture content will affect the analytical accuracy of soils or sludges. The overall error may be a minimal when the moisture range is small (5-20%), or it may be a major source of error when measuring the surface of soils that are saturated with water. Drying samples to a uniform moisture content before analysis is recommended.

4.8 Cases of Severe X-ray Spectrum Overlaps

When present in the sample, certain X-ray lines from different elements can be very close in energy and, therefore, interfere by producing a severely overlapped spectrum. Typical spectral overlaps are caused by the Kβ line of element Z-1 (or as with heavier elements Z-2 or Z-3) overlapping with the Kα line of element Z (where Z is the atomic weight). This is the so-called Kα, Kβ interference. Since the Kα, Kβ intensity ratio for the given element usually varies from 5:1 to 7:1;, the interfering element Z-1 must be present in concentrations greater than Z in order to disturb the measurement, which can often be the case in environmental analyses. The presence of large concentrations of vanadium (Z-1) could disturb the measurement of chromium (Z). The vanadium Kβ energy is 5.427 Kev and the chromium Kα energy is 5.41 Kev. The resolution of the detector is not sufficient to separate these energies. Therefore, large amounts of V in a sample will result in spectral overlap with the chromium giving erroneous results.

Other interferences can occur in the overlap of K, L, and M lines of various elements. While these are less common, examples of a severe overlap include arsenic and lead. Unwanted interference can be corrected, however, due to the limits of mathematical corrections, measurement sensitivity is reduced. Generally, As concentrations in samples with Pb:As ratios of 10:1 or more can not be efficiently calculated. This may result in zero As being reported regardless of the actual As concentration.

Identification of the elements present in typical field samples using ICP or similar techniques is essential prior to initiating a field sampling program utilizing XRF.

5. RESPONSIBILITIES

5.1 Project Manager/Project Chemist

The Project Manager or Project Chemist is responsible for ensuring that all Golder Associates personnel engaged in the analysis of soil samples by this procedure have been thoroughly trained in the use of this procedure and the equipment required.

5.2 Project Field Personnel

The project field personnel are responsible for controlling samples in accordance with governing QAPjP, and for complying with the requirements of this procedure.

6. INSTRUMENTATION

6.1 Limits and Precautions

The probe containing the X-ray source should be handled in accordance with the following radiological control practices:

1. The probe should always be in contact with the surface of the material being analyzed and the analyzed material should completely cover the probe opening (aperture) when the sources are exposed. Do not remove a sample or move the probe while the source is in operating mode.

2. When the sources are exposed, under no circumstances should the probe be pointed at the operator or surrounding personnel.

3. Do not place any part of the operator's or co-worker's body in line of exposure when the sources are exposed or partially covered.

4. The probe must be covered with the safety cover or laboratory safety shield when not in use.

5. The appropriate state agency or the Nuclear Regulatory Commission (NRC) office must be notified (see factory supplied data on radiological safety) immediately of any damage to the radioactive source or any loss or theft of the device.

6. Labels or instructions on the probe(s) must not be altered or removed.

7. The user must not attempt to open the probe.

8. The source(s) in the probe must be leak-tested every six months. The leak test certificates must be kept on file and a copy must accompany the instrument at all times.

9. The probe laboratory safety shield assembly must be used when the probe is inverted for measuring samples contained in cups.

10. During operation the probe must be kept at least 10 feet from computer monitors and any other source of radio frequency (RF). Some monitors have very poor RF shielding and will affect measurement results.

11. The instrument should not be dropped or exposed to conditions of excessive shock or vibration.

Additional precautions include:

1. The probe cable must never be pulled while unplugging the probe. The probe plug should be grasped at the ribbed metal connector and squeezed and pulled gently while unplugging the connector. The connector must never be forced when plugging in the connector.

2. The handle of the electronic unit must not be rotated unless the release buttons on each side of the handle are depressed.

3. The instrument should not be stored at an ambient temperature below -4°F or above 110°F.

4. The battery charging unit should only be used indoors in dry conditions.

5. Battery packs should be changed only in dry conditions.

7. REAGENTS

Generally, calibration standards are not necessary for site screening and extent of contamination analyses. Optionally, an application can be optimized or verified to be 1:1 proportional to another analytical (reference) method. This can be done by analyzing a set of Site-Specific Calibration Standards (SSCS) and performing a regression analysis on the reference and the XRF results for each element of concern. In an application any element's calibration can be adjusted by entering the desired slope and offset.

7.1 Site-Specific Calibration Standards (SSCS)

SSCS must be representative of the matrix to be analyzed by XRF. The concentration of the target elements in the SSCS should be determined by independent AA or ICP analyses that meet acceptable quality levels for referee data.

7.1.1 SSCS Sampling

See Section 4.2 on sample representivity. The SSCS samples must be representative of the matrix to be analyzed by XRF. It does not make sense to collect SSCS samples in the site containment area if you are interested in investigating off-site contaminant migration. The matrices may be different and could affect the accuracy of the XRF results. If there are two different matrices on site, collect two sets of SSCS samples.

A full range of target element concentrations is needed to provide a representative calibration curve. Mixing high and low concentration soils to provide a full range of target element concentrations is not recommended due to heterogeneity problems. Unlike liquid samples, solid samples can not be diluted and re-analyzed.

Additionally, collect several SSCS samples in the concentration range of interest. If the action level of the site is 500 mg/kg, providing several SSCS samples bracketing the action level will tend to improve the XRF analytical accuracy in this concentration range.

Generally a minimum of seven appropriate SSCS samples should be taken. A minimum sample size of 4 oz. is recommended. A larger size sample should be taken to compensate for sites with greater content of non-representative material such as rocks and/or organic debris. Standard glass or high-density polyethylene sampling jars should be used.

7.1.2 SSCS Preparation

The SSCS samples should be either by air dried overnight or oven dried at less than 105°C. Aluminum drying pans or large plastic weighing boats for air drying may be used. After drying, remove all large organic debris and non-representative material (twigs, leaves, roots, insects, asphalt, rocks, etc.).

The sample should be sieved through a 10-mesh stainless steel sieve. Clumps of soil and sludge should be broken up against the sieve using a stainless steel spoon. Pebbles and organic matter remaining in the sieve should be discarded. The under-sieve fraction of the material constitutes the sample.

Although a maximum final particle size of 10-mesh is normally recommended, a smaller particle size may be desired. The sample should be mixed by dividing the sieved soil into quarters and physically mixing opposite quarters with a clean stainless steel spoon. Re-combine and repeat the quartering and mixing procedure three times. Place the sieved sample in a clean sample jar and label it with both the site name and sample identification information.

The stainless steel sieves should be decontaminated using soap and water and dried between samples.

One or more plastic XRF sample cups should be filled with the sieved soil for each SSCS sample. A piece of 0.2-mil polypropylene film should be cut and stretched until it is wrinkle-free over the top of the X-ray sample cup and then sealed using the plastic securing ring. The cup should be labeled using unique identification information.

Confirmation analyses can be performed on either the XRF sample cup or the balance of the prepared sample. Analysis of the requested element(s) by AA or ICP should be performed on the total hydrofluoric (HF) digest.

8. OPERATIONAL CHECKS

8.1 Blank (Zero) Sample Check

The blank (Zero) sample check is performed to monitor the instrument's zero drift. This should be done once at the beginning of the day after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift on a blank or low level sample.

Mount the probe in the laboratory stand and select the appropriate application. Measure the Teflon™ blank provided with the unit using a minimum acquisition time of 60 seconds for each source. Review the results table. Most (95%) of the elemental results should be 0± (2 x STD) (their respective standard deviation), and all of them (99%) should be 0± (3 x STD) (their respective standard deviation). Repeat the measurement if the unit fails to meet these specifications. If several elements continue to be significantly out of these specifications, check the probe window and the blank sample for contamination.

8.2 Target Element Response Check

The purpose of the target element response check is to ensure that the instrument and the selected application are working properly prior to performing sample analysis. This

check should be performed at the beginning of the day. Use low, mid, and high samples or standards with known concentrations for some or all of the target elements to be checked. Select a low sample near the quantitation limit of the target elements. Select a mid sample near the site action level and a high sample near the maximum concentration of the target elements expected on site.

These samples should be measured using the same source acquisition times that will be used for sample analysis. Save the sample check results and spectra for documentation.

8.3 Sample Handling and Preparation

Sample handling and preparation is dependent upon the data use and goals of the investigation. Sample preparation can range from direct in-situ measurements, in which the soil or other surface measurements are made with minimal sample preparation, to sample grinding and/or analysis of sieve fractions without grinding. A maximum particle size of -10 mesh is recommended for prepared samples to achieve uniform particle size between samples, but smaller particles may be desirable in order to characterize transport mechanism (such as wind-borne or surface water transport). Sample preparation techniques should be described in site specific plan documents.

When making XRF measurements, be sure to maintain constant measurement geometry in order to minimize variations in analysis results. Document any anomalies in measurement geometry, sample surface morphology, moisture content, sample grain size, and matrix.

8.4 Soil Samples

Soil samples may be analyzed either in-situ or in prepared X-ray sample cups. Operating the XRF in a soils application assumes the sample to be infinitely thick. For in-situ measurements this is almost always the case but for sample cup measurements it is advisable to fill the cup nearly full and tap it on the bench to compact the soil. This ensures that the sample is as uniformly thick as possible from sample to sample. A safety shield should be used when analyzing sample cups.

Sample where analyses is performed in-situ should first be prepared by removing large rocks and debris from the area in contact with the probe. The soil surface should be rendered flat and compact prior to analysis. The XRF probe should be held firmly on the ground to maximize instrument contact with the ground. The probe should not be moved during analysis. Analysis of water saturated soils should be avoided. A thin layer of 0.2-mil polypropylene XRF film may be mounted on the surface probe to minimize contamination. Use of varying thicknesses of plastic (bags) have been shown to interfere

with light element measurements and may affect the calibration of other elements. Additionally, plastic may contain significant levels of target element contamination.

Course-grained soils conditions, nuggets of contaminated material, or rock may not permit a truly representative sample and may adversely bias the analytical result. Such samples should be prepared before analysis. Preparation consistency is important to minimize variation in analytical results. Crushing the sample which has been folded into a cotton rag with a small sledge hammer has proven to be effective field sample preparation method.

9. ROUTINE FIELD PROCEDURES

9.1 Calibration

Standardless

FPXRF can be equipped with fundamental parameter capabilities which allow for standardless calibration. It uses calibration curves based on matrices similar to those of the routine samples.

Site Typical

A site typical calibration curve is based on samples similar in composition, but not necessarily matrix matched. Extreme caution should be exercised when using a site-typical calibration curve. Situations have been encountered where increased iron levels in mine tailings relative to the calibration standards resulted in anomalously high chromium results (in excess of several wt% Cr!). Corroboratory analyses found chromium in the zero to 40 mg/kg range.

Site Specific

To minimize enhancement/absorption and spectral interference errors, calibration standards should be collected from the specific site in question. These Site Specific Calibration (SSC) standards must closely emulate the physical and chemical matrix of the routine samples. The SSC standards are prepared identically to field samples so that the particle size bias of the routine samples is included in the instrument calibration.

Characterization of the SSC standard must be done using a total digestion procedure rather than a partial extraction because XRF is a total analyte method independent of phase or specification.

10. QUALITY ASSURANCE/QUALITY CONTROL

10.1 Precision

The precision of the method is monitored by reading the low or mid SSCS at the start and end of sample analysis and after approximately every tenth sample (a daily total of seven measurements is recommended). Determining the precision around the site action level can be extremely important if the XRF results are to be used in an enforcement action. Therefore, selection of an SSCS at or near the site action level or level of concern is recommended. The sample is analyzed by the instrument for the normal field analysis time and the results are recorded. The standard deviation for each dependent element is calculated. The relative standard deviation (RSD) of the sample mean can be used to calculate precision. The RSD should be within ±40% for the data to be considered adequately precise.

10.1.1 Preliminary Detection Limit (DL) and Quantitation Limit (QL)

A preliminary DL and QL is needed to give the operator an indication of the instrument's capability out in the field. A low or blank SSCS sample is selected as described in Section 7.1. More than one standard may be needed to obtain low or blank concentration values for each element. Alternatively, the Teflon blank may be used if a blank soil or sediment sample is unavailable.

The sample is measured ten times without moving it using the anticipated field analysis measuring time. The standard deviation of the mean for each target element is calculated (using the N-1 formula).

If the standard deviation has a fractional component round up to the next whole number prior to calculating the DL and QL.

The definition of the DL is three times the calculated standard deviation value.

The definition of the QL is 10 times the calculated standard deviation value.

10.1.2 The Method Minimum Detection Limit (MMDL) and Method Quantitation Limit (MQL)

The MMDL and MQL are calculated from the measurement of a low SSCS selected as described in Section 7.1 at the start and end of sample analysis and after approximately every tenth sample (a daily total of seven measurements is recommended).

Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the SSCS using the same analysis, measuring time used for the samples. Enable the display thresholds prior to analyzing the next sample.

The standard deviation of the mean for each target element is calculated. If the standard deviation has a fractional component round up to the next whole number prior to calculating the MMDL and MQL.

The definition of the MMDL is three times the calculated standard deviation value.

The definition of the MQL is 10 times the calculated standard deviation value.

10.2 Reporting Results

All raw XRF data should be reported including the individual results of multiple analyses of samples and sampling points. The average and concentration range of each multiple analysis should also be reported.

A "reported" value for each analysis or average of multiple analyses should be processed in the following manner.

1. Round the value to the same degree of significance contained in the SSCS sample assay values (usually two) if the element's calibration has been adjusted (see Section 6.0).

2. Report all values less than or equal to the MMDL as not detected (ND).

3. Flag and note all values greater than the MMDL and less than or equal to the MQL as estimated (usually with a "J" next to the reported value).

4. Report all values above the MQL and within the linear calibration range (if the element's calibration has been adjusted (see Section 6.0).

5. Flag and note all values above the linear calibration range (greater than the highest SSCS used in the calibration adjustment procedure) with a "*" next to the reported value.

10.3 Accuracy

Accuracy, relative to a specific digestion method and elemental analysis procedure is determined by confirmation of the XRF sample result (prepared sample cups may be submitted) with AA or ICP analysis.

To do a total accuracy check, confirmation samples should be collected throughout the entire sampling effort. A minimum of 10% of the samples should be collected including a number of samples at or near the action level. The results of the metal analysis (dependent) and the XRF analysis (independent) are evaluated with a regression analysis. The correlation coefficient (r^2) should be 0.7 or greater. All XRF results should be presented along with an estimate of the error based on confirmation analyses.

Another very important source of potential difference between XRF and AA or ICP results is incomplete digestion employed prior to ICP or AA analyses. Since XRF is a total elemental technique, any comparison with referee results must account for the possibility of variable extraction depending upon the extraction method used and its ability to dissolve the mineral form in question.

10.3.1 Matrix Considerations

Other types of QA/QC verification should include verification that the instrument calibration is appropriate for the specific site to be assessed. This includes verification of potential multiple soil matrix types that may exist at a site. Matrix variations that affect the XRF measurement include large variations in calcium content such as may be encountered when going from siliceous to calcareous soils as well as variations in iron content.

11. DATA VALIDATION

11.1 Confirmation Samples

Confirmation samples are recommended at a minimum rate of 10%. Ideally, the sample cup that was analyzed by XRF should be the same sample that is submitted for AA/ICP analysis. When confirming an in-situ analysis, collect a sample from a 6 inch by 6 inch area for both an XRF measurement and confirmation analysis. The correlation coefficient between XRF and AA/ICP data should be 0.7 or greater.

11.2 Recording Results

Record all results and monitoring activities in a laboratory or field notebook. Alternatively, record results electronically on a hard drive or floppy disk.

12. HEALTH AND SAFETY

When working with potentially hazardous materials follow USEPA, OSHA, GAI and/or any other applicable health and safety practices.

13. REFERENCES

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STANDARD OPERATING PROCEDURE 24

SEDIMENT, EVAPORITE, AND PRECIPITATE SAMPLING

The following procedures are to be used to collect the following types of samples associated with ephemeral or intermittent washes: 1) sediment, including overbank sediment/soil, 2) evaporite, and 3) precipitate. Sediment is defined as unconsolidated mineral material located in normally dry channels and tributaries. Overbank sediment/soil is defined as mineral material that originated in a channel but has been transported to an overbank by wind and/or floods where it may have mixed to some degree with existing soil. Evaporite is defined as amorphous or slightly crystallized solid material that forms on sediment as a result of evaporation of baseflow or shallow ground water. Precipitate forms presumably as a result of the mixing of two different quality waters.

These procedures may be modified in the field, based on field and site conditions after appropriate annotations have been made in the bound field log book. These procedures are not to be used when sampling for volatile organic compounds.

Sediment Sampling

Locate the transect as shown in the Field Sampling Plan (FSP). Each channel, tributary, or overbank sample is a composite of six subsamples.

Layout each channel transect as follows:

1. Locate six, approximately evenly spaced, sampling points along a transect perpendicular to the channel (i.e., a cross section). Avoid locating sampling points in standing or flowing water. Measure the distance from point-to-point, as well as the total width of the channel.
2. Identify each sampling point with a pin flag labeled alphabetically from A to F. Sampling point A is located near the left bank when looking downstream
3. Read coordinates at sampling point A with a field Global Positioning System (GPS); reference point A to a local landmark and obtain a compass bearing in the direction of the transect.
4. Record all information on the Location Data Form along with a sketch of the location.

Layout each tributary transect as follows:

1. Locate six sampling points at the spacing defined in the FSP within and parallel to the tributary banks. Start the transect far enough upstream from the confluence with the main channel to avoid any backwater effects from the main channel. Measure the distance from point-to-point, as well as the total length of the transect.
2. Identify each sampling point with a pin flag labeled alphabetically from A to F. Sampling point A is located at the downstream end of the transect.
3. Read coordinates at sampling point A with a field GPS; reference point A to a local landmark and obtain a compass bearing in the direction of the transect.
4. Record all information on the Location Data Form along with a sketch of the location.

Layout each overbank transect as follows:

1. Locate five sampling points on each overbank (i.e., a total of 10 sampling points) along a transect perpendicular to the channel and floodplain (i.e., a cross section) at the spacing defined in the FSP. Start the transect layout approximately from the centerline of the channel. Measure the distance from point-to-point, as well as the total length of the transect.
2. Identify each sampling point with a pin flag labeled alphabetically from A to J. Sampling point A is located on the left-most point of the left overbank when looking downstream
3. Read coordinates at sampling point A with a field GPS; reference point A to a local landmark and obtain a compass bearing in the direction of the transect.
4. At each sampling point, layout a five-foot diameter circle centered on the sampling point. At six approximately evenly spaced points on that circle, identify sub-sampling points with pin flags.
5. Record all information on the Location Data Form along with a sketch of the location.

In the field, collect each sediment sample as follows:

1. At each sampling point (or sub-sampling point in the case of an overbank transect), place the center of the 3x3 ft grid at the pin flag. Place the appropriate sampling point placard (e.g., A), as well as the location number placard, next to the grid and photograph. Record the photograph number on the Sampling Point Data Form and describe the surface within the 3x3 ft grid as follows:

a) Percentage of the particle size distribution (>6, 3-6, 3/4-3, <3/4 in).

b) Percentage of organic matter.

c) Percentage of evaporite or precipitate.

d) Color (visual estimation), crusting, cementation, compaction, moisture condition, and any other relevant information.

2. Wear clean gloves while sampling.

3. Lay out a clean sheet of plastic and anchor corners as necessary.

4. At each sampling point:

   a) Using clean equipment (e.g., shovel, geologist's pick, or spatula as necessary), excavate a hole six inches deep or to bedrock, whichever is encountered first.

   b) Collect ½ pint (250 ml) in a clean measuring cup from approximately equal portions with depth along the side of the hole; manually discard all particles larger than approximately ½ inch while collecting the sediment.

   c) Empty the subsample onto the plastic sheet and spread out in order to air dry.

   d) Describe the subsample on the Sampling Point Data Form, using the same information as listed in Step 1, a to d, as appropriate.

5. Repeat Step 4 for each sampling point.

6. Once all samples are laid out on the plastic sheet in separate piles with their respective placards, as well as the location number placard, photograph the plastic sheet and samples. Record the photograph number on the Sampling Point Data Form.

7. Composite the samples by picking up the corners of the plastic sheet and mixing the sediment. Pour the composite sample into a 2 L container.

At the office or field laboratory, process each sediment sample as follows:

1. Wear clean gloves while handling each sample.

2. Empty the sample from the 2 L container into a clean tray. Continue air drying, if necessary.

3. Cone and quarter the sample in the tray.

4. Use one quadrant for field parameters (i.e., paste pH and EC). Measure paste pH and EC per SOP 26, "Field Laboratory Determination of Soil pH". Discard any unused sediment from that quadrant. Record the field parameters on the Location Data Form.

5. Use a second quadrant to fill an 8-oz jar (250 ml) for laboratory analysis. Prepare quality assurance samples (i.e., field blank duplicates) at this time. Discard any unused sediment from that quadrant. Assign sample numbers and initiate chain-of-custody at this time.

6. Return the remaining two quadrants to the 2 L container for archiving.

Evaporite Sampling

Locate the sampling site as shown in the FSP. Each evaporite sample is a discrete sample collected at single sampling point.

Layout the sampling point as follows:

1. Select a representative sampling point based on color, thickness, appearance, etc. of the evaporite in the vicinity of the sampling site.

2. Mark the sampling point with a pin flag.

3. Read coordinates with a field GPS; reference the sampling point to a local landmark.

4. Record all information on the Location Data Form along with a sketch of the location.

In the field, collect each evaporite sample as follows:

1. Place the center of the 3x3 ft grid at the pin flag. Place the appropriate location number placard next to the grid and photograph. Record the photograph number in the Sampling Point Data Form and describe the surface within the 3x3 ft grid as follows:

    a) Percentage of the particle size distribution (>6, 3-6, 3/4-3, <3/4 in).

    b) Percentage of organic matter.

    c) Percentage of evaporite or precipitate.

d) Color (visual estimation), crusting, cementation, compaction, moisture condition, and any other relevant information.

2. Wear clean gloves while sampling.

3. Use a clean, stainless steel spoon, trowel, or spatula as appropriate. Scrape evaporite from the sediment surface and fill a 4-oz glass jar. Avoid collecting sediment, organic matter, or other foreign material to the extent possible.

4. Assign sample numbers and initiate chain-of-custody at this time.

After collecting the evaporite sample, collect a sample of the underlying sediment per Steps 1 through 7 in the section on Sediment Sampling. Process the sediment sample per Steps 1 through 6 in the section on Sediment Sampling.

Precipitate Sampling

Locate the sampling site as shown in the FSP. Each precipitate sample is a discrete sample collected at single sampling point.

Layout the sampling point as follows:

1. Select a representative sampling point based on color, thickness, appearance, etc. of the precipitate in the vicinity of the sampling site.

2. Mark the sampling point with a pin flag.

3. Read coordinates with a field GPS; reference the sampling point to a local landmark.

4. Record all information on the Location Data Form along with a sketch of the location.

In the field, collect each precipitate sample as follows:

1. Wear clean gloves while sampling.

2. Use a clean, stainless steel spoon, possibly with small holes in it, or spatula, as appropriate. Scoop precipitate from the water and allow free water to drain before placing in the precipitate in the sample jar. Fill a 4-oz glass jar. Avoid collecting sediment, organic matter, or other foreign material to the extent possible.

3. Assign sample numbers and initiate chain-of-custody at this time.

Procedures Common to All Sediment, Evaporite, and Precipitate Sampling

The following procedures are common to all sediment, evaporite, and precipitate sampling:

1. Collect quality assurance samples per SOP 3, "Field Quality Control".
2. Number sample jars per SOP 1, "Field Document Control".
3. Complete all documentation per SOP 2, " Field Logbook and Field Data Sheets".
4. Prepare the chain-of-custody per SOP 4, "Sample Custody Procedures".
5. Ship samples per SOP 5, "Packaging and Shipping of Environmental Sample Containers".
6. Decontaminate sampling and/or processing equipment per SOP 6, "Decontamination of Equipment Used to Sample Soil and Water".

Equipment List for Field Sampling

Location and sampling point placards
Sample jars (2 L and 4-oz)
Plastic sheets
Shovel/geologist pick
Stainless steel spatulas and spoons
Pin flags
Gloves
Measuring wheel and/or measuring tape
Decon equipment per SOP 6
3x3 ft grid
Marking pens
Camera/film
Compass
Sample labels
Field GPS
Coolers
Data forms/logbook
Shipping supplies per SOP 5

SOP 24 SEDIMENT, EVAPORITE, AND PRECIPITATE SAMPLING

Location Data Form

CMC Document Number:

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Personnel: Date: Time:

Location:

Orientation from Point A:

Length from Point A: ft

GPS Location: Lat. N:

Long. E:

Elevation ft

Distances:

Point A to B: ft

Point B to C: ft

Point C to D: ft

Point D to E: ft

Point E to F: ft

SVL ID No

Field Parameters:

Paste pH

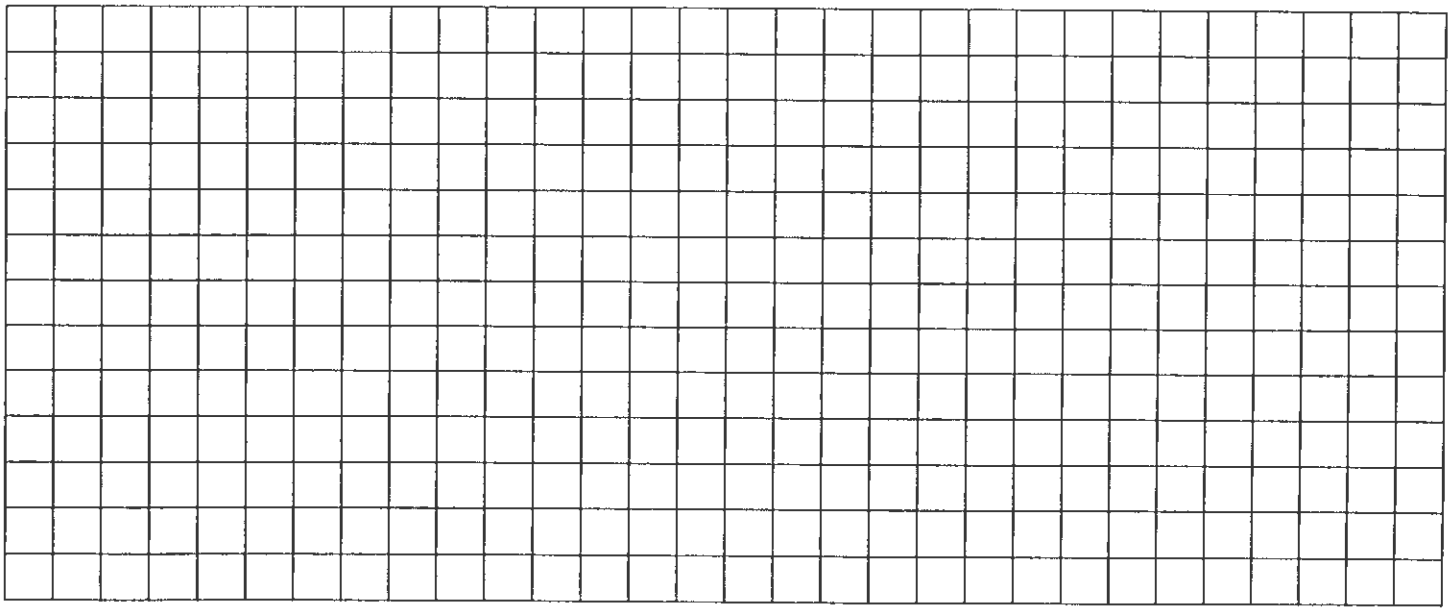
Temp. (°C)

Uncorr. EC (umhos/cm)

Photograph Information:

Location Description:

Location Figure (Scale: 1 unit = _ft) Indicate NorthIndicate Flow Direction Use Ball & Arrow with number for Photographs



Reviewed By: Name and Date

SOP 24 SEDIMENT, EVAPORITE, AND PRECIPITATE SAMPLING
Sample Point Data Form

CMC Document Number: _____ Location: _____ Page _____ of _____

Sample Point A Description:

Surface (grid):	% > 6"	% O.M.	Sample:	% > 6"	% O.M.
	%3 - 6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3"	% Prec.
	%¾ < "	Color		%< ¾"	Color

Sample Point B Description:

Surface (grid):	% >6"	% O.M.	Sample:	% > 6"	% O.M.
	% 3-6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3	% Prec.
	% <¾ "	Color		%< ¾"	Color

Sample Point C Description:

Surface (grid):	% > 6"	% O.M.	Sample:	% > 6"	% O.M.
	% 3- 6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3"	% Prec.
	% <¾ "	Color		%< ¾"	Color

Sample Point D Description:

Surface (grid):	% > 6"	% O.M.	Sample:	% > 6"	% O.M.
	% 3- 6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3"	% Prec.
	% <¾ "	Color		%< ¾"	Color

Sample Point E Description:

Surface (grid):	% > 6"	% O.M.	Sample:	% > 6"	% O.M.
	% 3- 6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3"	% Prec.
	% <¾ "	Color		%< ¾"	Color

Sample Point F Description:

Surface (grid):	% > 6"	% O.M.	Sample:	% > 6"	% O.M.
	% 3- 6"	% Evap.		% 3 - 6"	%Evap.
	%¾ -3"	% Prec.		% ¾ - 3"	% Prec.
	% <¼ "	Color		%< ¾"	Color

Reviewed by: Name and Date

STANDARD OPERATING PROCEDURE 25

INSTALLATION AND DEVELOPMENT OF SHALLOW GROUND-WATER MONITOR WELLS

The following procedures are to be used to install monitor wells to collect shallow ground-water samples from stream channels near the contact between the channel sediment and the underlying bedrock. The thickness of the saturated zone at the contact may vary rapidly with time, particularly in response to infiltrating runoff. The collection of shallow ground-water samples may require either vertical wells or horizontal wells, depending on the geometry of the channel cross-section. At locations where the saturated zone is thin (e.g., one or two feet), a horizontal well may provide a greater volume of sample and a more representative sample across the channel cross-section than a vertical well. Shallow ground-water monitor wells may be installed by drilling or trenching, depending on geometry of the channel cross-section and accessibility to the site. Monitor well locations are described in the Field Sampling Plan (FSP).

These procedures may be modified in the field, based on field and site conditions after appropriate annotations have been made in the bound field log book. These procedures are not to be used for deep ground-water monitor wells. Well installation and development should be documented in the field log book and the attached forms, as appropriate.

Materials and Design for Wells

The following materials and design are for shallow wells in stream channels. Figures 25-1 and 25-2 show the typical design of a vertical and horizontal monitor well, respectively. Note that an annular seal (e.g., bentonite) around the riser is not needed because these wells will be installed in permeable channel sediment where there is rapid hydraulic communication between the channel surface and the saturated zone perched on the bedrock contact.

Filter Pack

1. Typically, 10/20 silica sand is usually appropriate for the filter pack.

2. Do not select too fine a filter pack because this will reduce the yield of the well, causing longer sampling times.

3. Uniformity coefficients for filter pack materials should range from 1 to 3.

4. All filter pack material should be purchased from reputable suppliers who have properly cleaned and bagged the material.

5. To prevent downward migration into the screen, the filter pack is extended at least 1 to 2 feet above the top of the screen for vertical wells.

Well Screen

1. The well screen should be new, machine-slotted or continuous wrapped wire-wound, and composed of materials that are inert to the subsurface water being tested. Table 1 lists the advantages and disadvantages of several common screen materials.

2. The well screen material should be certified by the manufacturer as clean. If not certified by the manufacturer as clean, then the well screen should be steam cleaned or high-pressure water cleaned (if appropriate for the selected well screen materials) with water from a source of known chemistry immediately prior to installation.

3. The screen should be plugged at the bottom with the same material as the well screen.

4. The minimum nominal internal diameter of the well screen should be chosen based on the criteria that it will permit effective development and rapid sample recovery. In most instances, a minimal diameter of 2 inches is needed to allow for the introduction and withdrawal of sampling devices.

5. The slot size of the well screen should retain filter pack or natural formation, as well as permit efficient development of the well.

Riser

1. The riser should be new and composed of materials that are inert to the subsurface water being tested. Table 1 lists the advantages and disadvantages of riser materials.

2. The riser material should be certified by the manufacturer as clean. If not certified by the manufacturer as clean, then each section of the riser should be steam cleaned or high-pressure water cleaned (if appropriate for the selected material) using water from a source of known chemistry immediately prior to installation.

3. The minimal nominal internal diameter of the riser should be chosen based on the criteria that it will permit effective development and rapid sample recovery. In most instances, a minimum of 2 inches is needed to accommodate sampling devices.

4. Threaded joints are recommended. Alternatively, O-rings composed of materials that will not affect the subsurface water being sampled may be used.

Temporary Casing

1. The temporary casing material should be new and composed of materials that are inert to the subsurface water being tested. Table 1 lists the advantages and disadvantages of casing materials.

2. The casing material should be certified by the manufacturer as clean. If not certified by the manufacturer as clean, then the casing material should be steam cleaned or high-pressure water cleaned (if appropriate for the selected material) using water from a source of known chemistry immediately prior to installation.

3. The material type and minimum wall thickness of the casing should be adequate to withstand the forces of installation.

4. The diameter of the temporary casing for filter-packed wells should be selected so that a minimum annular space of 2 inches is maintained between the inside diameter of the casing and the outside diameter of the riser.

5. The ends of each casing section should be either flush-threaded or beveled for welding.

Monitor Well Installation (ASTM D 5092-90)

Shallow ground-water monitor wells can be installed by drilling or trenching. Vertical wells can be installed by either drilling or trenching, but horizontal wells can be installed only by trenching. Trench dewatering may be required in order to install a well at some locations.

General steps for installing a monitor well, whether by trenching or drilling, are as follows:

1. A stable borehole or trench must be constructed prior to installing the monitor well casing, screen and riser.

2. The well casing, screen, riser, and bottom plug materials should either be certified by the manufacturer as clean or should be cleaned with a steam cleaner or high-pressure water combined with a low-sudsing soap or detergent.

3. Working components of the drilling rig (e.g., drill pipe, subs, collars, belly, and all parts of the rig chassis near the borehole) or backhoe should be cleaned as described in step number 2.

4. All plastic screens and casing should be joined by threads and couplings or flush threads to prevent contamination from solvent glues.

5. A well completion diagram should be drawn in the field logbook as an ongoing process during the installation of the monitor well.

Installation of a Vertical Well by Drilling

General steps for installing a vertical monitor well by drilling are as follows:

1. The well screen and riser assembly are lowered to the predetermined level and held in position by a ballast or hydraulic arms. The assembly must be installed straight with the appropriate centralizers.

2. The riser should extend above grade and be capped temporarily to prevent entrance of foreign materials during completion operations.

3. The volume of filter pack (gravel and/or silica sand) required to fill the annular space between the well screen and borehole should be estimated and measured during installation.

4. The filter pack is placed in the annulus from the bottom of the borehole up to 2 to 5 feet above the well screen.

5. If used, the temporary casing or hollow stem auger is withdrawn, usually in stipulated increments. Care should be taken to minimize lifting the well assembly with the withdrawal of the temporary casing/augers. To limit borehole collapse in unconsolidated materials, the temporary casing/augers is usually withdrawn until the lowest point on the temporary casing/augers is at least 2 feet, but no more than 5 feet, above the filter pack.

6. The remaining stemming material can consist of channel-fill material. Large, angular rocks should be removed to prevent damage to the casing/riser.

Installation of a Vertical Well by Trenching

General steps for installing a vertical monitor well by trenching are as follows:

1. A temporary outer casing (e.g., 6 inch PVC) should be lowered into the trench so that it is vertical and resting on the trench bottom. Channel material should be placed around the base to hold the casing in place (e.g., approximately a one-foot lift). Brace the temporary casing with ropes or 2x4's, if appropriate.

2. Using the backhoe, suspend the well screen and riser assembly inside the temporary casing at the predetermined level and hold it straight with centralizers or other bracing.

3. The riser should extend above grade and be capped temporarily to prevent entrance of foreign materials during completion operations.

4. Place the filter pack and backfill within the temporary casing as described under the section on installation of vertical wells by drilling.

5. Using channel fill material, backfill around the temporary casing in lifts. Raise the temporary casing in increments less than the lift thickness, taking care to not let the filter pack spill out.

Installation of a Horizontal Well by Trenching

General steps for installing a horizontal monitor well by trenching are as follows:

1. The horizontal slotted pipe, with slots face up, and riser pipe should be bedded at the predetermined level on fine sediment, which can be either sieved channel-fill material or filter pack material. The horizontal slotted pipe should be bedded to approximately one-third of its diameter. The horizontal pipe should be sloped towards the riser (1V:20H, typical) to allow the water to collect in the riser.

2. The riser should extend above grade and be capped temporarily to prevent entrance of foreign materials during completion operations.

3. The volume of filter pack (gravel and/or silica sand) required should be estimated and measured during installation.

4. A temporary stemming form should be placed along the horizontal slotted pipe to place the filter pack. This stemming form can be two pieces of wood, approximately one foot high by the length of the horizontal slotted pipe, braced approximately one foot apart. After the horizontal slotted pipe is properly bedded, the form should be placed over the pipe and the filter pack material added to the appropriate thickness. A lift of backfill, with large rocks removed, should be placed over the filter pack material to protect the filter pack.

5. Backfill should be placed in lifts around the form while gradually removing the form. Care should be taken to minimize lifting the well assembly when withdrawing the stemming form. The remaining backfill material can consist of channel-fill material, but large, angular rocks should be removed to prevent damage to the casing/riser.

Monitor Well Protection

Well protection refers specifically to installations made at the ground surface to deter unauthorized entry to the monitor well. Typically a concrete pad, protective shroud with a lock,

and vented cap are placed on monitor wells. In areas where there is a high probability of damage to the well (high traffic, heavy equipment, poor visibility), it may be necessary to enhance the normal protection of the monitor well through the use of posts, markers, signs, etc.

Monitor Well Development

The purpose for developing a well (ASTM D 5092) is to:

- Remove fine-grained material from the well screen and filter pack that may otherwise interfere with water quality analyses.
- Restore the ground-water properties disturbed during the construction process; and
- Improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the screened interval.

In general, the shallow ground-water monitor wells should be developed by over pumping, back washing, surging, or a combination of these methods. The riser can be bailed or pumped (i.e., over pumping) thereby pulling water through the filter pack. Alternatively, water can be added to or pumped into the riser, assuming enough head is available to push the water out through the filter pack (i.e., back washing). Surging can be accomplished by turning the pump on and off or plunging the bailer up and down in the riser. Using more than one method is recommended to prevent bridging in the filter pack. The well development method, or methods, should be documented in the field logbook.

An important factor in any method of well development is that the work be started slowly and gently and be increased in vigor as the well is developed. Most methods require the application of sufficient energy to disturb the filter pack, thereby freeing the fines and allowing them to be drawn into the well. The coarser fractions then settle around and stabilize the screen.

Because the saturated zone in the channel fill may be thin and water may be limited, a portable water source (e.g., 55 gal drums) may be required. At least three well volumes (screen and filter pack) of water should be available, although more may be advisable given probable losses to the coarse channel fill.

Development should be continued until representative water, free of the drilling fluids, cuttings, or other materials introduced during well construction is obtained. Representative water is assumed to have been obtained when pH, temperature, and specific conductivity readings stabilize and the water is visually clear of suspended solids. The minimum duration of well development will vary according to the method used to develop the well. The duration of well development and the pH, temperature, and specific conductivity readings should be recorded in the field logbook.

References

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, D.M. Nielson, and J.E. Denne (1989). Handbook Of Suggested Practices for the Design and Installation of Ground-Water Monitoring Well Design And Installation. Dublin, OH: National Well Water Association, pp. 398.

Arizona Department of Water Resources (Undated). Well Construction and Licensing of Well Drillers, Handbook.

ASTM (1990). Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers. Standard D 5092-90. Philadelphia, PA.

Driscoll, F.G (1986). Groundwater and Wells. St. Paul, MN: Johnson Division, pp. 1089.

EPA (1986). RCRA Ground-Water Monitoring Technical Enforcement Guidance Document. Washington, D.C: U.S. EPA, pp. 208 and 3 Appendices.

Table 1. Comparisons of Well Casing, Screen, and Riser Materials

Type	Advantages	Disadvantages
Stainless steel	•Least absorption of halogenated and aromatic hydrocarbons •High strength at a great range of temperatures •Excellent resistance to corrosion and oxidation •Readily available in all diameters and slot sizes	•Heavier than plastics •May corrode and leach some chromium in highly acidic waters •May act as a catalyst in some organic reactions •Screens are higher priced than plastic screens
PVC (Polyvinyl-chloride)	•Lightweight •Excellent chemical resistance to weak alkalies, alcohols, aliphatic hydrocarbons, and oils •Good chemical resistance to strong mineral acids, concentrated oxidizing acids, and strong alkalies •Readily available •Low priced compared to a stainless steel and Teflon	•Weaker, less rigid, and more temperature sensitive than metallic materials •May adsorb some constituents from ground water •May react with and leach some constituents from ground water •Poor chemical resistance to ketones, esters, and aromatic hydrocarbons
Teflon	•Good resistance to attack by most chemicals •Lightweight •High impact strength	•Screen slot openings may decrease in size over time •Tensile strength and wear resistance low compared to other engineering plastics •Expensive relative to other plastics and stainless steel
Mild steel	•Strong, rigid; temperature sensitivity not a problem •Readily available	•Heavier than plastics •May react with and leach some constituents into ground water

Table 1. Comparisons of Well Casing, Screen, and Riser Materials

Type	Advantages	Disadvantages
Mild steel (cont.)	•Low priced relative to stainless steel and Teflon	•Not as chemically resistant as stainless steel
Polypropylene	•Lightweight •Excellent chemical resistance to mineral acids •Good to excellent chemical resistance to alkalies, alcohols, ketones, and esters •Fair chemical resistance to concentrated oxidizing acids, aliphatic hydrocarbons, and aromatic hydrocarbons •Low priced compared to stainless steel and Teflon	•Weaker, less rigid, and more temperature sensitive than metallic materials •May react with and leach some constituents into ground water •Poor machinability--it cannot be slotted because it melts rather than cuts
Kynar	•Greater strength and water resistance than Teflon •Resistant to most chemicals and solvents •Lower priced than Teflon	•Not readily available •Poor chemical resistance to ketones, acetone

(After Driscoll, 1986)

SOP 25 INSTALLATION AND DEVELOPMENT OF SHALLOW GROUND-WATER MONITOR WELLS

HISTORY OF HOLE

JOB NO_____ SHEET_____OF_____

GEOLOGIST_____DATE_____BORING NO._____
DRILLER_____SURFACE ELEVATION_____WEATHER_____TEMP._____°F
CONTRACTOR_____DRILL FLUID_____DEPTH _____TO_____
LOCATION_____TYPE OF BARREL_____CASING SIZE_____CORE SIZE_____

BEGINNING OF SHIFT	END OF SHIFT
TIME_____DEPTH OF HOLE_____	TIME_____HRS.PRODUCTIVE_____HRS DELAYED_____
DEPTH TO WT.___DEPTH TO CASING_____	DEPTH OF HOLE_____DEPTH OF CASING_____DEPTH TO WT__

CHECKED BY:

SOP 25 INSTALLATION AND DEVELOPMENT OF SHALLOW GROUND-WATER MONITOR WELL

MONITORING WELL INSTALLATION LOG

JOB NO.___ LOCATION _____ WELL NO._____ SHEET ___ OF_____

DRILLING METHOD_____ GROUND ELEV. _____ WATER DEPTH_____

WEATHER_____ DRILLING COMPANY_____ COLLAR ELEV. _____ DATE/TIME_____

TEMP_____ DRILL RIG_____ DRILLER_____ STARTED ____ COMPLETED_____

MATERIALS INVENTORY

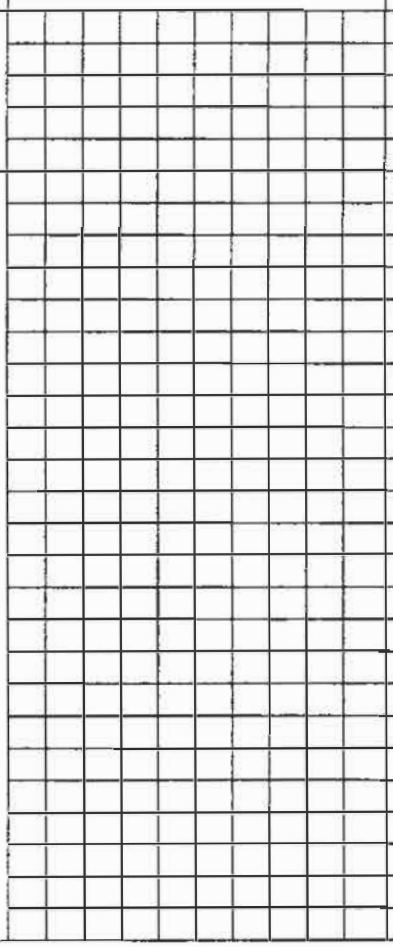
WELL CASING_____ WELL SCREEN_____ ANNULAR SEAL_____

CASING TYPE_____ SCREEN TYPE_____ INSTALLATION METHOD_____

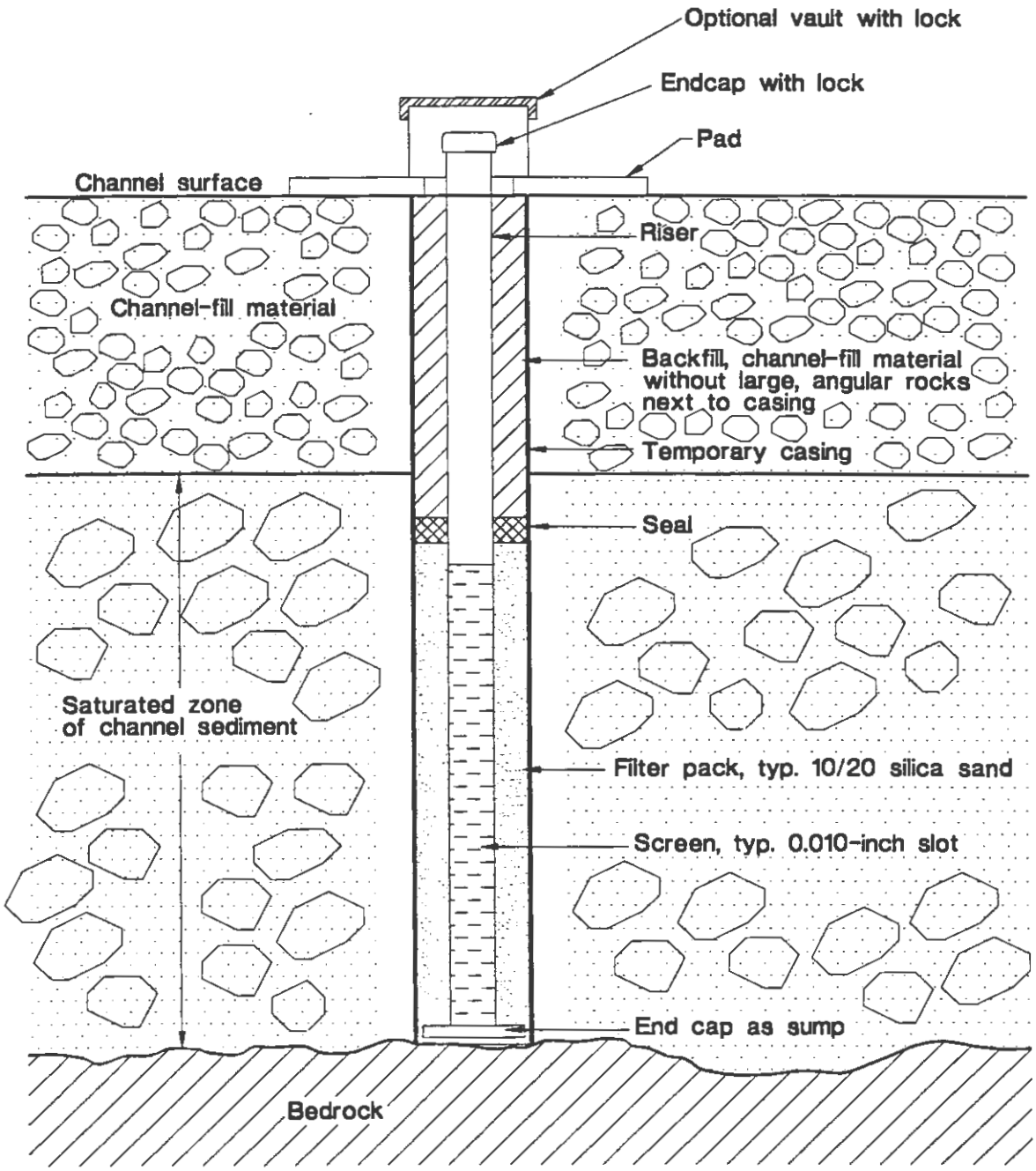
JOINT TYPE_____ SLOT SIZE_____ FILTER PACK QTY._____

GROUT QTY._____ CENTRALIZERS_____ FILTER PACK TYPE_____

GROUT TYPE_____ INTSTALLATION METHOD_____

ELEV./ DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE		WELL DEVELOPMENT NOTES

OP/5115/51151100.DWG

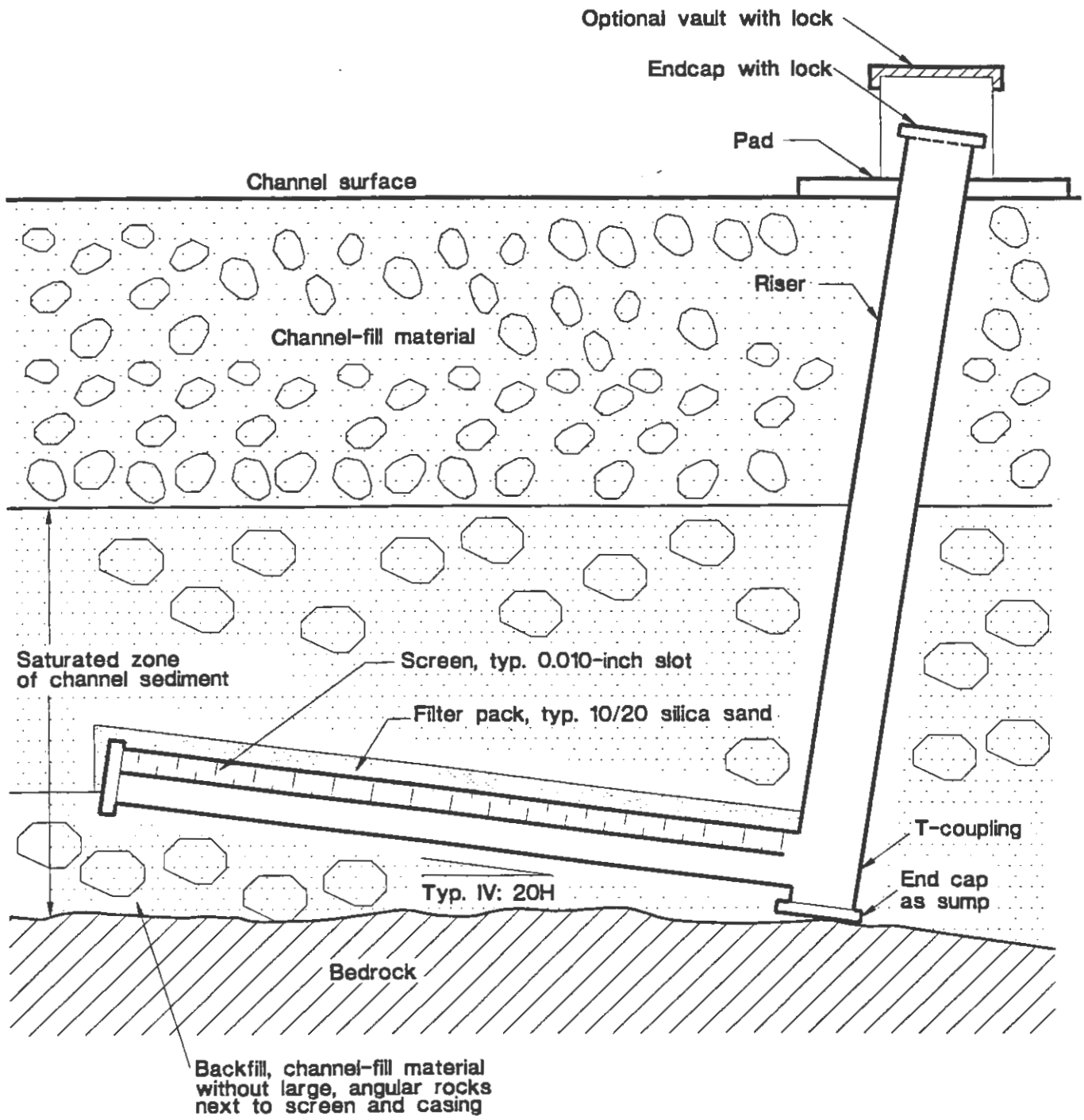


Not to scale

Golder Associates

DANIEL B. STEPHENS & ASSOCIATES, INC.
ENVIRONMENTAL SCIENTISTS & ENGINEERS

FIGURE 28-1
Typical Vertical Monitor Well Design



Not to scale

Golder Associates

DANIEL B. STEPHENS & ASSOCIATES, INC.
ENVIRONMENTAL SCIENTISTS & ENGINEERS

FIGURE 28-2
Typical Horizontal Monitor Well Design

STANDARD OPERATING PROCEDURE NO. 26
FIELD LABORATORY DETERMINATION OF SOIL pH

MATERIALS REQUIRED

1. Orion pH meter [refer to SOP-11 for calibration and operating procedures]

2. pH probes and pH 4, pH 7 and pH 10 buffer solutions

3. Hard plastic spoons (teaspoon size, two minimum)

4. Glass stirring rods (two minimum)

5. 50-milliliter (ml) sample beaker (or disposable cup) with lid. Quantity depends on number of samples.

6. Deionized/distilled (DI/DS) water (two liters minimum)

7. 0.01 M $CaCl_2$ (1.47 grams $CaCl_2$ x 2 H_2O/liter = 2 liters minimum)

8. Paper towels

FIELD LABORATORY PROCEDURES

1. Place approximately 1 teaspoon (about 10 grams) of soil sample in sample beaker.

2. Add about 20 ml of 0.01 M $CaCl_2$ into beaker.

3. Stir with glass rod to make slurry. (Clean glass rod with DI/DS water prior to preparing another soil sample).

4. Attach lid to beaker and shake vigorously.

5. Let beaker stand until sediment has settled. (This will take about 5 minutes for sandy samples to 30 minutes for clayey samples.)

6. Calibrate pH meter according to procedures outlined in SOP-11.

7. Immerse clean pH probe in the "clean" solution. Gently move the probe up and down without disturbing the sediment.

8. Record pH value of solution in field log book when stabilized.

9. Decontaminate pH probe (SOP-11) and continue on to next sample.

Reference:

Manual on Soil Sampling and Methods of Analyses, 2nd edition, 1978, prepared by Subcommittee) on Method of Analysis, J.A. McKeague, Ed.

APPENDIX C

LABORATORY QUALITY ASSURANCE PLAN AND LIST OF STANDARD OPERATING PROCEDURES

QAP

QUALITY ASSURANCE PLAN

SVL ANALYTICAL, INC.

One Government Gulch
P.O. Box 929
Kellogg, ID 83837

1-800-597-7144

SVL ANALYTICAL

QUALITY ASSURANCE PLAN

SVL ANALYTICAL
One Government Gulch
P.O. Box 929
Kellogg, Idaho 83837

November 4, 1996

Blake Johnson

LAB DIRECTOR'S SIGNATURE

11/8/96

REVIEW DATE

This Quality Assurance Plan is subject to periodic revision. In these revisions, consideration is given to the needs and wishes of both the current clients and SVL Analytical, Inc. (SVL). SVL may be required to conduct previously unanticipated analyses or to evaluate unanticipated analytical parameters. In this case, the methods selected shall be from documented, published methods which insure reproducible data of known quality.

TABLE OF CONTENTS

I. INTRODUCTION

This manual is issued to describe the quality assurance program (QAP) utilized at SVL Analytical, Inc. (SVL). This program has the unqualified support of SVL Analytical management as well as the agreement, acceptance and adherence of the laboratory staff.

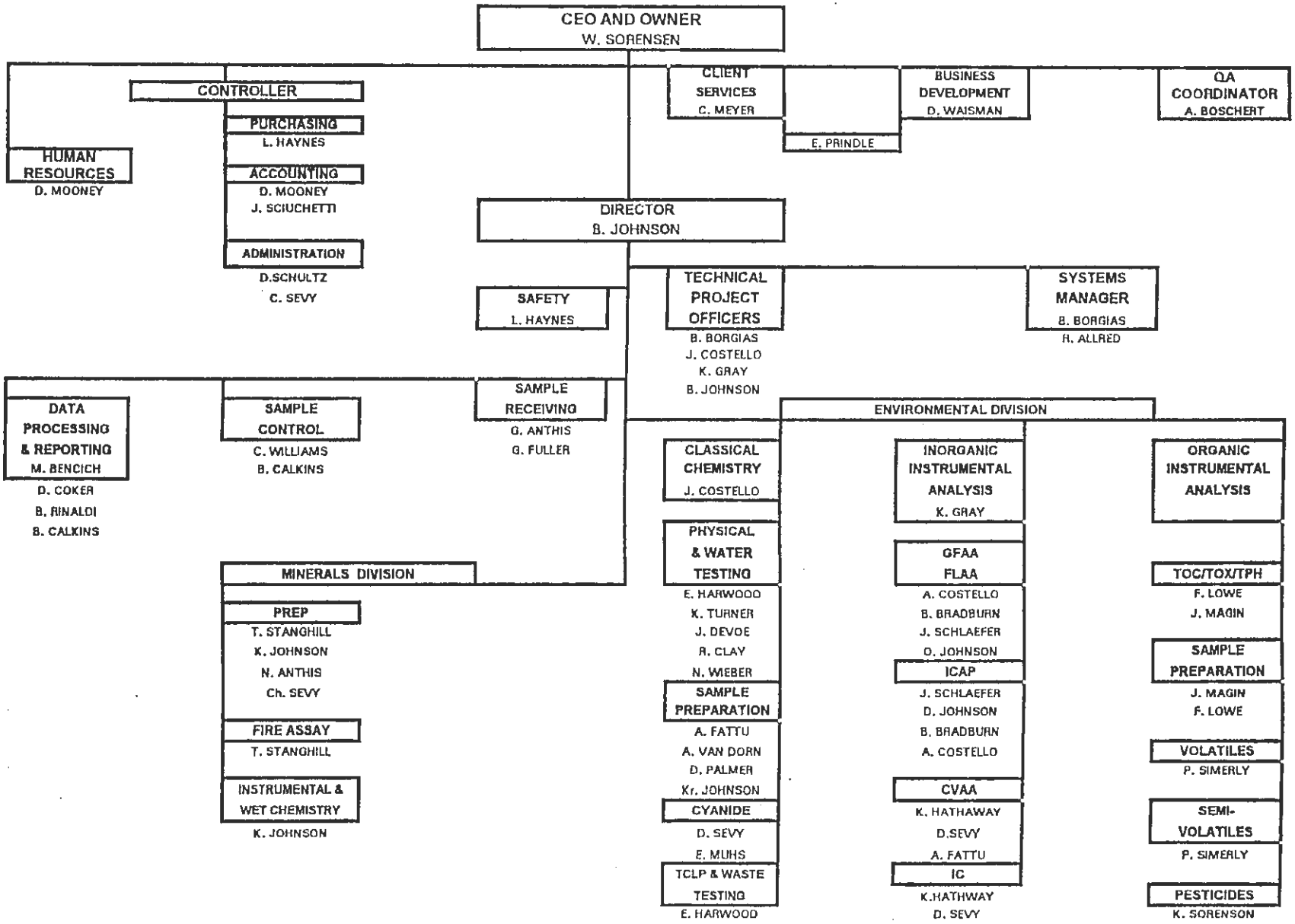
SVL is an analytical laboratory specializing in the performance of tests and parameters used in the characterization of environmental and mining samples. Since 1972, SVL has analyzed water, soil, sediment, sludge, oil, paint, rock, fish and other animal tissues, vegetation, air filters, and other sample types.

SVL occupies modern facilities specifically designed and organized to ensure an efficient mode of operation. The 25,000 square foot laboratory building has been modified to the specific needs of our large capacity analytical laboratory. Building access, security and safety features have been carefully considered. Access through the outside laboratory entrance and to internal areas is limited to laboratory and other essential personnel. Each laboratory division is plumbed and wired separately with easily accessible shut-off stations.

A. Organizational Chart

The organizational structure of SVL follows a traditional scheme of management with a few modifications. The CEO and owner is at the top of the chain of command followed by the lab director. The Quality Assurance, Marketing and business divisions report directly to the CEO; all other lab employees report to the director. A complete organizational chart which depicts the structure of SVL Analytical, Inc. is contained on the following page.

SVL Analytical, Inc.
ORGANIZATIONAL CHART



B. Key Personnel

Complete resumes follow in this Document; the listings below identify key personnel:

Position	Employee	Degree	Lab Experience
President:	Wayne Sorensen	BS 1962	29
Laboratory Director:	J. Blake Johnson	PhD 1969	13
Inorganic Laboratory Supervisor:	Kirby Gray	BS 1972	22
ICP Spectroscopist:	John Schlaefer	BS 1990	5
	Don Johnson	BA 1989	6
ICP Operator:	Ann Costello	BS 1971	11
	Bruce Bradburn	MS 1990	6
Atomic Absorption Operators:	Ann Costello	BS 1971	11
	John Schlaefer	BS 1990	5
	Bruce Bradburn	MS 1990	6
	Don Johnson	BA 1989	6
	Danny Sevy		10
Inorganic Sample Prep Specialist:	Eric Harwood	BS 1980	13
	Arlene Davis	BS 1975	7
	Alice Van Dorn		6
	Dean Palmer	BS 1979	1
Classical Chemistry Lab Supervisor:	Joe Costello		21
Classical/Cyanide Analysts:	Janice DeVoe	BS 1977	12
	Kathleen Turner	BS 1992	4
	Eric Muhs	BS 1993	3
	Ron Clay	BS 1989	5
	Nick Wieber	BA 1994	2
	Brenda Smits	BS 1996	1
Organic Laboratory Supervisor:			
Organic Laboratory Analysts:	Ken Sorenson	BS 1984	9
	Paula Simerly	MS 1992	7
	Eric Krueger	BS 1985	8
	Judy Magin		27
Quality Assurance Officer:	Anne Boschert	BS 1983	10
Technical Project Manager:	Jim Jarvis	BS 1987	8
Systems Manager:	Brandan Borgias	PhD 1985	12
Programmer Analysts:	Brandan Borgias		
	Russell Allred		14

Key Personnel For CLP Contract

Inorganic Laboratory Supervisor:	Kirby Gray
Quality Assurance Officer:	Anne Boschert
Systems Manager:	Brandan Borgias
Programmer Analysts:	Brandan Borgias Russell Allred
ICP Spectroscopist:	John Schlaefer Don Johnson
ICP Operator:	Ann Costello Bruce Bradburn
Atomic Absorption Operators:	Ann Costello John Schlaefer Bruce Bradburn Don Johnson Kevin Hathaway Danny Sevy
Inorganic Sample Prep Specialist:	Eric Harwood Arlene Davis Alice Van Dorn Dean Palmer
Classical Techniques (Cyanide) Analyst:	Janice DeVoe Kathleen Turner Erik Muhs Ron Clay Nick Wieber Brenda Smits
Technical Staff Redundancy:	Joe Costello

WAYNE R. SORENSEN

PROFESSIONAL EXPERIENCE:

1973 - Present	SVL Analytical, Inc. - Kellogg, ID President: Owner and founder of the laboratory. Administers company policies and formulates business strategies.
Oct 69 - Apr 73	The Bunker Hill Company-Kellogg, ID Supervised a large integrated mine, mill and smelter analytical laboratory and trained personnel.
Mar 68 - Oct 69	Kennecott Copper, Ray Mines Division Chief Chemist: Supervised an assay lab, trained assayers for new analytical methods and conducted applied research.
May 65 - Mar 68	Kennecott Copper, Western Mining Division Research Center Analytical Chemist: Analytical methods development and applied metallurgical research on copper.

EDUCATION:

1958-1962	Utah State University - Logan, Utah B.S. Chemistry (minor: mathematics, physics)
1965	Salt Lake Trade Tech - Basic Industrial Statistics
1968	Arizona State University- Modern Industrial Spectroscopy
1969	Arizona State University- Creative Management

PUBLICATIONS:

"A Study of Variables Affecting the Quality of Electrowon Copper" paper presented at the 1968 meeting of the Electrolytic Process Committee and the 1969 National AIME Conference.

Electrolyte circulation system for an electrolytic cell; patent applied for.

J. BLAKE JOHNSON

PROFESSIONAL EXPERIENCE:

Jan 90 - Present	SVL Analytical, Inc. Kellogg, ID. Laboratory Director: Manage and direct the activities of the Laboratory.
Aug 89 - Jan 90	Consultant--Spokane, Washington.
Jul 79 - Aug 89	Baroid Corporation--Houston, Texas. Director of Exploration and Property Management: Managed and directed all geological investigations, worldwide, and managed all domestic production properties.
Dec 78 - Jul 79	Assistant Director of Exploration.
Mar 73 - Dec 78	NL Industries--Golden, Colorado Chief Geochemist: Planned and implemented all geochemical investigations, worldwide.
Feb 72 - Mar 73	Geosensors--Spokane, Washington Geochemist: Investigated the relationships between airborne radiometric data and uranium deposits and petroleum reservoirs.
Jun 69 - Feb 72	Vanguard Exploration--Spokane, Washington Geochemist: Performed laboratory and field investigations as applied to mineral exploration.
Summers 65 - 68	The Bunker Hill Company--Kellogg, ID Research Metallurgist: Performed lab and pilot-scale extractive metallurgical research.

EDUCATION:

1967-1969	University of Idaho--Moscow, ID Ph.D. Geology (minor-Chemistry)
1963-1967	Whitworth College--Spokane, Washington B.S. Geology (minor-Chemistry)

PUBLICATIONS:

Apr 1971	"Geochemistry of Belt Supergroup Rocks, Coeur d'Alene District, Shoshone County, Idaho"; unpublished Ph.D. dissertation, University of Idaho.
Jun 1967	"Studies on the Molecular Weight of Petroleum Asphaltenes Via the Vapor Pressure Osmometer"; paper presented of the Northwest Regional Meeting of the American Chemical Society, at Richland, Washington.

BRANDAN A. BORGIAS

PROFESSIONAL EXPERIENCE:

1991 - Present	SVL Analytical, Inc. - Kellogg, ID Systems Manager, Computational Chemist. Responsibilities include maintaining QA/QC documentation, developing computerized QC controls for the lab instrumentation, and developing the SVL's LIMS.
Jun 1989--Mar 1990	Cray Research, San Ramon, CA. Software Technical Support Analyst. Co-Administrator of network composed of eight file servers and over 50 client work stations distributed throughout the western U.S. Unix (Sun OS and Cray UNICOS) operating systems experience.
1985--1989	University of California, UCSF. Postdoctoral Scholar. Developed computer programs (FORTRAN) for the refinement and analysis of macromolecular structure. VAX, Sun, and Cray computers and VMS and UNIX operating systems.
1979--1985	University of California, Berkeley. Graduate Research and Teaching Assistant. Dissertation on coordination isomers of highly efficient chelating agents for Fe. Teaching Assistant for X-ray Crystallography, and General, Analytical, and Biophysical Chemistry.

EDUCATION:

1979--1985	University of California, Berkeley. PhD Chemistry, 12/85. Elected to **Sigma Xi.**
1975--1979	Reed College, Portland. BA Chemistry/Physics, 5/79. Elected to **Phi Beta Kappa,** 1979.

COMPUTER TRAINING

Feb 1993	Clarion Software. Upgrading to Clarion Professional Developer 3.0.
Mar 1992	ACS Short Course. Laboratory Information Management Systems: From Problem Definition to System Evaluation.
8/89 to 12/89	Cray Research. - Cray Y-MP Series System Architecture for Systems Analysts. - Designing For Speed. - Advanced Fortran Features and Optimization.
Summer 1988	National Center for Supercomputing Applications (NCSA). NSF Summer Institute in Supercomputing.
Spring 1988	Pittsburgh Supercomputing Center. NIH Biomedical Super-computing Workshop.
Fall 1979	Reed College. Fortran Programming.

BRANDAN A. BORGIAS

PUBLICATIONS:

The Characterization & Structure of $[H_7O_3]^+[As(catecholate)_3]^-$ p-dioxane, B.A. Borgias, G.G. Hardin and K.N. Raymond, Inorg. Chem., (1986) **24,** 1057-1060.

Structural Chemistry of Gallium(III). Crystal Structures of $K_3[Ga(catecholate)_3]\cdot 1.5H_2O$ and $[Ga(benzohydroxamate)_3]\cdot H_2O\cdot CH_3CH_2OH$, B.A. Borgias, S.J. Barclay and K.N. Raymond, J. Coord. Chem. (1986) **15,** 109-123.

Isomerization and Solution Structures of Desferrioxamine B Complexes of Al and Ga, B.A. Borgias, A.D. Hugi and K.N. Raymond, Inorg. Chem. (1989), **28,** 3538-3545.

COMATOSE: A Method For Constrained Refinement of Macromolecular Structure Based on Two- Dimensional Nuclear Overhauser Effect Spectra, B.A. Borgias and T.L. James, J. Magn. Reson. **79,** 493-512 (1988).

2D NOE Complete Relaxation Matrix Analysis, B.A. Borgias and T.L. James, in NMR in Enzymology, **176** in Methods in Enzymology (N.J. Oppenheimer and T.L. James, eds.) Academic Press, Orlando, 169-183 (1989).

MARDIGRAS: Matrix Analysis of Relaxation for DIscerning GeometRy of an Aqueous Structure, B.A. Borgias and T.L. James, J. Magn. Reson. **87,** 475-487, (1990).

ERIC A. KRUEGER

PROFESSIONAL EXPERIENCE:

Jan 97 - Present	SVL Analytical, Inc. - Kellogg, ID Organic Department Head/GCMS Analyst
Dec 89 - Oct 96	Bayshore Laboratories - Brown Deer, WI Laboratory Analyst: Performed environmental and forensic drug toxicology analyses using GCMS and GC with FID, PID, ECD, DELCD and NP detectors, HPLC and EIA autoanalysis modalities;proficient in solid-liquid, liquid-liquid and purge-and-trap extractions. Experience with metals analysis using AA, ICP and liquid IC instruments.
Jun 89 - Dec 89	Real Veal, Inc. - Ixonia, WI Laboratory Technician: Performed analyses of feedstuffs and groundwater using AAs, GC-FID, Kjeldhal nitrogen and ether-based fatty acid extractions. Maintained records and equipment.

EDUCATION:

1981 -1985	University of Wisconsin - Stevens Point, WI B.S. Biology
1990	Hewlett-Packard Detector Operation and Maintenance Course
1987	Hitachi Autoanalyzer Operation and Maintenance Course

RUSSELL L. ALLRED

PROFESSIONAL EXPERIENCE:

Sep 87 - Present	SVL Analytical, Inc. - Kellogg, ID Programmer Analyst: Provides computer and systems analysis, including accounting and USEPA CLP data management and compliance screening.
1980 - Sep 87	Cook Lumber--Murray, Utah Computer Analyst: Maintained a multi-user system that affected all aspects of the business and trained employee users.

EDUCATION:

1987	Salt Lake Community College Computer Science
1978-1986	University of Utah, Salt Lake City, Utah Computer Science

JOSEPH L. COSTELLO

PROFESSIONAL EXPERIENCE:

Oct87-Present	SVL Analytical, Inc. - Kellogg, ID Chief Chemist - Classical Chemistry Lab: Responsible for wet chemistry analysis and sample preparation utilizing USEPA CLP procedures, including TCLP. Qualified USEPA CLP atomic absorption and ICP operator.
1978-1987	Energy Laboratories - Billings, Montana Chemist: Supervised soil testing laboratory and performed instrumental and classical analysis of water, geological and environmental samples.
1975-1978	Northern Testing Laboratories - Billings, Montana Laboratory Technician: Responsible for sample preparation and analysis of environmental, industrial and agricultural constituents.

EDUCATION:

1968-1971	College of Great Falls - Great Falls, MT Chemistry
	Thermo Jarrell-Ash ICP theory and Practice

KIRBY L. GRAY

PROFESSIONAL EXPERIENCE:

Mar87 - PRESENT	SVL Analytical, Inc. - Kellogg, ID Chief Chemist Inorganic Instrument Analysis Lab: Responsible for sample analysis by ICP, GFAA, FLAA, IC and CVAA.
Sep86-Mar87	Radersburg Mining Co.-Toston, MT Chemist: Responsible for fire assay, FLAA, and sample preparation.
May84-May86	Sunshine Mining Co.-Kellogg, ID Chemist: Responsible for fire assay, FLAA, and classical chemistry.
Aug83-Aug83	IDHW, State of Idaho-Kellogg, ID Environmental Technician: Operated X-ray fluorescence meter and collected soil samples.
May72-May82	The Bunker Hill Co.- Kellogg, ID Material Recovery Supervisor: Responsible for operation and maintenance of water treatment plant, sulfuric acid plant, baghouse, cadmium refinery, and electric reverbatory furnace at a lead smelter.

EDUCATION:

Sep68-May72	University of Idaho-Moscow, ID B.S. Geological Engineering
Sep66-Jun68	North Idaho College-Coeur d'Alene, ID Engineering major

ERIC D. HARWOOD

PROFESSIONAL EXPERIENCE:

Sep87 - Present	SVL Analytical, Inc. - Kellogg, ID Classical Techniques Analyst: Perform TCLP extractions, cyanide analysis and operate CVAA utilizing USEPA procedures.
Sep83 - Sep87	Asgrow Research Center - Twin Falls, ID Research Technician: Performed research on vegetable seed identification, purity, testing and evaluation.

EDUCATION

1976 - 1980	Eastern Washington University - Cheney, Washington B.S. Biology with Chemistry minor

JANICE B. DeVOE

PROFESSIONAL EXPERIENCE:

Mar90 - Present	SVL Analytical, Inc. - Kellogg, ID. Classical Techniques Analyst: Perform analyses on soil and water samples utilizing USEPA CLP procedures.
Sep80 - Mar84	Ferry County Memorial Hospital- Republic, Washington, Medical Technician
Nov79 - Jun80	Good Samaritan Hospital - Phoenix, Az Medical Technician
Aug78 - Aug79	Ferry County Memorial Hospital- Republic, Washington, Medical Technician
Aug77 - Jul78	Harris Laboratories - Lincoln, Nebraska, Laboratory Technician

EDUCATION:

1973-1977	Fort Lewis College - Durango, Colorado B.S. Biology

JOHN SCHLAEFER

PROFESSIONAL EXPERIENCE:

Aug91-PRESENT	SVL Analytical, Inc. - Kellogg, ID Atomic Absorption Operator: Operate GFAA utilizing USEPA CLP procedures. Also able to operate TJA ICP, Buck-404 TPH-IR, Dohrmann TOC analyzer. Proficient at CLP protocols. Limited sample preparation experience.

EDUCATION:

1986-1990	University of Idaho, Moscow, ID B.S. Physics; minor in Math.
Aug-1995	Thermo-Jarrell Ash ICP Atomic Spectroscopy Theory & Practice Seminar

ANN MARIE COSTELLO

PROFESSIONAL EXPERIENCE:

Nov91-PRESENT	SVL Analytical, Inc. - Kellogg, ID Atomic Absorption Operator: Operate GFAA and CVAA using USEPA CLP procedures. Also trained in the operation of the ICP instrument for CLP samples of both water and soil matrices.
1979-1980	Energy Laboratories - Billings, MT Lab Technician: Plant and soil analysis using classical chemistry and AA techniques.
1975-1977	Chen Northern - Billings, MT Lab Technician: Plant and soil analysis using classical chemistry and AA techniques.
1972-1975	Montana State University Plant Research Center - Bozeman, MT Lab Technician: Plant and soil analysis using classical chemistry and AA techniques.

EDUCATION:

1967-1971	Montana State University, Bozeman, MT B.S. Microbiology

DANNY J. SEVY

PROFESSIONAL EXPERIENCE:

Apr86-Present	SVL Analytical, Inc. - Kellogg, ID Inorganic Instrument Operator: Currently runs metals analyses using the graphite furnace atomic absorption (GFAA) instruments using SW846 methodology as well as USEPA methods. Also trained in the operation of cyanide analysis, CVAA and IC instruments.

EDUCATION:

1973-1977	Kellogg High School - Kellogg, ID Diploma
1989 -1990	North Idaho College - Coeur d' Alene, ID Chemistry and Mathematics courses

ARLENE FATTU

PROFESSIONAL EXPERIENCE:

Mar89 - Present SVL Analytical, Inc. - Kellogg, ID
Laboratory Technician: Performs inorganic sample preparation and operates CVAA and GFAA instruments.

EDUCATION:

1971 - 1975 University of Idaho - Moscow, ID
B. S. Home Economics (chemistry courses)

M. LEE HAYNES

PROFESSIONAL EXPERIENCE:

Nov89 - Present	SVL Analytical, Inc. - Kellogg, Idaho Safety Officer--Responsible for corporate health and safety policy, implementation of Chemical Hygiene Plan, waste disposal, and recycling.
1978 - Present	Purchasing--Responsible for purchasing, receiving, and verifying orders with vendors.
Nov87 - Present	Shoshone County Disaster Services--Assistant Civil Preparedness Director
Jan91 - Present	Private Instructor--Hazardous Materials and Hazardous Waste
Sep78 - Oct89	Shoshone County Assessor's Office - Wallace, ID Senior Appraiser

EDUCATION:

1970	Burroughs Computer School - Chicago, IL
1967	Officers Candidate School - U.S. Army Commissioned
1963-1966	Kellogg High School - Kellogg, ID Diploma

MELBA BENCICH

PROFESSIONAL EXPERIENCE:

Feb88 - Present	SVL Analytical, Inc. - Kellogg, ID Coordinator, Data Processing and Reporting: Supervises the division's reporting department utilizing USEPA CLP procedures for deliverables and compliance screening.
1984-1988	Shoshone Insurance - Kellogg, ID Duties included accounting, customer service relations and updating manuals.
1982 - 1984	Time To Travel - Wallace, ID Travel Consultant
1974 - 1981	The Bunker Hill Company - Kellogg, ID Data Control Analyst

EDUCATION:

1964 - 1967	Wallace High School - Wallace, ID Diploma
1967 - 1968	North Idaho College - Coeur d' Alene, ID General Studies
1980	International Correspondence School Mathematics

DAVE WAISMAN

PROFESSIONAL EXPERIENCE:

Apr93 - Present	SVL Analytical, Inc. - Kellogg, ID Marketing Representative.
Mar88 - Apr93	Hecla Mining Company, Republic, WA. Senior Exploration Geologist. Managed Exploration Office. Responsible for project cost tracking, drilling performance tracking, supervision of abandonment and reclamation of drill sites, design, budget and management of exploration efforts.
Apr87 - Nov87	Golder Associated, Inc. Seattle, WA Geologist, Geotechnical Engineer. Well-site geologist for water monitoring wells at Hanford Nuclear Reservation. Well construction and QA review for Test and Operating Procedures for Basalt Waste Isolation Project.
May85 - Jan87	Consulting Geologist. Missoula, MT Geological consulting in SW Montana for two major mining companies. Responsibilities included property evaluations, mapping and sampling. Experienced in reverse circulation and diamond drilling, and trace element geochemistry.
Jun84 - Jan85	Meridian Minerals Co. Billings, MT Geologist, precious metals reconnaissance in Belt and volcanic rocks of SW Montana, property submittal evaluations, trace element geochemistry.

EDUCATION:

1982 - 1985	University of Montana, Missoula MT MS Geology 1985
1975 - 1979	Colorado State University, Fort Collins BS Geology 1979

PUBLICATIONS:

Waisman, D.J., 1990, "Hecla's Golden Eagle Deposit, Republic Mining District", presented at the 96th Annual Northwest Mining Association Convention, 1990.

Waisman, D.J., 1992, "Minerals of the Black Pine Mine, Granite County, Montana", The Mineralogical Record, December 1992 (Vol. 23, No. 6, pp, 477-483).

G. CHRISTINE MEYER

PROFESSIONAL EXPERIENCE:

1993 - Present	SVL Analytical - Kellogg, ID Marketing Coordinator. Secures commercial contracts. Confers with technical staff and assigns project management for contracts. Primary in-house service representative, responsible for developing and distributing company literature to existing and potential clients.
Jun78 - 1993	SVL Analytical - Kellogg, Idaho Projects Manager, Minerals Division. Secure contracts with clients. Supervise data generation and reporting to ensure quality control, expedite deliverables, and maintain customer service. Monitor all phases of Minerals Division projects.
1977 - 1978	Gary's Drug Center - Kellogg, Idaho Pharmaceutical aide. Assisted in dispensing prescriptions.
1975 - 1977	Shoshone School District #391 - Kellogg, Idaho Substitute teacher. Assumed classroom responsibilities in the absence of a teacher.
1975	Idaho State Department of Lands - Kingston, Idaho Office manager responsible for fire dispatch, clerical duties, payroll, and customer service.

EDUCATION:

1970 - 1973	Kellogg High School - Kellogg, ID Diploma
1973 - 1974	North Idaho College - Coeur d'Alene, Idaho Social services studies
1989	Customer service training seminar
1990	MS-DOS Computer class

PRESENTATIONS:

"Everything You Always Wanted to Know About Fire Assaying, But Were Afraid to Ask", Geological Society Meeting, 1992.

ANNE P. BOSCHERT

PROFESSIONAL EXPERIENCE:

May94 - PRESENT	SVL Analytical, Inc. - Kellogg, ID Quality Assurance Coordinator: Responsibilities include establishing and maintaining QA program for laboratory which includes the implementation and creation of an uniform format system for SOPs which facilitates tracking, reviewing, and archival; established a method of documentation consistently applied throughout the lab;
1991 - 1992	Enseco Cal Laboratory - W. Sacramento, CA Quality Assurance Officer Duties included monitoring lab compliance with regulatory agencies for federal contracts; organizing and compiling QAPs; writing SOPs; conducted, arranged, and performed audits.
1989 - 1991	Radian Corporation - Sacramento, CA Quality Assurance Specialist and Environmental Assessment Field Technician Duties included supervising field activities for a large quarterly groundwater sampling analysis program; authoring 5,000 page document (over 40 pages of text) summarizing analytical data for said project; reviewed and evaluated analytical results, acted as liaison between project and lab staff; and formulated quarterly reports summarizing results.
1984 - 1989	Sacramento Medical Foundation Blood Center - Sacramento, CA Laboratory Technician Duties included preparing, documenting, and separating units of blood serum for testing; performance of evaluative tests; organizing and entering test data into computer system.

EDUCATION:

1978 - 1983	Eastern Montana College - Billings, MT B.A. Biology (Minor - Chemistry)

KENNETH D. SORENSON

PROFESSIONAL EXPERIENCE:

Jun94 - Present	SVL Analytical Inc. - Kellogg, ID Organic Chemist - Operates GC and GCMS instruments.
1990 - 1991	OHM Remediation Services Corp. - New Hope, MN Field Chemist - Duties included supervising field chemists and sampling technicians on remedial projects; providing analytical support for emergency and non-emergency remediation projects; assumed responsibilities for Site Health and Safety Officer to establish and maintain a safe working environment; and wrote daily and final analytical reports for remediation projects.
1989 - 1990	ETC Corporation - Minneapolis, MN Chemist 2
1986 - 1988	Braun Inc. - Minneapolis, MN Lead GC Chemist
1984 - 1986	PACE Laboratories - Golden Valley, MN Analytical Chemist
1983 - 1984	University of Wisconsin - Stevens Point, WI Analytical Water Chemist

EDUCATION:

1980 - 1984	University of Wisconsin - Stevens Point, WI B.S. Chemistry/Water Resources

KEVIN HATHAWAY

PROFESSIONAL EXPERIENCE:

Mar87 - Present	SVL Analytical, Inc. - Kellogg, ID Instrument operator for Cold Vapor Atomic Absorption Spectrophotometer; performs mercury analysis, also trained as a Classical Chemistry analyst.

EDUCATION:

1969 - 1973	Kellogg High School - Kellogg, ID Diploma
1993 - 1994	North Idaho College - Coeur d' Alene, ID Basic Concepts in Chemistry

ALICE VAN DORN

PROFESSIONAL EXPERIENCE:

May90 - Present	SVL Analytical, Inc. - Kellogg, ID Classical Chemistry Sample Prep Technician Duties include filter digestions for water and some soil; air filter monitoring and digestions. Other analyses performed are TDS, TSS, conductivities, Ph and alkalinities.

EDUCATION:

1957 - 1960	Pierce High School - Pierce, ID
1970 (D-S)	Green River Community College - Auburn, WA General Studies
1970 - 1972	Southwestern Oregon Community College - Coos Bay, OR AA Business Science; including Biology course work.

JUDY MAGIN

PROFESSIONAL EXPERIENCE:

Oct94 - Present

SVL Analytical, Inc. - Kellogg, ID
Organic Sample Prep Technician
Responsible for performing sample extractions, solid phase extraction, liquid/liquid extraction on the following matrices; soil, water, and waste. Duties also include routine record keeping and data entry.

1968 - 1994

Minnesota Valley Testing Laboratories, Inc. - New Ulm, MN
GLP Laboratory Technician: Performed organic extractions including liquid-liquid partition, solid phase extraction, gel permeation, and open column chromatography. Matrices included soil, water, plants, and food products. Performed routine record keeping and data entry as well as training lab personnel.

Previous positions with this employer included Soils Lab Assistant to the Nutrients and Minerals supervisor and experience in the inorganic lab covering areas such as domestic & waste water, plant nutrients & minerals, feed nutrients, and used oil analysis.

Training included techniques in "Good Laboratory Practices Standards" (GLP) as delineated in 40 CFR, Part 160 (US EPA), Laboratory Safety, Quality Assurance, and familiarity with the following instruments: color spectrophotometer, atomic absorption spectrophotometer, ultrasonic processor, electric kiln, flash point detector, analytical balances, pH meters, vacuum box, centrifuge, heating & distilling units, rotary evaporator, steam water bath, and gas chromatography (limited).

EDUCATION:

1964 - 1967 Wabasso Public School - Wabasso, Minnesota

1968 Mankato Commercial College - Mankato, MN
General Business Course work

ERIK A. MUHS

PROFESSIONAL EXPERIENCE:

Jun94 - Present SVL Analytical, Inc. - Kellogg, ID
Classic Techniques Analyst: Performs classical Wet Chemistry analyses on water and soil samples using CLP procedures. Also responsible for operating RFA instrument. This includes the preparation and analysis of cyanide and Nitrite - nitrate (as nitrogen) tests for soil and water samples.

1988 -1993 (Summers) SVL Analytical, Inc. - Kellogg, ID
Lab Tech in the Bucking Room, Cyanide and Water Chem labs. Duties included general sample preparation and analysis of the following parameters: cyanide, nitrate, sulfur and phosphorus.

Responsibilities also included preparation of water samples for spectrographic analysis and mine waste samples for analysis by MWM, TCLP, and SPLP methods. Processed yard samples in accordance with EPA guidelines. Maintained rock crushers and air cleaners, trained and supervised new employees.

1987 (Summer) Callahan Mining Corp. - Ishpeming, Michigan
Sample Prep Tech and General Maintenance: Duties included operation of heavy equipment such as ceiling crane and large and small forklifts, bobcat and diamond rock saw. Completed 8 hr. industrial safety course per OSHA regulations.

EDUCATION:

1986 - 1993 University of Idaho - Moscow, Idaho
B.S. Electrical Engineering

PAULA SIMERLY

PROFESSIONAL EXPERIENCE:

Nov94 - Present	SVL Analytical, Inc. - Kellogg, ID Organic Chemist: Performs semi-volatile analyses on a routine basis, also provides back-up relief for analysts who analyze volatile, pesticide, and BTEX analyses. Additional duties include data entry, generation of reports, and review and updating of organic SOPs.
Jan94 - Nov94	ACZ Laboratories, Inc. - Steamboat Springs, CO Mass Spectrometry Manager: Responsibilities included managing the rebuilding of the Mass Spec Section of full service organic lab. Duties also included training mass spec operators, instrument setup, troubleshooting and maintenance, management and daily assignments and scheduling. Routine methods performed included SW-846, EPA 500 and 600 Series.
1989 - 1993	EPA Region 7 Contractor, ManTECH ENVIRONMENTAL, INC. Mass Spectrometrist: Duties included the performance of volatile and semi-volatile organic compound analyses on soils, water and drum samples using HP GC with Mass Selective Detector and RTE and Chemstation data systems. Also trained personnel on the operation of above instruments. Organic Analytical Chemist - 1989 to 1993 (additional experience with ManTECH): Operated a GC with ECD and NPD for the analysis of herbicides, PCB's, and pesticides in soil, water, foliage, animal tissue, wipes, and air samples. Performed analysis on CLP contracts.
1989	U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) - Kansas City, Kansas Chemist: Responsibilities included digestion, extraction, analysis and reporting of all metals samples following EPA CLP protocol using ICAP, GFAA and CVAA instruments. Used several techniques of extraction including silica gel column, florisil column,carbon column, sulfuric acid clean-up and GPC.

EDUCATION:

1982 - 1987	Iowa State University - Ames, Iowa B.S. Chemistry
1990 - 1992	University of Missouri - Kansas City, Missouri M.S. Physical Chemistry
1994	Hewlett-Packard Chemstation Enviroquant Training
1994	Supervisor Training Course
1993	Certification - OSHA 40 Hour Training
1989	Varian Mass Spectrometer Seminar

RONALD CLAY

PROFESSIONAL EXPERIENCE:

May95 - Present	SVL Analytical, Inc. - Kellogg, ID Classic Techniques Analyst: Performs classical Wet Chemistry analyses on water and soil samples including: TDS, TSS, TKN, Ammonia, Phosphorus, Sulfur, Acid Base Accounting, Fluorides and Sulfides.
Oct91 - Jan95	DataChem Laboratories - Salt Lake City, UT Chemist I, Environmental Chemistry, Inorganic Section: Responsibilities included preparing and analyzing water and soil samples for TPH using FT-IR spectrophotometry, total cyanide using conventional and MIDI distillations, TOX and EOX (extractable organic halides) using microcoulometry titration. Duties also included preparing samples for ICP, CFAA, FLAA and CVAA.
Jan90 - Aug91	Miller Laboratories - Ogden, UT Chemist, Chemistry Department: Responsibilities included nutritional analysis of feeds, pet food and food for human consumption, including protein by TKN, fat by ether extraction and acid hydrolysis, moisture, ash, salt by Volhardt, and minerals analysis by flame AA.

EDUCATION:

1986 - 1989	Weber State College, Ogden, UT B. S. Criminalistics, Minor - Chemistry

BRUCE BRADBURN

PROFESSIONAL EXPERIENCE:

May95 - Present	SVL Analytical, Inc. - Kellogg, ID Instrument Operator: Performs operation of the ICP and GFAA instruments utilizing USEPA CLP procedures. Also capable of operating Flame AA and Cold Vapor AA instruments.
Apr94 - Jun95	American Analytical Laboratories, Inc. - Seattle, WA Laboratory Manager: Responsible for general laboratory operations including pesticide and PCB analyses, hydrocarbons in soil and water, other semi-volatile GC analyses, inorganic analyses, operation of ICP, GC, flame and furnace AA instruments, as well as data review and client consultation.
Mar91 - Nov93	Northwest Laboratories of Seattle: Seattle, WA Chemist: Duties included analysis and certification of products and raw materials, ICP, GC, FTIR, bomb calorimetry. Understanding of ASTM, EPA and A.O.A.C. methodologies.

EDUCATION:

1982 - 1987	Western Washington University - Bellingham, WA B.S. Chemistry
1988 - 1990	University of New Mexico - Albuquerque, NM M.S. Chemistry

DONALD W. JOHNSON

PROFESSIONAL EXPERIENCE:

Jul95 - PRESENT	SVL Analytical, Inc. - Kellogg, ID Inorganic Instrument Operator: Operate ICP, GFAA and FLAA utilizing USEPA CLP procedures.
1993 - 1995	ESAT Region 10, EPA Lab - Manchester, WA Instrument operator and project manager.
1991 - 1993	SVL Analytical, Inc. - Kellogg, ID Inorganic Instrument Operator: Operated the following instruments: ICP, GFAA, FLAA, IC, and CVAA.

EDUCATION:

Sep 1992	University of Idaho, Northwestern Quality Symposium
Mar 1992	Thermo-Jarrell Ash ICP Atomic Spectroscopy Theory & Practice Seminar
1986 - 1990	University of St. Thomas, Houston TX B.A. General Studies: Major in Chemistry, Minor in Mathmatics

DEAN PALMER

PROFESSIONAL EXPERIENCE:

Mar96 - Present	SVL Analytical,Inc. - Kellogg, ID Sample Prep Technician, Water Lab: Primary responsibilities include preparation of water samples for analysis by ICP and GFAA (extracts and distillates) using SW-846 an EPA 200 series methods.
1983 - 1994	Northern States Power Company - Welch, MN Prairie Island Nuclear Plant Training Center, Production Engineer: principal duties included the instruction of employees in the areas of math and physics as well as general employee training. Developed and taught course in site orientation, power plant fundamentals, industrial safety, radiological protection and respirator use.
1980 - 1982	Kerr-McGee Nuclear, Grants, NM Associate Mechanical Engineer: Responsibilities included the design and modification of mine mechanical equipment such as pumping, hydraulics, noise abatement, hoisting.

EDUCATION:

1968 - 1972	North Dakota State University, Fargo, ND B.S. Social Science - Secondary Ed; Minor - Mathematics
1975 - 1979	South Dakota School of Mines and Technology, Rapid City, SD B.S. Mechanical Engineering

NICHOLAS A. WIEBER

PROFESSIONAL EXPERIENCE:

Jul96 - Present	SVL Analytical, Inc. - Kellogg, ID Inorganic Chemist: Classical Wet Chemistry division. Duties include sulfur determination (ABAs) through operation of the LECO instrument. Additional experience includes operation of the Ion Chromatograph instrument.
1994 - 1996	Polymer Technology International - Issaquah, WA Research and Production Chemist: responsibilities included supervision of 70 workers, assisted fellow research chemist in the development of new products. Also worked with light source, fiber optics and monochromater in Vis-NIR spectrophotometer.
Jun94 - Aug94	University of Washington - Seattle, WA Research Project working with contaminated soil, primarily determining the hexavalent and trivalent and total chromium content as well as other heavy metals using EPA SW-846 methods.

EDUCATION:

1989 - 1994	University of Washington, Seattle, WA B.A. Chemistry

BRENDA SMITS

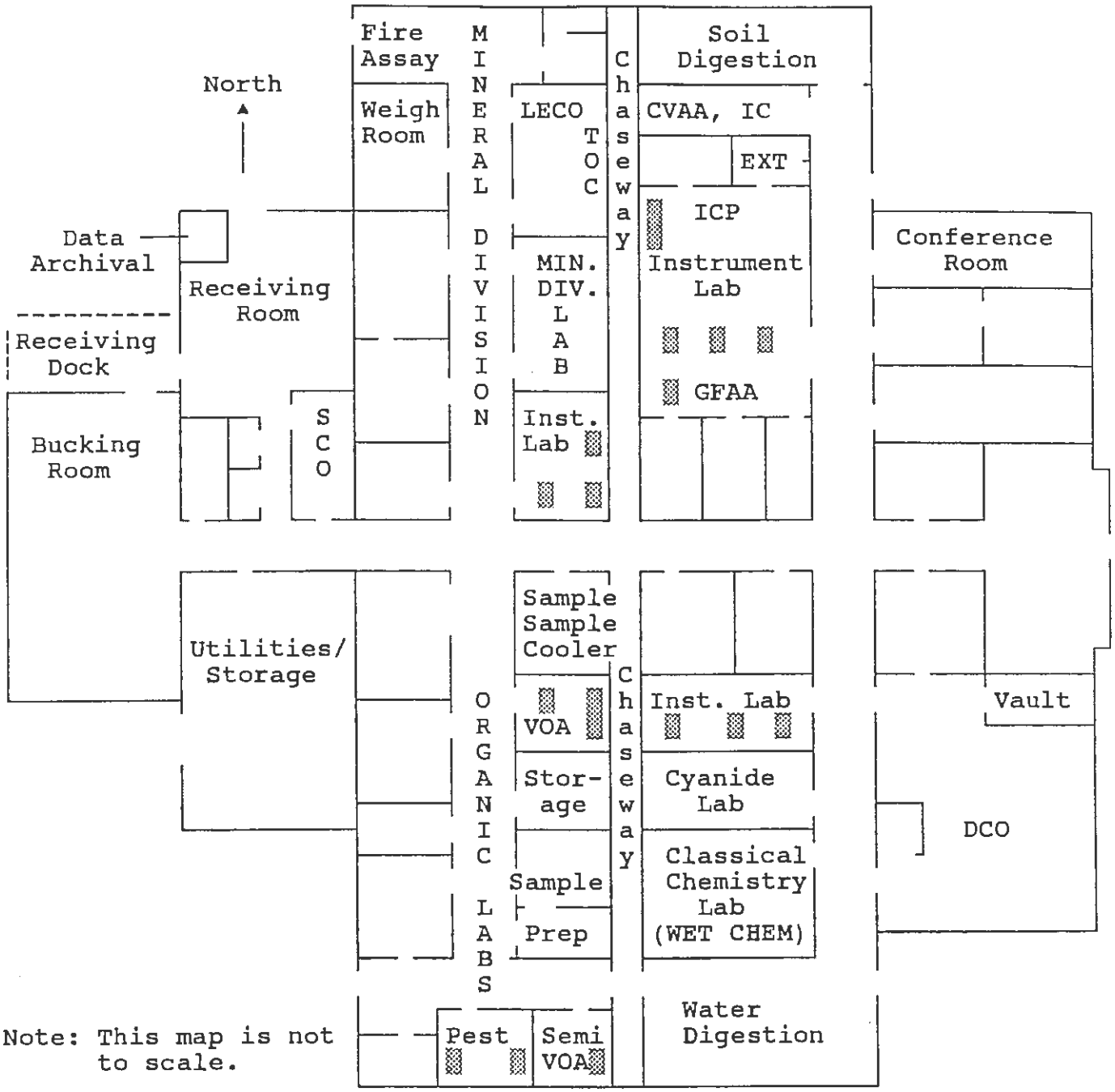
PROFEESSIONAL EXPERIENCE:

Dec 96 - Present	SVL Analytical, Inc - Kellogg, ID Classical Wet Chemistry Analyst:
Jun 95 - Aug 96	WWU Chemistry Department, Murdock Foundation Grant Performed in the Organic Chemistry lab research area, responsibilities included: synthesized unconjugated aldehydes using a vitamin B_{12} model compound, gave weekly oral presentations of lab progress.

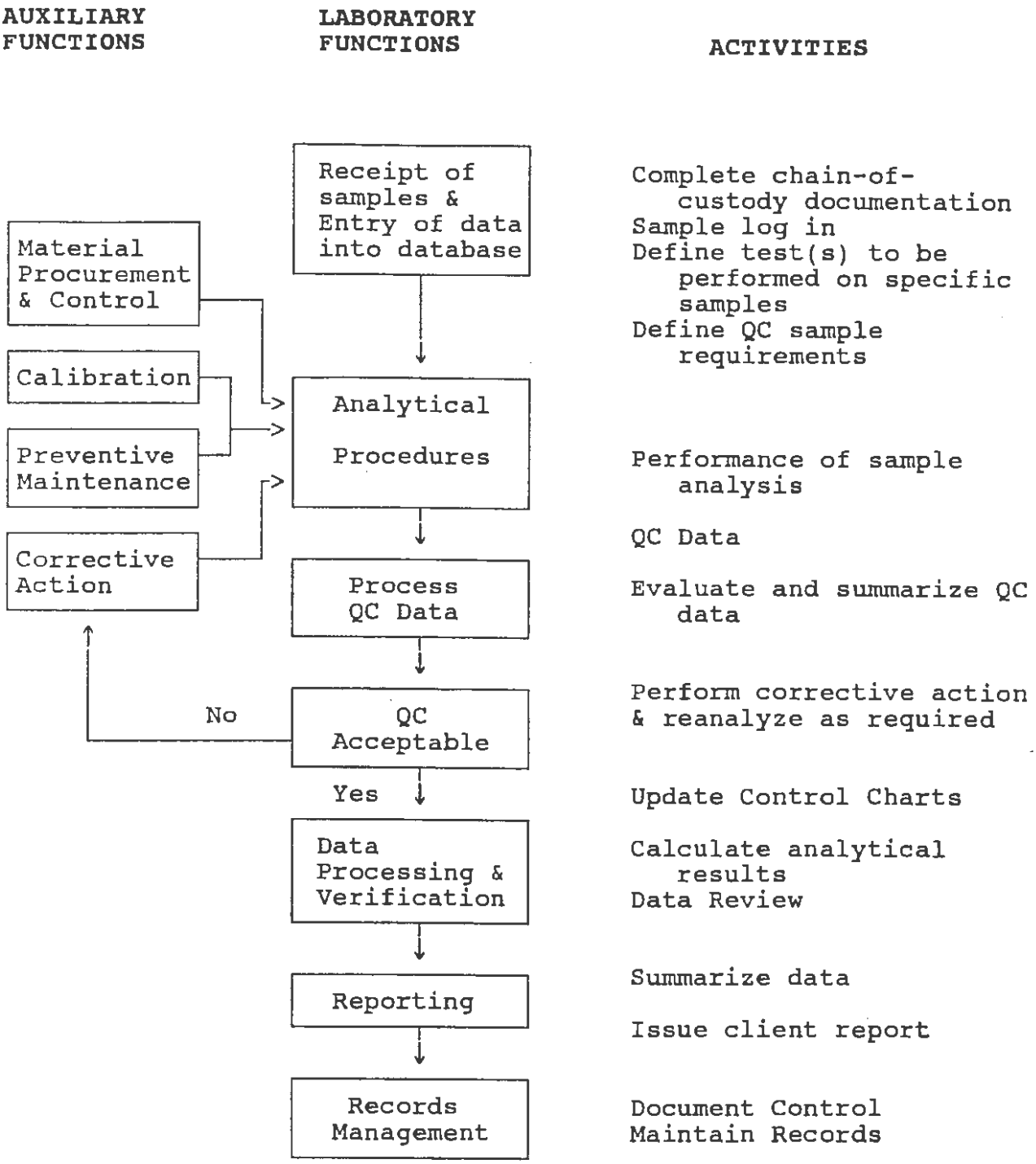
EDUCATION:

1992 - Aug I996	Western Washington University - Bellingham, WA B.S. Biochemistry, Aug 1996

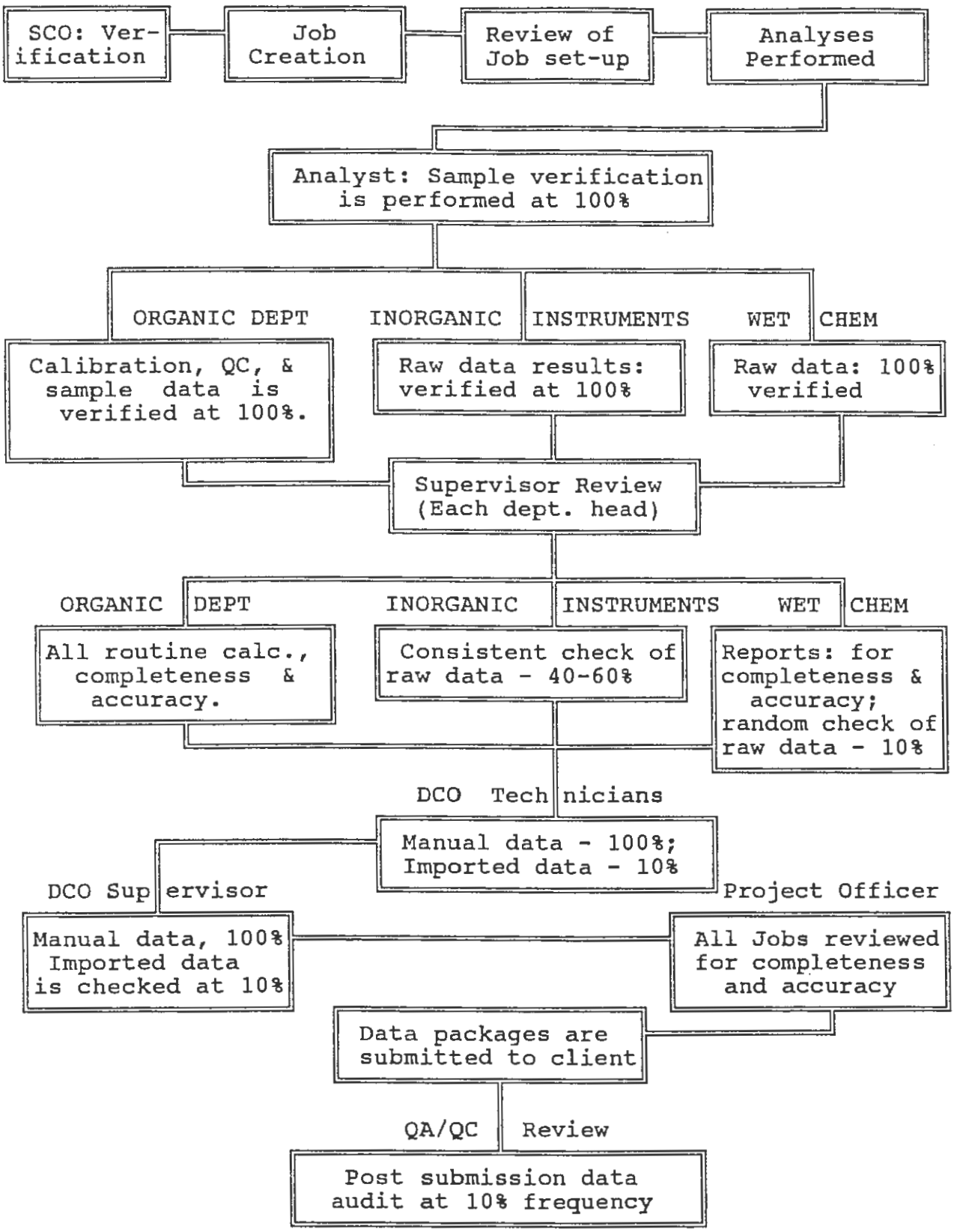
C. SVL Main Building Layout



D. Laboratory Analysis Flow Chart



E. Data Review Flow Diagram



II. EQUIPMENT AND ANALYSES PERFORMED

A. Analytical Instrumentation

No.	Instrument	Manufacturer	Model
	INORGANIC		
1	Inductively Coupled Plasma Spectrometer	Jobin Yvon	138 Ultrace
1	Inductively Coupled Plasma Spectrometer	Thermo Jarrell-Ash	ICAP-61E
1	Inductively Coupled Plasma Spectrometer	Thermo Jarrell-Ash	ICAP-61
2	Atomic Absorption Spectrophotometer	Varian	SpectrAA 300Z
	with Graphite Furnace Atomizer	Varian	GTA-96
1	Atomic Absorption Spectrophotometer	Varian	SpectrAA 40Z
	with Graphite Furnace Atomizer	Varian	GTA-96
1	Atomic Absorption Spectrophotometer	Varian	SpectrAA 30
	with Graphite Furnace Atomizer	Varian	GTA-96
1	Atomic Absorption Spectrometer with	Varian	SpectrAA 20
	Graphite Furnace Atomizer	Varian	GTA-96
2	Atomic Absorption Spectrometer with	Varian	SpectrAA 20
	Vapor Generation Accessory	Varian	VGA-76
1	Atomic Absorption Spectrophotometer	TJA	Smith-Hieftje 22
1	Atomic Absorption Spectrophotometer	Thermo Jarrell-Ash	Video 12E
	with Atomic Vapor Accessory	Thermo Jarrell-Ash	440
1	Atomic Absorption Spectrophotometer	Thermo Jarrell-Ash	Video 22E

1	Ion Chromatograph	Dionex	2000i
1	Ion Chromatograph	Dionex	DX-I00
2	Auto analyzers w/ autosamplers	Alpkem	RFA/2
3	MIDI Distillation Units	BSL	MIDI-VAP
2	Auto Titrator w/ autosampler	Brinkmann	Titrino 716
I	UV/Visible Spectrophotometer	Bausch & Lomb	501
1	UV/Visible Spectrophotometer	Bausch & Lomb	Spec 70
1	Spectrofluorometer	Turner	110
1	Turbidimeter	Hach	2100N
1	pH Meter	Corning	130
1	pH Meter	Corning	150
1	pH Meter	Beckman	123133
2	Gold Strip Mercury Analyzer	Jerome	301
1	Sulfur Determinator	LECO	SC132
1	Elemental Analyzer	LECO	CSN2000
ORGANIC			
1	Gas Chromatograph with dual Electron Capture Detectors and Autosampler	Hewlett-Packard Hewlett-Packard	5880A 7673
1	Gas Chromatograph with dual Electron Capture Detectors and Autosampler	Hewlett-Packard Hewlett-Packard	5890 II 7673
1	Gas Chromatograph with Hall Electrolytic Conductivity, Photo Ionization, and Flame Ionization Detectors and Liquid Sample	Hewlett-Packard	5890 II

	Concentrator/Auto.	Tekmar	LSC-2000/2016
1	Gas Chromatograph with Mass Selective Detector and Autosampler	Hewlett-Packard Hewlett-Packard Hewlett-Packard	5890A 5970 MSD 7673A
1	Gas Chromatograph with Mass Selective Detector and Liquid Sample Concentrator/Auto.	Hewlett-Packard Hewlett-Packard O/I Analytical	5890A 5970 4560/MPM-16
1	Gas Chromatograph with Mass Selective Detector and Liquid Sample Concentrator/Auto	Hewlett-Packard Hewlett-Packard Tekmar	5890 II 5972 3000/2016
1	Gas Chromatograph with Flame Ionization Detector and Autosampler	Hewlett-Packard Hewlett-Packard	5890 II 7673A
1	Carbon Analyzer (TOC)	Dohrmann	DL-80
1	Halide Analyzer (TOX)	Mitsubishi	TOX-10
1	Infrared Spectrophotometer	Buck	Model 404

MISCELLANEOUS

2	Semi-Micro Balance	Mettler	AE240
1	Analytical Balance	Mettler	H20T
1	Analytical Balance	Mettler	H18
1	Analytical Balance	Mettler	HK60
1	Filter Balance	Mettler	AJ100
2	Micro Balance	Mettler	M3
1	Micro Balance	Cahn	C-31
4	Pan Balance	Mettler	PJ360
3	Pan Balance	Mettler	PB30
2	Pan Balance	Mettler	BB244
1	Pan Balance	Mettler	BB240
1	Pan Balance	Mettler	P2000N
1	Dissecting Microscope	Nikon	104
1	Polarizing Microscope	Nikon	106
1	Centrifuge	Garver	53
1	Conductance Meter	YSI	YSI 3220

B. Routine Analyses Performed

Analytes	Method	Technique
Acidity	EPA 305.1	Titration
Ag,Al,As,Au,B,Ba,Be,Bi,Ca, Cd,Ce,Co,Cr,Cu,Fe,K,La,Li, Mg,Mn,Mo,Na,Ni,P,Pb,Sb,Se, Si,Sn,Sr,Ti,Tl,V,Y,Zn,Zr	EPA 200.7	ICP
Alkalinity, Bicarbonate, Carbonate, and Hydroxyl	SM 403	Titration
Alkalinity (total)	EPA 310.1	Titration
Ag,As,Au,Cd,Cr,Cu,Fe,Ni, Pb,Sb,Se,Tl	EPA 200.2 series	GFAA
Bromide, Chloride, Fluoride, Nitrate, Nitrite, Sulfate, Ortho Phosphate	EPA 300.0	IC
Benzene, Toluene, Ethylbenzenes and Xylenes (Aromatic Volatiles)	EPA 8020/602	GC/PID
Chlorine, Residual	EPA 330.2	Colorimetric
Chromium, Hexavalent	SM 312B	Colorimetric
Color	EPA 110.2	Colorimetric
Corrosivity	SW 846	Electrometric
Cyanide, Amenable	EPA 335.1	Colorimetric
Cyanide, Weak Acid Dissociable	4500 CN - G (SM 412H)	Colorimetric
Cyanide, Reactive	EPA 9010 EPA 9012	Colorimetric Automated UV
Cyanide, Total	EPA 335.3	Colorimetric
EP Toxicity	EPA 1310	Leach/ Filter
Fluoride	EPA 340.2	Ion Specific Electrode
Hardness (Ca,Mg by calculation)	EPA 200.7	ICP
Halogenated Volatile Organics	EPA 8010/601	GC/ELCD
Hydrogen Sulfide	SM 427E	Colorimetric
Mercury	EPA 245.2	CVAA

Nitrogen, Ammonia	EPA 350.3	Ion Specific Electrode
Nitrogen, Ammonia	EPA 350.2	Colorimetric
Nitrogen, Nitrate	EPA 353.2	Colorimetric
Nitrogen, Nitrite	EPA 353.2	Colorimetric
Nitrogen, Total Kjeldahl	EPA 351.4	Colorimetric
Non-halogenated Volatile Organics	EPA 8015	GC/FID
Odor	EPA 140.1	Comparison
Oil and Grease	EPA 413.1	Gravimetric
Phosphate, Ortho	EPA 365.2	Colorimetric
Phosphate, Total	EPA 365.4	Colorimetric
pH	EPA 150.1	Electrometric
Phenols (total)	EPA 420.1	Colorimetric
Polychlorinated Biphenyls (PCBs)/ Pesticides	EPA 8080/608	GC/ECD/ECD
Semi-volatile Organics (BNA)	EPA 8270/625	GC/MS
Silica	EPA 370.1	Colorimetric
Silica, Dissolved	EPA 200.7	ICP
Silica, Total	SM 425B	Gravimetric
Solids, Settleable	EPA 160.5	Gravimetric
Solids, Total	EPA 160.3	Gravimetric
Solids, Total Dissolved (TDS)	EPA 160.1	Gravimetric
Solids, Total Suspended (TSS)	EPA 160.2	Gravimetric
Solids, Total Volatile (TVS)	EPA 160.4	Gravimetric
SPLP	EPA 1312 Draft	Extraction
Specific Conductance	EPA 120.1	Electrometric

Specific Gravity	SM 213E	Gravimetric/ Hydrometer
Sulfate	EPA 375.3	Gravimetric
Sulfide	EPA 376.1	Colorimetric
Sulfide,Reactive	EPA 9030	Colorimetric
Sulfite (requires immediate analysis)	EPA 377.1	Titration
TCLP	EPA 1311	Extraction
Total Organic Carbon (TOC)	EPA 415.2	IR
Total Petroleum Hydrocarbons (Diesel)	EPA 8015 Mod.	GC/FID
Total Petroleum Hydrocarbons (Gasoline)	EPA 8015 Mod.	GC/FID/P&T
Total Petroleum Hydrocarbons	EPA 413.2 EPA 418.2	IR IR
Turbidity	EPA 180.1	Turbidimetric
Volatile Organics	EPA 8240/8260 EPA 624	GC/MS/P&T

SVL also performs the following tests:

* Priority Pollutants (under CFR 40, 261)
* Hazardous Substance List (HSL)
* Drinking Water (SDWA) Organic method 524.2
* Overburden testing
* Cation exchange capacity
* Sulfur forms
* Complete inorganic geochemical analysis
* Fire assay
* Asbestos

III. ANALYTICAL PROCEDURES

Analysis of samples is performed according to SVL Standard Operating Procedures (SOPs - refer to chapter V. QA/QC Procedures, section J. for a description of SOPs) which outline the technique to be used. The SOPs are created using established procedures such as those referenced in the following section:

1. "Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79/020.
2. "Methods for the Determination of Organic Compounds in Drinking Water", EPA/600/4-88/039, Supplements I & II.
3. "Test Methods for Evaluating Solid Wastes", SW 846, Sept. 1986
4. "Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992.
5. ASTM Book of Standards, part 31 (water),
6. USEPA CLP Inorganic Statements of Work, 787, 788, 390, ILM02.0, ILMO3.0 & ILMO4.0

On occasions when USEPA approved or recommended procedures are not available, SVL will select methods in liaison with the client. The method selected will be agreed to in writing before implementation of the procedure occurs.

IV. ETHICS AND DATA INTEGRITY AGREEMENT

SVL Analytical, Inc. is committed to providing its clients with accurate and defensible data and meeting all client requirements for data quality and integrity. To achieve this commitment, and as a condition for employment, all employees agree to follow SVL's policy regarding ethics and data integrity which is characterized in the items listed below.

- All work performed shall be in accordance with appropriate work order agreements, specified methods, SOP's, contracts, etc..

- All data values reported (e.g., sample results), including analysis dates and times, represent actual values obtained and are not modified, or manipulated in any manner which is not described in the referenced method.

- Analysts performing technical methods in the name of SVL shall not represent work which was performed by other individuals as their own.

- Client results shall be kept strictly confidential and released to a third party only with written permission by the client.

- Violation of these standards is grounds for disciplinary action as stated in section II of SVL's Employee Handbook, including termination.

V. QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

SVL recognizes that an effective and vigorously pursued quality control program is key to providing analytical data which is legally defensible, technically accurate, and scientifically meaningful.

At SVL, quality control begins once the objectives of a survey are defined and proceeds through data reporting. Control procedures are defined for every step of the program and detailed in current standard operating procedures (SOP).

SVL realizes that without these controls in all phases of the laboratory and analytical process, data becomes suspect and hence, of less value to our client. Therefore, SVL is dedicated to providing data of the highest quality, usability, and defensibility for every project we undertake.

A. Quality Assurance Policy and Objectives

The primary emphasis of the QAP is twofold. The first of these is to define quality control procedures for all activities that take place in the laboratory. These include the following: receipt, handling, and storage of samples; preparation and maintenance of standards, reagents, gases, and water; calibration and maintenance of analytical equipment; performance, and evaluation of analytical methodologies (in conformance with the parameters defined by the appropriate regulatory agency, e.g., USEPA SW 846); and the compilation and generation of reportable data packages.

The other emphasis of the QAP is to characterize the documentation practices utilized in all facets of the laboratory process.

The objective is to provide a uniform basis for instrument maintenance, document control, analytical methodologies, data generation, quality assurance, and quality control.

The procedures outlined in this manual are the basis of the SVL Analytical Quality Assurance Plan (QAP).

B. Quality Assurance Management

SVL employs one full time Quality Assurance Coordinator who reports directly to the Lab Owner thus providing independence from the routine operation of the individual departments of the lab. The Quality Assurance Coordinator is responsible for the management and implementation of the quality assurance program. She is responsible for monitoring the overall adequacy of the program as well as determining departmental conformance to the QA program. The QA Coordinator is responsible for recommending corrective actions as necessary.

In addition, the Quality Assurance Coordinator develops quality control programs; monitors quality assurance activities to determine conformance with policies and procedures; evaluates and maintains records of data quality and other pertinent performance information; and coordinates quality-problem investigations.

Departmental supervisors are responsible for seeing that their staff receive adequate training in and follow the specific procedures outlined in this QAP. Once a year, the current QAP document is required reading for the technical and managerial staff at SVL.

C. Sample Collection and Handling

This section describes the quality control procedures to be followed in the collection and handling of samples for SVL. These procedures are recommended to all clients submitting samples for chemical analysis. Glassware preparation is included in this section because it is an integral part of any sampling program. It is assumed that the objectives of a study for which samples are to be collected have been stated and the number of samples, types of

samples, frequency of collection, and duration of the sampling program have been established. Finally, it is assumed that all personnel involved in sample acquisition are aware of the above factors.

If utilized, the procedures characterized here result in more confidence in the data produced and the samples are processed more efficiently. The result of standardizing sample collection and handling procedures is less confusion for the project manager, field personnel, and laboratory staff.

The most important aspects of quality control for sample collection and handling are sample integrity and representativeness.

1. **Sample Integrity**

Sample preservation is critical for sample integrity given the potential for transportation delays and hold ups. Chemical reactions may occur and some chemical species begin to change upon sample collection. Unfortunately, for most samples immediate analysis is neither economically feasible or logistically possible. Although no miracle chemical preservative valid for every parameter exists, SVL strongly recommends the preservation methods, container type, sample size and estimated maximum holding times for collection of water and wastewater samples summarized in Table VI-1.

Solid samples are best preserved by refrigeration at 4°C ± 2C°. Analysis begins as soon as possible after lab receipt of samples. SVL does its utmost to ensure that all holding times are met for water samples as listed in Table VI-1. A complete record is maintained on each sample to provide a history of handling from the time of collection through analysis and sample disposal.

2. **Sample Representivity**

Sampling precision is a means of determining sample representivity as measured by collecting duplicate samples until seven (7) pairs of data are available. These samples can be obtained either at seven (7) different sampling sites or at the same sampling site on seven (7) different trips, depending on the parameters being tested. These data are used to determine acceptable sampling precision limits. Generally, sampling precision is determined in the initial phase of a long-term sampling program. It is checked thereafter with a single duplicate sample, preferably accompanying every sample delivery group.

Field blanks allow identification of systematic and random sample contamination which may result from the sampling equipment, storage containers, sampling agents, or chemicals added to preserve samples. This contamination can be checked by filling a randomly selected sample container with distilled water and the appropriate chemical preservative. Field blanks are analyzed as samples and therefore, are treated exactly as samples: all aliquots, preservation, filtration, storage and handling procedures are performed as if the field blanks are samples. To achieve accurate and meaningful data, field blank "sample" containers are filled at the sampling site, not after returning to the field laboratory.

The following notes may be helpful in reducing the impact upon data of contamination which is encountered through collection and handling in the field.

Two general classifications of contamination exist; random and systematic. Random contamination causes imprecision in analytical results as noted by significant differences between results of duplicate analyses. Systematic contamination generally results in consistent shifts in baseline concentrations; this is demonstrated through the use of field blanks. The point is that systematic contamination is much easier to eliminate and to deal with in interpreting the data. The best way to restrict contamination of the systematic type is to treat every sample, blank, replicate, subsample, split sample, etc., exactly alike within the limits of preservation, holding and procedural prerequisites. It may, therefore, be necessary to do a few dry runs through filtering or preservation procedures to achieve a routine. The vast majority of contamination of this type occurs with analytes detected in levels of trace concentrations only.

Many sources of possible sample contamination exist including the following:

a. Contaminated sample containers.

b. Unclean glassware and filters.

c. Impure solvents and reagents.

d. Use of cleaning products inappropriate for the proposed analysis.

e. Inadequate rinsing of glassware during the cleaning process.

f. Inadequate presample rinsing--the sample bottle should be rinsed two (2) to three (3) times with small volumes of the sample before the bottle is filled to overflowing. Presample rinsing is not possible for certain parameters (e.g., oil and grease) or when pre-preserved bottles are used.

g. Particulate matter (hair, tobacco smoke, dust)-- all sample handling should be done in as clean an area as possible. Filtration apparatus should be protected from contamination. As an example, Kimwipes™ must be used with caution during handling of samples scheduled for trace metals analyses since they may contain appreciable amounts of zinc.

h. It is advisable to rinse filters several times with distilled water between samples and also to pre-rinse the filter with 50 mLs of sample which is run through the walls of the filter funnel (under vacuum). This filtrate is then discarded.

i. Filter pads are handled by the extreme edge; that portion which is clamped between the halves of the filtering apparatus is handled with appropriate forceps (plastic forceps for samples scheduled for metals analyses and metal forceps for those scheduled for trace organic analyses).

j. Use of improper sample container for the parameter specified; e.g., trace metals samples are not to come in contact with any metallic surface and trace organic samples are not to come in contact with any plastic surface.

3. **Cleaning Procedures for Sample Containers and Filtering Equipment**

a. Glassware for General Use. Immediately after use, glassware is immersed in a solution of synthetic detergent. It is scrubbed with a brush, rinsed several times with tap water, and subsequently rinsed with deionized water. Glassware thus treated may be used for procedures contingent upon the performance of additional steps specific for that particular parameter.

b. Organic Parameters. For samples where the presence of gross organic contaminants (e.g., oil and grease) may present a problem, a 1:1 sulfuric acid cleaning solution with ammonium persulfate is used. The Glassware is immersed in this solution for two hours. Subsequently, the glassware is rinsed several times with tap water, followed by multiple deionized water rinses. The glass is considered clean when water drains uniformly without forming droplets.

c. Trace Metal Parameters. A 1:1 nitric acid solution is used to prep glassware for trace metal analyses. The glassware is soaked in this warm nitric acid solution for one hour, followed by multiple rinses with tap water and with deionized water.

d. Filter Pads. Filter pads for dissolved metal filtration are prepped with non-phosphate detergent and rinsed with a 1:1 nitric acid solution followed by several rinses with deionized water. This can be achieved, simply, by clamping the pads in filter funnels and pulling this cleaning solution and subsequent rinses through under high vacuum.

TABLE VI-1

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT

Measurement	Vol. Req. (ml)	Container	Preservative	Holding Time
PHYSICAL PROPERTIES				
Color	50	P,G[1]	Cool, 4°C	48 Hrs.
Conductance	100	P,G	Cool, 4°C	28 Days
Hardness	100	P,G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Cool, 4°C	24 Hrs.
pH	25	P,G	None Req.	Analyze Immediately
RESIDUE********				
Filterable	100	P,G	Cool, 4°C	7 Days
Non-Filterable	100	P,G	Cool, 4°C	7 Days
Total	100	P,G	Cool, 4°C	7 Days
Volatile **********	100	P,G	Cool, 4°C	7 Days
Settleable Matter	1000	P,G	Cool, 4°C	48 Hrs.
Temperature	1000	P,G	None Req.	Analyze Immediately
Turbidity	100	P,G	Cool, 4°C	48 Hrs.
METALS				
Dissolved	200	P,G HNO_3 to pH<2	Filter on site	6 Mos.
Suspended	200	P,G	Filter on site	6 Mos.
Total	100	P,G	HNO_3 to pH<2	6 Mos.
Chromium VI	200	P,G	Cool, 4°C	24 Hr.

TABLE VI-1 (CONT)

Measurement	Vol. Req. (ml)	Container	Preservative	Holding Time
Mercury, Dissolved	100	P,G	Filter, HNO_3 to pH<2	28 Days
Mercury, Total	100	P,G	HNO_3 to pH<2	28 Days
INORGANIC, NON-METALLICS				
Acidity	100	P,G	Cool, 4°C	14 Days
Alkalinity	100	P,G	Cool, 4°C	14 Days
Bromide	100	P,G	None Req.	28 Days
Chloride	50	P,G	None Req.	28 Days
Cyanide	500	P,G	Cool, 4°C NaOH to pH>12	14 Days
Fluoride	300	P	None Req.	28 Days
Iodide	100	P,G	Cool, 4°C	24 Hrs.
NITROGEN**********				
Ammonia	400	P,G	Cool, 4°C H_2SO_4 to pH<2	28 Days
Kjeldahl, Total	500	P,G	Cool, 4°C H_2SO_4 to pH<2	28 Days
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH<2	28 Days
Nitrate	100	P,G	Cool, 4°C	48 Hrs.
Nitrite	50	P,G	Cool, 4°C	48 Hrs.
PHOSPHORUS**********				
Ortho-Phosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	48 Hrs.
Total	50	P,G	Cool, 4°C H_2SO_4 to pH<2	28 Days
Total, Dissolved	50	P,G	Filter on site Cool, 4°C H_2SO_4 to pH<2	24 Hrs.

TABLE VI-1 (CONT)

Measurement	Vol. Req. (ml)	Container	Preservative	Holding Time
Silica	50	P only	Cool, 4°C	28 Days
Sulfate	50	P,G	Cool, 4°C	28 Days
Sulfide	500	P,G	Cool, 4°C add 2 ml zinc acetate plus NaOH to pH>9	7 Days
Sulfite	50	P,G	None Req.	Analyze Immediately
ORGANICS Group I				
COD	50	P,G	Cool, 4°C H_2SO_4 to pH<2	28 Days
Oil & Grease	1000	G only	Cool, 4°C H_2SO_4 to pH<2	28 Days
Organic Carbon	25	P,G	Cool, 4°C H_2SO_4 or HCl to pH<2	28 Days
Phenolic	500	G only	Cool, 4°C H_2SO_4 to pH<2	28 Days
MBAS	250	P,G	Cool, 4°C	48 Hrs.

ORGANICS Group II

Measurement	Volume Required Water/Soil	Container	Water Preservative	Holding Time
Volatile Organics 8010/8020/8260	2x40ml/1x4oz	G,T	Cool, 4°C HCL, pH<2	14 days
Semi-volatile Organics 8270/8080	1 L / 1x8 oz	G,T	Cool, 4°C No Preserv.	7/14 days
TPH - Total Petro. Hydrocarbons				
THP-Gas	2x40 mL/1x4 oz	G,T	Cool, 4°C	14 days
TPH-Diesel	1 L / 1x8 oz	G,T	Cool, 4°C	14 days
TPH-IR	1 L / 1X8 oz	G,T	Cool, 4°C	14 days

TABLE VI-1 (CONT)

NOTES:

1. Plastic (P), Glass (G), Teflon-lined cap (T). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

Preservation:

Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, the samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

Holding Time:

Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.

D. Sample Receipt and Handling

Sample receipt and handling procedures at SVL are based upon the CLP guidelines to ensure efficient generation of high quality analytical results. SVL SOPs cover all sample handling procedures and are easily accessible to the sample custodian and staff.

1. Requesting Analysis

A request for analysis shall be completed by the field personnel. It is imperative that the Order for Analytical Services (SVL's is in the form of a chain-of-custody, see example located in Section X) or an equivalent be provided which defines analytical requirements and enables the lab to meet sample holding times.

2. Chain-of-Custody

Laboratory custody conforms to procedures establisbed for the USEPA Contract Laboratory Program (CLP). Improper sample and data handling and inadequate chain-of-custody procedures affect the credibility and acceptability of analytical results, regardless of their accuracy and precision. Therefore, it is essential that all samples be properly collected, handled, and analyzed. It is imperative that a chain-of-custody be maintained to document that the proper processing of samples, from the time of collection to the time of analysis, did occur. Use of a Chain-of-Custody or an equivalent form is required to document this process.

All pertinent information is obtained and recorded on the chain-of-custody (as filled out by the field/sample collectors). At a minimum, the following information is recorded: sampling conditions, date and time of sample collection, type of sampling device, type of sample container, number and size of samples and other information required by the laboratory for proper sample handling and analysis. To prevent tampering, sample seals may be used.

3. Sample Handling

SVL is in communication with a client designated individual (designee) as necessary throughout the process of sample scheduling, shipment, analysis and data reporting to ensure that samples are properly processed. This communication includes immediate notification of the designee of anomalies and irregularities with samples or sample paperwork which is received by SVL and discrepancies or problems encountered in sample analysis that will affect the data produced.

A temperature reading is taken by the SVL sample custodian for all sample shipping containers (coolers) upon initial receipt and opening. Each sample is checked for visible damage and the presence of an intact custody seal. Each sample is assigned an unique sample identification number batched with other samples which have been received from the same client and assigned a Job number (for details, please see the next paragraph). After initial sample check-in and generation of sample labels, additional sample/client information is logged into SVL's in-house laboratory information management system (LIMS). Samples are stored in a secured area until they are checked-out for analysis by the technical personnel (samples are checked-in after testing is complete).

Each batch of samples received at SVL is given a unique job number consisting of the year received and a sequential identifier (e.g., "60001"). This job number remains with the sample throughout the analytical process. Each sample is also given an unique, sequential six-digit laboratory identification number (e.g., "100001"). The sequential nature of the laboratory identification numbers allows for quick identification of job and sample status during the analytical process. Samples are labeled with sample and Job identification numbers before being stored. For labeling examples, see Fig. V-1 which follows. Identification labels are also affixed to digestates which contain information pertinent to analysis (for example, see Fig. V-2).

```
100001
Client:
Client Sample ID
SVL JOB #:60001
Recv Date:01/15/96
```

Fig. V-1. Sample Label

```
Client Sample ID
SVL # :00001  Matrix :WATER
JOB # :60001   CASE #: XXXX
SDG # :XXXXXXXXXX
ICAP ANALYZE BY: 02/2/96
```

Fig. V-2. Digestate Label

4. Sample Storage and Security

Samples, which require refrigeration, are maintained in a walk-in cooler at 4°C, except at times of sample prep or analysis. Samples which do not require refrigeration are maintained in a sample storage annex i.e., HNO_3. The cooler as well as the annex area is secured by lock and supervised by the Sample Custodian who is responsible for control of the samples while in the laboratory's custody. A security log is maintained which is initialed as samples are deposited or removed (see "Internal Sample Location Log" in Section X). Samples are retained at SVL for a minimum of 30 days (or longer if required by the client) after a data report is issued to the client so as to facilitate the resolution of potential analytical problems. At the end of the specified period, samples are returned to the client or discarded according to the procedures outlined in the SOP SVL 1001, "Sample Disposal."

E. Reagents, Standards, Gases, and Water

In an effort to keep contamination to a minimum, SVL recognizes the importance of using quality materials in the analytical process. Detailed below are descriptions of the procedures practiced at SVL to maintain contaminant free reagents, standards, gases, and water.

1. Reagent Chemicals

The most significant source of sample contamination for trace metal and organic analyses results from the acids and solvents used in digestion and extraction, respectively. To minimize this potential for contamination, SVL uses BAKER INSTRA-ANALYZED™ or better grade reagents for all environmental analyses. Solvents used for organic analyses are of GC grade purity.

Analysts are trained in the proper procedures for handling reagents with care to avoid accidents and contamination. The initial quality or grade of a reagent becomes immaterial at the point of contamination. The practice of these few simple rules will prevent bulk contamination:

a. Scoopulas, spatulas, pipettes, etc. are never used in reagent bottles.

b. An approximate amount of reagent required is dispensed into a secondary (clean) vessel; reagents are never dispensed directly from the reagent container.

c. Excess reagent is discarded. **Excess reagent is not returned to the bottle.**

2. Standards

The sources and quality of all standards, reagents, and chemicals used by SVL are documented. A record is maintained which indicates the name of the person preparing a standard, the source of the standard being used, weight or volume measurements, units, and dilutions. A separate laboratory equipped with sink and hood is dedicated to standard preparation. Standards are not stored in either the standard preparation or sample storage areas.

External reference standards are routinely obtained from governmental agencies such as USEPA. These standards are used to check and document the concentration of calibration standards and for method validation. If such standards are not available, standards from a reputable source, which carry a signed Certificate of Analysis, are used.

3. Gases

All carrier, oxidant, and fuel gases used by SVL meet or exceed instrument manufacturers' specifications. Gases are stored in a remote, secure area of the laboratory. Appropriate precautions are taken to prevent attaching incorrect cylinders to manifold systems. Each manifold is labeled and used for one (1) type of gas only. Carrier gas supply lines for organic analyses include in-line purifier traps.

A central air compressor and ballast tank are present in the building. The system supplies air under pressure to all laboratory areas.

4. Water

The primary general use water in the laboratory is furnished by a reverse osmosis system followed by a micropore filter with a minimum of one (1) ion-exchange resin cartridge. This satisfies the specifications of ASTM Type II water. Water used in the water lab is circulated through a four (4) cartridge ion-exchange system, until the water registers a conductivity of not more than 16.67 megaohm/cms; this meets the specifications of ASTM Type I water.

Reagent water used for organic analyses is obtained via a Nano-Pure™ water purifier system. This water source is regularly screened for method specific contaminates.

F. Calibration and Maintenance of Analytical Equipment

The following are descriptions of key instruments of concern which detail the routine calibration and maintenance procedures employed at SVL.

1. Analytical Balances. Mettler analytical balances are maintained by three levels of calibration; all balances are checked daily with an appropriate Class S weight, all balances are checked weekly over a three point range of weights using Class S weights, and balances are calibrated annually by an independent contractor. Upon completion of this annual calibration, a calibration status label is affixed to each balance.

2. UV/Vis Spectrometers. Spectrometers are operated in accordance with the manufacturers instructions. Calibration of these instruments is performed annually by an independent contractor. In addition the following steps are taken to ensure instrument control: Instruments are checked for proper wavelength and optical alignment, all absorption cells are optically matched and kept scrupulously clean, free of scratches, fingerprints, smudges, and evaporated film residues. Method specific verification or confirmation is performed as prescribed by each method.

3. Atomic Absorption Spectrometers. Maintenance of Varian and Thermo Jarrell-Ash Atomic Absorption spectrometers are performed according to manufacturer's recommendations and recorded in an instrument specific maintenance logbook. Calibration curves are established from analysis of three standards, of which

the stock solutions are made fresh daily. The initial (ICV) is made with a second source standard (EPA when possible) which is close to the midpoint of the calibration curve and is analyzed at the beginning of the run. A continuing calibration blank (CCB) and a continuing calibration verification (CCV) are analyzed at a frequency of 10%.

4. Inductively Coupled Plasma Spectrometer. Maintenance of the Thermo Jarrell-Ash ICAP-61 is according to manufacturer's specifications and are recorded in an instrument specific logbook. The calibration procedure includes the establishment of a seven point calibration curve, a CCB, CCV, and a second source ICV. Check samples are performed at a frequency of 10%.

5. Ion Chromatograph. The Dionex ion chromatograph is operated in accordance with manufacturer's instructions. All maintenance specified in the instruction manual are performed at the time intervals specified. Auto-calibration for the instrument established through the use of four standards is performed immediately following maintenance of the instrument and after that on an "as needed" basis. The calibration curve is verified daily with standards made fresh that day and the acceptance criteria is a retention time of $\pm$10%. In addition, a CCB and a CCV are performed at a frequency of 10%.

6. Gas Chromatographs/Detectors. Operation and maintenance of the various Hewlett-Packard gas chromatographs/detectors used by SVL for organic analyses are detailed in the respective standard operating procedures (SOPs) for these methods. Recommended manufacturer's maintenance schedules are followed and documented in the respective instrument logbooks. A routine GC/GCMS calibration consists of the following: an initial multi-point calibration to establish the calibration curve, a daily or continuing calibration to reconfirm the condition of the instrument, and a confirmation or verification at the end of the analytical sequence. The frequency of the continuing calibration for the GC is, at a minimum, once every 20 samples. Continuing calibration for the GC/MS occurs at least every twelve hours.

All repairs and maintenance to analytical instrumentation is recorded on SVL Form E004 "INSTRUMENT REPAIR LOG" and/or an instrument maintenance log kept at the instrument. See Fig V-4 on next page for example.

SVL Analytical, Inc.

INSTRUMENT REPAIR LOG

Instrument ID:_____

OUT OF SERVICE

Date:_____Time:_____Operator:_____

BACK IN SERVICE

Date:_____Time:_____Operator:_____

STATEMENT OF PROBLEM:

_____
_____
_____
_____

CORRECTIVE ACTION TAKEN:

_____
_____
_____
_____

PARTS REPLACED:

_____
_____
_____
_____

COST:

_____
_____

Repaired By:_____Date:_____

SVL Form :E004

Fig. V-4. Instrument repair log

G. Quality Control Protocols

SVL offers three (3) levels of data report packages. Level 1 reports consist of data results as standard report; QC data is not included in this report (although, all samples analyzed are batched with a preparation blank, laboratory control sample, spike and duplicate sample). Level 2 reports consist of the observance of USEPA CLP analytical protocols and a standard report (similar to Level 1 except it includes QC data). In level 3 reports, USEPA CLP analytical protocols are observed and USEPA CLP deliverables are reported (specific CLP forms are used and raw data and all required documentation is included).

Blanks

Preparation blanks are analyzed at a minimum of one per every batch of twenty (20) or fewer samples or each matrix type, whichever is more frequent. A preparation blank consists of laboratory pure water that is processed through all procedures, materials, and labware used for sample preparation and analysis.

In cases of non-aqueous samples, reagent blanks serve as preparation blanks. Sample batches that contain contaminated blanks are routinely re-prepared.

Laboratory Control Sample

A laboratory control sample (LCS) is a sample of known value used to validate the analytical procedure. One LCS is analyzed with every batch of twenty (20) or fewer samples or each matrix type, whichever is more frequent. Sample batches containing LCS's that are out of control limits are re-prepared. Control limits for solid LCS's are set by the supplier (typically $\pm$3s). Water or other aqueous LCS's have control limits of $\pm$20%.

LCS samples, for both organic and inorganic analyses, are prepared from different reference materials than those used in the preparation of the instrument calibration standards. Control limits specified by the method are used to monitor system performance.

Duplicate Sample

These are aliquots made in the laboratory of the same sample, each aliquot is treated exactly the same throughout the analytical method. The relative percent difference (RPD) between the values of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$RPD = \frac{|S - D|}{(S+D) \div 2} \times 100$$

Where,
RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

One duplicate sample is used for every batch of twenty (20) or fewer samples or each matrix type, whichever is more frequent. The tolerance limit for percent difference typically does not exceed $\pm$ 20 RPD. However, the duplicate is also a measure of the homogeneity of the sample matrix. An abnormally high RPD may be an indication of a non-homogeneous sample. Conversely, the RPD can measure the effectiveness of any grinding, sieving, and mixing procedures which may have been performed on the sample prior to analysis.

Check Standard and Controls

A check standard is prepared in the same manner as a calibration standard. The concentration is usually mid-range for the specific calibration curve. Controls are used to validate an existing calibration curve, and also typically fall mid-range on the calibration curve. The control is from a different (second) source than that of the standards and check standard. The USEPA CLP program identifies a "control" as the "initial calibration verification standard"

(ICV) and the "check standard" as the "continuing calibration verification standard" (CCV). Check standards are run at a frequency of 10%.

The check standard can provide information on the accuracy of the total analytical method and of instrumental performance and response consistency independent of various sample matrices and of the sample preparation procedure. Specific requirements and procedures for calibration and check standards are outlined in the procedure manuals referred to previously.

For organic analysis, a calibration check standard is analyzed at regular intervals as specified by the method, usually every 12 hours of run time. The results of the calibration check standard are evaluated to ensure that instrument calibration is within acceptable limits. This standard solution is prepared from the same reference materials as the initial calibration standards.

Matrix Spike, Matrix Spike Duplicate, and Surrogates

A sample matrix spike is prepared by adding a known amount of a pure compound to the environmental sample prior to digestion or extraction. This compound is identical to the analyte for which the sample is being assayed. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method, i.e., sample preparation and analysis.

An analytical spike is prepared by adding a known amount of analyte(s) to a digestate or extract of a sample for which the analyte(s) concentration has been determined. These spikes simulate the background and interferences found in the actual sample. The calculated percent recovery of the analytical spike is considered to reflect the relative accuracy of the sample analysis procedure only. Both the matrix spike and the analytical spike are also an indication of the effect of the sample matrix on the ability of the methodology to detect the specific analyte. When no change in volume due to the spike occurs, it is calculated as follows:

$$\%\text{Recovery} = \frac{(SSR - SR)}{SA} \times 100$$

Where, SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Tolerance limits for acceptable percent recoveries are established by clients data quality objectives, but normally are ± 20-25%.

For organics analysis the same spiking solution used to prepare the LCS is used to prepare the matrix spike and matrix spike duplicate samples. Matrix spike samples are prepared for every batch of twenty or fewer samples. The results obtained from the analysis of these matrix spike samples must meet the same control limits that apply to the LCS.

Surrogates are similar to spikes, except they are a compound not normally found in nature, nor expected in a particular set of samples. Surrogate compounds are added to every sample during the preparation stage. The results for these surrogate compounds must meet the control limits specified by the method.

Low Level Standards

As detection limits continue to drop lower and risk-assessment based criteria are used more frequently, it is increasingly important to have reliable data near the instruments detection limit (IDL). Very low level standards (LLS) are employed to better assess the quality of data at these near IDL concentrations. These LLSs are detection limit standard (USEPA CRA & CRI) which are run on the ICP at the beginning and end of instrument analytical runs. Due to the low concentration levels of these standards, typically, no guidelines for their recoveries exist,

other than that they are above the detection limit. Therefore, a rule of thumb criteria of ±50% is used for these standards.

This practice of performing low level standards does not apply to organic analysis, where the only determination for detection limits is via an initial replicate study and every 6 months thereafter.

Interference Check Samples

For analytes determined by ICP spectroscopy, an interference check sample is run at the beginning and at the end of an analysis sequence. This sample consists of interfering elements (usually Ca, Mg, Al, and Fe) at elevated levels to check, and allow the instrument operator to make corrections for, interelement interferences. In cases where the sample matrix is known, and other interelement interferences occur (i.e. As on Cd), SVL will make a custom ICS sample if requested. In cases where no analyte is present in the ICS, instrumental values should be ±5x the IDL, otherwise the instrumental value should be ±20% of the true value.

Completeness and Usability

Completeness describes the percentage of measurements that meet QA acceptance criteria for requested determinations. For QC materials that are not sample dependent (e.g., calibrations and verifications, LCS's and Blanks, low level standards and ICS's), 100% completeness is the requirement of SVL. For spikes, duplicates, duplicate spikes, and other QC samples that are matrix dependent, no requirements can be set for matrices other than water samples. SVL will follow CLP guidelines as a minimum for qualifying data. Clients may, on mutual agreement, specify more rigid QC protocols (i.e., reanalysis of dups and spikes, redigestion and reanalysis of dups and spikes). A completeness criteria of 90% will be used for water matrices, excluding Sb and Ag.

Usability describes the percentage of measurements that can be used for making decisions based on reported values. In many cases, estimated values are sufficient to characterize certain analytes in a sample. We believe the client is the best judge in interpreting the usability of their data and therefore make no attempt to set guidelines for this parameter.

QA Reports

The QA Coordinator shall prepare a written report to the Laboratory Director and technical staff on a quarterly basis. The report shall summarize the Nonconformance Memo's, highlight corrective actions taken, review recurring QA issues, and note any action regarding audits. In addition, these reports cover recent modifications which occurred during the previous three months concerning QA policy changes and general lab practices.

Control Charts

Control charts are maintained for Laboratory Control Samples (LCSS, LCSW), for both aqueous and solid matrices. Selected analytes are maintained on control charts. Typical parameters are: As by 206.2, Ni, Sb, and Zn by 200.7, F by 300.0, and TOC by 415.2. Immediately after sample analysis, laboratory personnel update the appropriate charts and perform corrective action as necessary.

SVL uses an USEPA certified LCS with a known population mean and USEPA set control limits. Currently, the LCSS used is EPA-LV (0287). The LCSW is derived from the suite of initial calibration solutions acquired from EPA-EMSL and ICF Technology, Inc. A standard X bar control chart is used to plot LCS results. Upper and lower warning limits (UWL, LWL) of ± 2s (where s equals standard deviation) are calculated with no less than fifteen (15) measurements; the upper and lower control limits (UCL, LCL) are determined by either the supplier (for solid LCS's) or the appropriate SOW for aqueous LCS's (usually ±20%). Warning limits are updated at least quarterly. An analytical run is considered out of control when, for any analyte:

- Any one point is outside control limits.
- Any three consecutive points are outside warning limits.
- Any eight consecutive points are on the same side of the centerline.

- Any six consecutive points are such that each point is larger (smaller) than its immediate predecessor.
- Any obvious cyclic pattern is seen in the points.

For organic analyses, limits for accuracy and precision assessment are based on the monitoring of the LCS for non-matrix impaired results. The results of the LCS are initially compared to method specified limits to determine acceptability, once an adequate in-house pool of recovery data has been generated (5-10 data points), SVL determines its own control limits. These limits at least meet, if not exceed the limits specified by the methods. Any sample batch results in which the LCS has failed to meet method specified acceptance requirements are considered suspect and are re-analyzed and re-prepped as required.

In addition, the results for matrix spike and matrix spike duplicate samples are monitored for QC acceptance i.e, precision and accuracy, as specified by the method. In-house control limits are generated based on individual matrix types (i.e, water, soil, waste); as sufficient data points become available. Control limits for surrogate compounds are also routinely monitored.

H. Audits

The success of any QA program is driven by its ability to monitor the effectiveness of the quality systems which are in practice. In other words, an assurance program is only as good as its auditing procedures.

1. Performance Evaluations

Internal Performance Evaluations

The Quality Assurance Coordinator conducts internal performance evaluations (PE) on an annual basis. This consists of a group of samples that are tested for the typical parameters run at SVL. PEs are run double-blind, with only the Quality Assurance Coordinator and Sample Control Officer aware of which samples are controls. PEs are run on randomly selected dates. Results are reported to the Laboratory Director.

External Performance Evaluations

SVL participates in the USEPA WS and WP PE study series (comprised of 4 studies annually) for a variety of parameters. As a USEPA CLP laboratory SVL is also required to participate in the EMSL-LV Inorganic Performance Evaluation Study. Copies of the most recent results are available upon request.

2. System Audits

The Quality Assurance Coordinator conducts internal QA/QC system audits on an annual basis. These audits provide a thorough overview of implementation of the QAP within the laboratory. If project specific audits are performed by the Quality Assurance Coordinator because of project requirements, the audit shall focus only on the performance of the laboratory for the project.

Audits shall be performed in the following manner:

A. An audit plan shall be prepared, reviewed, and updated for every annual audit, with the information gained during previous audits being considered. The audit plan shall be the basis for the audit and should define participating auditors, applicable documents, the audit schedule, and the scope of laboratory activities to be audited.

B. At the close of the audit, a post-audit meeting shall be held to discuss the audit findings. The auditor can close a finding during this discussion if the laboratory staff can satisfactorily demonstrate that the finding is inappropriate.

C. An Audit Summary Report shall be prepared by the Quality Assurance Coordinator which discusses the following:

- Date and location of audit.
- Persons contacted in the laboratory
- Laboratory operations audited.
- Findings and observations requiring corrective action.
- For each finding a due date for corrective action, means of verifying correction, and closure statement is required. All findings must be closed.

The Audit Summary Report shall be issued as soon as possible after completing the audit.

D. Based on the audit plan, a detailed audit checklist shall be prepared for use on future audits. An example of a System Audit Checklist is given on the following pages.

During the course of system audits, the Quality Assurance Coordinator shall be cognizant of recurring non-conformance areas in the laboratory and/or trends which could affect quality. Recurring non-conformance items and trends should be addressed in the audit report. Correction for such events may require a review of the adequacy of the QAP. If the inherent problem lies within the QAP, the plan shall be amended through appropriate revision of Quality Assurance documents.

3. Data Audit

Data audits are conducted at a frequency of 10 % and are performed on a monthly basis. The purpose of the data audit is twofold; to function as an additional level of review for outgoing data packages and as a means for the QA office to be alerted to and watchful of chronic problems and trends which may be developing in data package production or anywhere along the analytical process.
Selection of data package for audit occurs in the following manner. The data packages are randomly cho and are representative of the current month's rate of production (e.g. if total package output for the month .. 120, 12 data packages are reviewed).

A complete review of the data contained in the report is performed (100 % of results are checked) including a review of the Chain-of-custody, holding times, and the invoice. All QC sample calculations are reviewed and all raw data results are verified against the reported results.

I. Corrective Action

Any analysis not conforming to control limits stated above must be halted until the laboratory supervisor is consulted. The analyst corrects the problem, with assistance if necessary, and fills out the appropriate SVL Nonconformance Memo. The laboratory supervisor reviews the form and passes it on to the Quality Assurance Coordinator. Corrective action protocols conform to procedures established for the USEPA Contract Laboratory Program (CLP), or by client specific agreements.

SVL Analytical, Inc.

QA/QC SYSTEMS AUDIT

Performed By:_____ Date of Audit:_____

Copies To: _____
_____
_____

The purpose of this audit is to verify the quality of analyses performed by the laboratory.

I. Sample Control	YES	NO	N/A
1. Is the refrigerator temperature monitored and recorded daily?	___	___	___
2. Are all samples labeled?	___	___	___
3. Is the Sample Location Log correct and up to date?	___	___	___
4. Are samples stored in the refrigerator in an orderly fashion and on their assigned shelves?	___	___	___
5. Are samples disposed of according to schedule?	___	___	___
7. Are instructions for sample receiving available?	___	___	___
8. Are instructions for sample preservation available?	___	___	___
9. Are order for analytical services/chain of custody sheets signed?	___	___	___

COMMENTS_____
_____
_____

SVL Analytical, Inc. QA/QC SYSTEMS AUDIT
Page 2 of 4

II. Water/Digestion Lab	YES	NO	N/A
1. Is preventive maintenance performed and documented?	___	___	___
2. Do specific instruments have repeated maintenance problems?	___	___	___
3. Are sample/instrument logbooks up to date?	___	___	___
4. Are standards traceable to a nationally certified source?	___	___	___
5. Are standards properly prepared and stored?	___	___	___
6. Is the temperature of all drying ovens recorded daily?	___	___	___
7. Are "S" class weights used to check calibration of analytical balances?	___	___	___
8. Is a record of yearly service available for every analytical balance?	___	___	___
9. Is the conductivity of the distilled water supply checked daily?	___	___	___
10. Is the pH meter checked daily, or before use, and recorded?	___	___	___
11. Are test procedures readily available to the analyst?	___	___	___
12. Are QA documents available to the analyst?	___	___	___
13. Are records available indicating analysis duplicates and spikes?	___	___	___
14. Are methods available for analysis of routine and non-routine samples?	___	___	___

COMMENTS_____

SVL Analytical, Inc. **QA/QC SYSTEMS AUDIT**
Page 3 of 4

III. **Instrument Lab**	YES	NO	N/A
1. Is preventive maintenance performed and documented?	___	___	___
2. Do specific instruments have repeated maintenance problems?	___	___	___
3. Are sample/instrument logbooks up to date?	___	___	___
4. Are standards traceable to a nationally certified source?	___	___	___
5. Are standards properly prepared and stored?	___	___	___
6. Is the temperature of all drying ovens recorded daily?	___	___	___
7. Are test procedures readily available to the analyst?	___	___	___
8. Are QA documents available to the analyst?	___	___	___
9. Are records available indicating analysis duplicates and spikes?	___	___	___
10. Are methods available for analysis of routine and non-routine samples?	___	___	___

COMMENTS_____

SVL Analytical, Inc. **QA/QC SYSTEMS AUDIT**

IV. **Sample Disposal**	YES	NO	N/A
1. Are all samples evaluated for toxicity per SVL SOP 15?	___	___	___
2. Are all drums labeled with the appropriate label (i.e., "Hazardous Waste")?	___	___	___

COMMENTS _____

J. Standard Operating Procedures

Standard Operating Procedure (SOP) as defined by the EPA, is a written document which provides directions for the step-by-step execution of an operation, analysis, or action that is commonly accepted as the method for performing certain routine or repetitive tasks.

All operational procedures at SVL conform to a uniform numbering scheme and standard format which is outlined in the SOP on writing SOPs (SVL 1002). SOPs are formatted in a uniform and consistent manner thereby facilitating proper and efficient use by laboratory staff.

It is the policy of SVL to create and maintain SOPs that are useful, accurate, current, and accessible to all employees at SVL. To this end, SVL endeavors to incorporate the input of analysts, staff and/or those most closely involved with the tasks outlined in the SOPs.

To obtain reliable results and ensure reproducibility, SVL believes in and implements a policy of generating, distributing and using accurate and effective SOPs. One step toward achieving this goal is that all operating procedures are subjected to a minimum of two levels of review; i.e., the lab supervisor and the QA officer are required to give approval to all SOPs prior to their release and use by laboratory staff.

The lab supervisor is responsible for ensuring that the technical components of the procedure as written are in agreement with the procedure as performed and technically accurate. The QA review is desinged to ensure compliance with the stated method, any applicable regulations, and conforming to SVL's QA program.

In addition, the QA review also evaluates based upon the conformance to established SOP format and compliance with SVL management policy and this document - the Quality Assurance Plan.

In the event that a "draft" SOP fails to meet any of these requirements, it is denied approval by the QA office, returned to the appropriate personnel for modification to comply with the above stated requirements. This "draft" process is continued until all issues have been resolved and the document is deemed acceptable by the QA office.

The numbering system for SOPs is comprised of seven characters: the letters SVL followed by a four digit, unique number which comforms to the following classifications:

- 1000 series - QA and Health & Safety
- 2000 series - Sample and Data Management
- 3000 series - Organic Procedures
- 4000 series - Inorganic Procedures
- 6000 series - Mineral Division Procedures

As new procedures are generated, the QA office determines the appropriate category and assigns the next consecutive number for that category.

A complete list of all SVL SOPs, including those procedures which have been retired from use, is listed on the following pages.

Master List of SVL SOPs

SERIES REVIEWED	SOP NUMBER	SOP TITLE	D A T
1000 Series:			
Safety and QA	SVL 1001	SAMPLE DISPOSAL	SEP 08, 94
	SVL 1002	STANDARD FORMAT FOR WRITING SOPs	JUL 06, 94
	SVL 1003	LOCKOUT PROCEDURE	NOV 11, 94
	SVL 1004	READING & CAL. OF THERMOMETERS	AUG 19, 94
	SVL 1005	QUALITY ASSURANCE AUDITS	AUG 15, 94
	SVL 1006	INTERNAL SAMPLE LOCATION	JAN 10, 95
	SVL 1007	SOIL STERILIZATION	MAR 06, 95
	SVL 1008	HAZARDOUS WASTE DISPOSAL	NOV 11, 94
	SVL 1009	CORRECTIVE ACTION PROTOCOL	MAY 26, 95
	SVL 1010	TRAINING AND DOCUMENTATION	MAY 30, 95
	SVL 1011	PERFORMANCE OF MDL STUDY	DEC 08, 95
	SVL 1012	BUCKING ROOM PROCEDURE	FEB 26, 96
2000 Series:			
Sample & Document	SVL 2001	SAMPLE RECEIVING	AUG 19, 94
Management	SVL 2002	DUTIES OF SAMPLE CUSTODIAN	JUL 12, 94
	SVL 2003	SVL JOB CREATION	AUG 19, 94
	SVL 2004	SAMPLE STORAGE & SECURITY	AUG 19, 94
	SVL 2005	TRACKING SAMPLE ANALYSIS	AUG 19, 94
	SVL 2006	DATA RECORDING & CORRECTIONS	JUN 13, 95
	SVL 2007	CASE FILE ASSEMBLY	JUN 13, 95
	SVL 2008	HANDLING CONFIDENTIAL DOCUMENTS	JUN 13, 95
	SVL 2009	TECHNICAL REVIEW OF DATA	AUG 19, 94
	SVL 2010	EPA DATA DELIVERABLES GENERATION	AUG 19, 94
	SVL 2011	DOCUMENT & DATA PACKAGE SHIPPING	AUG 19, 94
	SVL 2012	DATA MANAGEMENT & HANDLING	AUG 19,
	SVL 2013	DATA PACKAGE PRODUCTION	AUG 13,
	SVL 2014	ACID BASE ACCOUNTING/EXCEL PROGRAM	SEP 29, 94
	SVL 2015	LEVEL 3 - CLP DATA PACKAGE	AUG 13, 93
	SVL 2016	SAMPLE LABEL GENERATION	JAN 26, 96
3000 Series:			
Organic	SVL 3001	GLASSWARE WASHING INSTRUCTIONS	JAN 08, 96
	SVL 3002	SAMPLE PREP: TPH-GASOLINE/BTEX	JAN 08, 96
	SVL 3003	SAMPLE PREP: VOC - 8010, 8020	JAN 08, 96
	SVL 3004	SAMPLE PREP: TPH DIESEL/MOTOR OIL	JAN 08, 96
	SVL 3005	SAMPLE PREP: TPH-DRO	JAN 08, 96
	SVL 3006	SAMPLE PREP: TRPH	JAN 08, 96
	SVL 3007	SAMPLE PREP: SVOC - 8270	JAN 08, 96
	SVL 3008	SAMPLE PREP: CHLORINATED PESTICIDES/PCB (8081)	JAN 08, 96
	SVL 3009	SAMPLE PREP: VOC - 8260	JAN 08, 96
	SVL 3010	SAMPLE PREP: CHLORINATED HERBICIDES (8150)	JAN 08, 96
	SVL 3011	SAMPLE PREP: TCLP (1311)	JAN 08, 96
	SVL 3012	SAMPLE PREP: GPC (GEL-PERMEATION CHROMATOGRAPHY)	JAN 08, 96
	SVL 3013	SAMPLE PREP: WTPH-HCID (WA STATE DOE)	JAN 08, 96
	SVL 3020	ANALYSIS: TPH-GASOLINE, GRO &BTEX	JAN 08, 96
	SVL 3021	ANALYSIS: HALOGENATED VOLATILE ORGANICS (8010)	JUN 10, 96
	SVL 3022	ANALYSIS: AROMATIC VOLATILE ORGANICS (8020)	JUN 10, 96
	SVL 3023	ANALYSIS: VOLATILE ORGANICS (524.2)	JUN 10, 96
	SVL 3024	ANALYSIS: TPH-DIESEL & TPH-MOTOR OIL	JAN 08, 96
	SVL 3025	ANALYSIS: TPH-DRO	JAN 08, 96
	SVL 3026	ANALYSIS: TRPH-IR (418.1 TOTAL RECOVERABLE PETRO. HC)	JAN 08, 96
	SVL 3027	ANALYSIS: SEMI-VOLATILE ORGANICS (8270)	JAN 08, 96
	SVL 3028	ANALYSIS: VOLATILE ORGANICS (8260)	JAN 08,

SERIES REVIEWED		SOP NUMBER	SOP TITLE	D A T E
Series 3000: (CONT.)		SVL 3029	ANALYSIS: CHLORINATED PESTICIEDES/ PCB (8081)	JAN 08, 96
		SVL 3030	ANALYSIS: CHLORINATED HERBICIDES (8151)	JAN 08, 96
		SVL 3031	ANALYSIS: TOTAL HALOGENS IN OIL (9076 TOX)	JAN 08, 96
		SVL 3032	ANALYSIS: PCBs IN OIL (8081)	JAN 08, 96
		SVL 3033	ANALYSIS: WTPH-HCID (WA STATE DOE)	JAN 08, 96
		SVL 3040	QC CRITERIA FOR GC METHODS - GC & GC/MS	JAN 08, 96
		SVL 3041	STANDARD PREP, TRACEABILITY AND DISPOSAL	JAN 08, 96
		SVL 3042	DATA REVIEW AND REPORTING	JAN 08, 96
		SVL 3050	ANALYSIS:	
Series 4000: Inorganic		SVL 4001	CONTAMINATION PREVENTION	AUG 25, 94
		SVL 4002	CALIBRATION OF MEASURING APPARATUS	MAR 26, 96
		SVL 4003	GLASSWARE CLEANING	AUG 25, 94
		SVL 4004	DETERMINING pH OF WATER SAMPLES	AUG 25, 94
		SVL 4005	DETERMINING PERCENT SOLIDS	AUG 19, 94
		SVL 4006	SAMPLE PREPARATION	AUG 19, 94
		SVL 4007	TRACEABILITY OF STANDARDS & STOCK SOLUTIONS	JUN 13, 95
		SVL 4008	OPERATION OF ICP	MAR 14, 96
		SVL 4009	OPERATION OF GRAPHITE FURNACE	FEB 12, 96
		SVL 4010	DETERMINATION OF MERCURY - CVAA	MAR 14, 96
		SVL 4011	CYANIDE BY MANUAL DISTILLATION	OCT 31, 94
		SVL 4012	CYANIDE BY MIDI DISTILLATION	SEP 09, 94
		SVL 4013	ACID WASHING	SEP 16, 96
	Retired	SVL 4014	SUMMARY OF LEVEL 1 DIGESTION	AUG 13, 94
	Retired	SVL 4015	TOTAL METALS LEVEL 1 DIGESTION (3030)	AUG 13, 94
	Retired	SVL 4016	SUMMARY OF LEVELS 2 & 3 DIGESTION	AUG 13, 94
		SVL 4017	TOTAL METALS CLP DIGESTION (3030)	AUG 13, 96
	Retired	SVL 4018	DISSOLVED METALS (3030)	AUG 13, 94
		SVL 4019	SOIL DIGESTION (3050)	MAR 20, 95
	Retired	SVL 4020	US BUREAU OF MINES DIGESTION	AUG 13, 93
		SVL 4021	FILTER DIGESTION	MAR 29, 95
		SVL 4022	PERCENT MOISTURE/PERCENT SOLIDS (SVL 999)	JAN 22, 96
		SVL 4023	ICP SCAN (SVL METHOD)	AUG 13, 93
		SVL 4024	COLOR (110.2)	AUG 14, 95
		SVL 4025	CONDUCTIVITY (120.1)	APR 07, 95
		SVL 4026	TURBIDITY (180.1)	AUG 13, 96
		SVL 4027	HARDNESS: CALC. & TITRIMETRIC (130.1 & 130.2)	JAN 22, 96
		SVL 4028	DETERMINATION OF pH (150.1)	APR 07, 95
		SVL 4029	SPECIFIC GRAVITY (2710)	JAN 22, 96
		SVL 4030	DETERMINATION OF ALKALINITY (310.1)	APR 07, 95
		SVL 4031	ACIDITY (305.1)	OCT 23, 95
		SVL 4032	SULFIDES (376.1)	JAN 22, 96
		SVL 4033	HYDROGEN SULFIDE GAS GENERATION (4500-S-F)	SEP 25, 95
		SVL 4034	SOLIDS: DISSOLVED & SUSPENDED (160.1 & 160.2)	APR 07, 95
		SVL 4035	SOLIDS: TOTAL & VOLATILE (160.3 & 160.4)	AUG 10, 95
	Retired	SVL 4036	PARTICLE (GRAIN) SIZE (D-422)	SEP 16, 96
		SVL 4037	METHYLENE BLUE SUBSTANCES (425.1)	NOV 15, 94
		SVL 4038	PHENOLS (420.1)	OCT 20, 94
		SVL 4039	OIL AND GREASE (413.1)	JAN 22, 96
		SVL 4040	TOTAL PHOSPHOROUS: WATERS (4500-P)	JAN 22, 96
		SVL 4041	TOTAL PHOSPHOROUS: DIGESTION FOR SOLIDS	JAN 22, 96
		SVL 4042	ORTHO-PHOSPHOROUS: PHOSPHATE (365.2)	JAN 22, 96
		SVL 4043	CHEMICAL OXYGEN DEMAND	DEC 02, 94
		SVL 4044	ORGANIC MATTER	MAR 03, 95
		SVL 4045	TOTAL KJELDAHL NITROGEN (351.4)	DEC 22, 94
		SVL 4046	AMMONIA AS NITROGEN (350.3)	NOV 07, 95

SERIES REVIEWED		SOP NUMBER	SOP TITLE	D A T E
Series 4000: (CONT.)		SVL 4047	NITRATE-NITRITE (353.2)	NOV 04, 94
		SVL 4048	NITRATE AS N_2: AUTOMATED Cd REDUCTION (4500-NO3)	, 93
		SVL 4049	CATION EXCHANGE CAPACITY (9081)	AUG 13, 9
	Retired	SVL 4050	CYANIDE DISTILLATION (MANUAL)	AUG 13, 93
	Retired	SVL 4051	CYANIDE DISTILLATION (MIDI)	AUG 13, 93
	Retired	SVL 4052	TOTAL CYANIDE: COLORIMETRIC (335.3)	AUG 13, 93
	Retired	SVL 4053	TOTAL CYANIDE: TITRIMETRIC (335.2)	AUG 13, 93
		SVL 4054	CYANIDE AMENABLE TO CHLORINATION (335.1)	JAN 22, 96
	Retired	SVL 4055	WEAK & DISSOCIABLE CYANIDE (4500-CN I)	AUG 13, 93
		SVL 4056	FREE CYANIDE (4500-CN D)	JAN 22, 96
	Retired	SVL 4057	SPOT TEST FOR CYANIDE (4500-CN K)	AUG 13, 93
		SVL 4058	ELEMENTAL SULFUR (SVL METHOD)	NOV 15, 94
		SVL 4059	CHROMIUM-HEXAVALENT (218.4)	NOV 15, 94
		SVL 4060	LOSS ON IGNITION (SVL METHOD)	AUG 13, 93
		SVL 4061	ACID GENERATION POTENTIAL	MAY 20, 96
		SVL 4062	LEAD-EDTA TITRATION	AUG 13, 93
		SVL 4063	ZINC (SVL METHOD)	AUG 13, 93
		SVL 4064	JTS SAMPLES (YARD SAMPLES)	JUN 16, 94
		SVL 4065	METEORIC WATER MOBILITY	JUN 16, 94
		SVL 4066	TCLP (1311)	AUG 13, 93
		SVL 4067	TCLP - MULTIPHASE (1311)	AUG 13, 93
		SVL 4068	SPLC (1312)	AUG 13, 93
		SVL 4069	Cs BY FLAME EMISSION (SVL 101)	AUG 13, 93
		SVL 4070	TOTAL SUSPENDED PARTICULATES	APR 10, 95
		SVL 4071	HYDROLYZABLE AND TOTAL ORGANIC PHOSPHORUS	AUG 13, 93
		SVL 4072	ACID NEUTRALIZATION POTENTIAL	OCT 02, 95
		SVL 4073	ACID BASE ACCOUNT	OCT 02, 95
		SVL 4074	AMMONIA: BORATE TECATOR DISTILLATION	JAN 22, 96
		SVL 4075	WAD CYANIDE	FEB 09, 95
		SVL 4076	RFA BY COLORIMETRIC	MAY 26, 9
		SVL 4077	DIGESTION: METHOD 3040 - OILS, GREASE, & WAXES	MAR 20, 9
		SVL 4078	DIGESTION: METHOD 3020 - METALS BY GFAA	MAR 20, 95
		SVL 4079	DIGESTION: METHOD 3010 - METALS BY FLAA	MAR 20, 95
		SVL 4080	DIGESTION: METHOD 3005 - TOTAL RECOVERABLE AND DISSOLVED METALS	MAR 21, 95
		SVL 4081	CHROMIUM HEXAVALENT (Cr-VI) METHOD 1687	JAN 22, 96
		SVL 4082	ARSENIC SPECIATION	JAN 22, 96
		SVL 4083	ION CHROMATOGRAPHY - METHOD 300.0	DEC 05, 95
		SVL 4084	AUTO TITRATION - ALKALINITY	MAR 01, 95
		SVL 4085	FLAA for LEAD	
		SVL 4086	SOXALET	
		SVL 4087	FLUORIDE by ISE - METHOD 340.2	JAN 22, 96
		SVL 4088	DIGESTION OF DRINKING WATER SAMPLES	NOV 30, 95
		SVL 4089	LECO	
		SVL 4090	FILTER PREPARATION	MAR 28, 96
		SVL 4091	TOTAL RECOVERABLE METALS DIGESTION (200.2)	
		SVL 4092	EXTRACTION FOR Cr(VI) SOLID SAMPLES (3060A)	AUG 05, 96
		SVL 4093	CASSETTE FILTER DIGESTION	AUG 15, 96
		SVL 4094	CLP SOILS DIGESTION	AUG 22, 96
		SVL 4095	FLASHPOINT	SEP 17, 96
Series 6000: Minerals Division		SVL 6001	AQUA-REGIA DIGESTION	MAR 06, 95
		SVL 6002	CARBONATE FUSION	MAR 09, 95
		SVL 6003	CLP DIGESTION	MAR 09, 95
		SVL 6004	HOT CN LEACH FOR AU & AG	MAR 20, 95
		SVL 6005	CLOSED VESSEL DIGESTION	MAY 06, 95
		SVL 6006	NITRIC - FLUORBORIC ACID DIGESTION	

SERIES REVIEWED	SOP NUMBER	SOP TITLE	D A T E
Series 6000: (CONT.)	SVL 6007	PEROXIDE FUSION DIGESTION	
	SVL 6008	PERCHLORIC NITRIC & HYDROFLUORBORIC ACID DIGESTION	
	SVL 6009	FIRE ASSAY	JUN 01, 95
	SVL 6010	PRESSURE DISSOLUTION: GEOCHEM AG & AU	MAY 05, 95
	SVL 6011	FLAME ATOMIC ABSORPTION (FlAA)	
	SVL 6012	SAMPLE PREP	FEB 26, 95
	SVL 6013	ACID AMMONIUM ACETATE DIGESTION	
	SVL 6014	DETERMINATION OF TOTAL URANIUM (U_3O_8)	

VI. DATA MANAGEMENT

SVL utilizes state of the art networking software (Novell NetWare® 3.11™) and hardware to integrate laboratory operations; from sample receiving to report generation, automation and connectivity enable SVL to rapidly process and manage large amounts of data. Network linked PCs are located in analytical laboratories to enable personnel to review data on individual jobs and samples, methods, and SOPs.

Analysts perform specific analyses and enter data onto benchsheets or directly into the computer system depending on the type of report desired by the client. After a set of analyses has been completed, the results are calculated according to the methods specified in the procedural protocols. At a minimum 10 percent of these calculations are double-checked by the laboratory supervisor or his/her designee. Those calculations checked are indicated by a check mark. The signature of the reviewer and the date reviewed are placed on each document checked. **If any discrepancies are found in a 10 percent spot check, then another 20 percent are checked. If no discrepancies are discovered, the data is accepted and a report issued to the client. If other discrepancies are found, all data is reworked and reanalyses conducted when necessary.**

Data that will be used to create an USEPA CLP deliverables package is then loaded into a Ward Scientific software program for CLP report generation. After assembly, Contract Compliance Screening software is utilized to screen data packages for completeness and accuracy before delivery to the client. SVL has the capability of providing hardcopy and diskettes for SOW 7/87, 7/88, 3/90, ILM02.1, ILM03.0 and ILMO4.0 deliverables requirements. IBM compatible diskettes are available in all EPA CLP formats, as well as popular spreadsheet and database files.

Data that are to be assembled into a standard report are loaded into SVL's proprietary Sample Management system. Reports are available in a number of routine and custom hardcopy formats. ASCII, spreadsheet, and database data files are also available. If a client has a specific format, we are usually able to provide data ' will merge into their previous records without problems.

All data related to each job are archived for at least 12 months after reports have been issued. This period may be longer or shorter, at the clients discretion.

Hayes™ compatible modem transfer of data is available. SVL maintains a bulletin board allowing clients to download their specific results in "real time". E-mail is also an option for "on-line" clients.

VII. CERTIFICATIONS *

Inorganic:

SVL has a current USEPA CLP inorganic contract. USEPA Contract Laboratory performance is continually monitored through on-going Quality Assurance evaluations conducted by the Environmental Monitoring and Systems Laboratory/Las Vegas (EMSL/LV). These evaluations consist of periodic reviews of analytical data and supporting documentation complemented by on-site laboratory inspections and quarterly evaluation of analytical performance through performance sample results. On-site laboratory evaluations ensure continuing laboratory adherence to analytical and QA/QC procedures and that overall performance meets the requirements of the USEPA Contract Laboratory Program.

Drinking Water:

- State of Idaho
- State of Montana
- State of Washington
- State of Oregon
- State of Arizona
- State of Colorado
- State of Nevada
- State of North Dakota
- State of Utah

Environmental Laboratory Accreditation:

- State of Nevada
- State of Utah
- State of Arizona
- State of Washington
- State of California

Organics:

SVL has current certification for all organics analyses listed in this document, by the following state agencies. These certifications are based on PE sample results from the EPA Water Pollution (WP) and Water Source (WS) Study Programs. SVL is presently pursuing additional certifications with several other state programs.

Environmental Laboratory Accreditation:

- State of Washington
- State of Utah
- State of Arizona
- State of Nevada
- State of California

Drinking Water

- State of Idaho
- State of North Dakota
- State of Oregon
- State of Arizona
- State of Montana
- State of Washington
- State of Utah

Organic and Inorganic Validations:

- U.S. Army Corps of Engineers

* Refer to supporting documents section for copies of certificates.

VIII. GLOSSARY

Accuracy — The degree of agreement of a measured value with the true or expected value of the quantity of concern

Aliquot — An exact fraction of a solution or suspension.

Bias — A systematic error inherent in a method or caused by some artifact or idiosyncrasy of the measurement system. Temperature effects and extraction efficiencies are examples of the first kind. Blanks, contamination, mechanical losses, and calibration errors are examples of the latter kinds. Bias may be both positive and negative, and several kinds can exist concurrently so that net bias is all that can be evaluated, except under special conditions.

Blank — An artificial sample designed to monitor the introduction of artifacts into the process. For aqueous samples, reagent water is used as a blank matrix; however, a universal blank matrix does not exist for solid samples, and therefore, no matrix is used.

Reagent blanks are aliquots of analyte-free water or solvent analyzed with the analytical batch.

Prep Blanks are reagent blanks which are created at the time of sample preparation using all the reagents used in the paration of the samples (i.e. distillation or extraction)

Method blanks are reagent blanks which are put through all the steps of a specific method along with the samples.

Field Blanks are randomly selected sample containers that are filled with distilled water and the appropriate chemical preservative in the field.

Trip blanks and Equipment blanks (or rinsates) are two specific types of field blanks. Trip blar are not opened in the field. They are a check on sample contamination originating from samp transport, shipping, and from site conditions. Equipment blanks (or rinsates) are opened in the field and the contents are poured appropriately over or through the sample collection device, collected in a sample container, and returned to the laboratory as a sample. Equipment blanks are a check on sampling device cleanliness.

Blind Sample — A sample submitted for analysis whose composition is known to the submitter but unknown to the analyst. A blind sample is one way to test proficiency of a measurement process.

Calibration — Comparison of a measurement standard or instrument with another standard or instrument to report or eliminate by adjustment any variation (deviation) in the accuracy of the item being compared.

Check Standard — A blank which has been spiked with the analyte(s) from an independent source in order to monitor the execution of the analytical method.

Contamination

There are two general classifications of contamination; random and systematic. Random contamination causes imprecision in analytical results as noted by significant differences between results of duplicate analyses. Systematic contamination generally results in consistent shifts in baseline concentrations as demonstrated by field blanks.

CLP The Contract Laboratory Program (CLP) created by the United States Environmental Protection Agency to perform analytical work required in support of Superfund.

Control Limit The limits shown on a control chart beyond which it is highly improbable (within a 99.7 % probability) that a point could lie while the system remains in a state of statistical control.

Control Chart A graphical plot of test results with respect to time or sequence of measurement, together with limits within which they are expected to lie when the system is in a state of statistical control.

Detection Limit The smallest concentration/amount of some component of interest that can be measured by a single measurement with a stated level of confidence.

Instrument Dection Limit (IDL) - The smallest concentration detectable on a specific instrument.

Method Detection Limit (MDL) - The smallest concentration detectable by a specific method (the measurements used for this determination are carried through all the steps required by the method).

Double Blind A sample known by the submitter but submitted to an analyst in such a way that neither its composition nor its identification as a check sample are known to the latter.

Duplicate Sample Aliquots are made in the laboratory of the same sample, and each aliquot is treated exactly the same throughout the analytical method. The relative percent difference (RPD) between the values of the duplicates, as calculated below, is taken as a measure of the <u>precision</u> of the analytical method. The relative percent difference for original sample and duplicate is calculated as follows:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

Where,
RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

Homogeneity The degree to which a property or substance is randomly distributed throughout a material. Homogeneity depends on the size of the sample under consideration. Thus a mixture of two minerals may be nonhomogeneous at the molecular or atomic level but homogeneous at the particulate level.

Laboratory Control Sample(LCS) A material of known composition that is analyzed concurrently with test samples to evaluate a measurement process.

Matrix Spike Designed to provide information about the effect of the sample matrix on the digestion and measurement methodology. The spike is added prior to sample extraction/digestion and analysis. Individual component sample recoveries are calculated as follows:

$$\%Recovery = \frac{(SSR - SR)}{SA} \times 100$$

Where, SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Mean The sum of all observations divided by the number of observations.

Method An assemblage of measurement techniques and the order in which they are used.

Performance Audit A process to evaluate the proficiency of an analyst or laboratory by evaluation of the results obtained on known test materials.

Precision The degree of mutual agreement characteristic of independent measurements as the results of repeated application of the process under specified conditions.

Procedure A set of systematic instructions for using a method of measurement or sampling or the steps or operations associated with them.

Quality Assessment The overall system of activities whose purpose is to provide assurance that the quality control activities are done effectively. It involves a continuing evaluation of performance of the production system and the quality of the products produced.

Quality Assurance A system of activities which the purpose is to provide to the producer or user of a service the assurance that it meets defined standards of quality. It consists of two separate but related activities, quality control and quality assessment.

Quality Control The overall system of activities whose purpose is to control the quality of a service so that it meets the needs of users. The aim is to provide quality that is satisfactory, adequate, dependable, and economic.

Relative Standard Deviation The standard deviation divided by the mean and multiplied by 100.

$$RSD = s/X * 100$$

Sample A representative sample of any material (aqueous, nonaqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required.

Standard Operating Procedure A procedure adopted for repetitive use when performing a specific measurement or sampling operation. It may be a standard method or one developed by the user.

Subsample A portion taken from a sample. A laboratory sample may be a subsample of a gross sample; similarly, a test portion may be a subsample of a laboratory sample.

Standard Deviation The positive square root of the variance (i.e., σ for populations and s for a sample set of the population). A measure of the average spread around the mean.

Variance The value approached by the average of the sum of the squares of deviations of individual measurements from the mean. Mathematically, it may be expressed as:

$$\frac{\Sigma(X_i - m)^2}{n} \rightarrow \sigma^2 \text{ as } n \rightarrow \infty$$

Ordinarily, it cannot be known but only its estimate s^2, which is calculated by the expression:

$$s^2 = \frac{\Sigma(X_i - X)^2}{n - 1}$$

Warning Limits The limits on a control chart within which most of the test results are expected to lie (within a 95% probability) while the system remains in a state of statistical control.

APPENDIX A: SUPPORTING DOCUMENTS

STATE OF IDAHO

DEPARTMENT OF HEALTH AND WELFARE

WATER QUALITY LABORATORY CERTIFICATION

For

THROUGH JUNE 30, 1997
Year

SVL ANALYTICAL
Laboratory

ONE GOVERNMENT GULCH
Address

KELLOGG, IDAHO 83837-0292
CITY/STATE

This is to certify that the above named laboratory has met the requirements provided in Chapter 1, Title 39 of the Idaho Code [101, 102, 103, and 105] and the rules and regulations governing certification of Idaho Water Quality Laboratories as approved by the Idaho State Board of Health and Welfare. This certification applies to testing of public drinking water for the following parameters:

SEE ATTACHED PAGE

Chief, Bureau of Laboratories

State of Idaho
DEPARTMENT OF HEALTH AND WELFARE
Division of Health

BUREAU OF LABORATORIES

2220 Old Penitentiary Rd.
Boise, Idaho 83712
(208) 334-2235

PHILIP E. BATT
Governor
LINDA L. CABALLERO
Director
RICHARD H. SCHULTZ
Administrator

SVL Analytical; Kellogg, Idaho is certified to test Idaho drinking water samples until June 30, 1997 for:

Inorganics

Antimony	Copper	Nickel
Arsenic	Corrosivity	Nitrate
Barium	Cyanide	Nitrite
Beryllium	Fluoride	Selenium
Cadmium	Lead	Sodium
Chromium	Mercury	Thallium

Organics

Total trihalomethanes

VOCs

Benzene
Carbon tetrachloride
Chlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,1-Dichloroethylene
c-1,2-Dichloroethylene
t-1,2-Dichloroethylene
Dichloromethane
1,2-Dichloropropane
Ethylbenzene
Styrene
Tetrachloroethylene
Toluene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Vinyl chloride
Xylenes (total)

The State of Washington

Department of Ecology

This is to certify that

SVL Analytical, Incoporated

Kellogg, Idaho

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an **ACCREDITED LABORATORY** for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective on the **21st day of January 1997** and shall expire on the **20th day of January 1998.**

Witnessed under my hand this **14th day of January 1997.**

Cliff J. Kirchmer

Cliff J. Kirchmer, Ph.D.
Quality Assurance Officer

LAB ACCREDITATION
C074

SCOPE OF ACCREDITATION

SVL Analytical, Incorporated
Kellogg, Idaho

is accredited by the State of Washington Department of Ecology to perform analyses for the parameters listed below, using the analytical methods indicated. This scope of accreditation applies to non-potable water analyses only. Accreditation for all parameters and methods is final, unless otherwise noted. EPA refers to the U.S. Environmental Protection Agency.

PARAMETER	METHOD	NOTES
Acidity	EPA 305.1	2
Alkalinity	EPA 310.1	
Ammonia	EPA 350.3	
Bromide	EPA 300.0 A	2
Calcium	EPA 200.7/6010A	
Chemical Oxygen Demand	EPA 410.1	
Chloride	EPA 300.0 A	
Cyanide Total	EPA 335.3	
Fluoride	EPA 300.0 A	
Hardness Total	EPA 130.2	
Hardness Total	EPA 200.7/6010A	
Magnesium	EPA 200.7/6010A	
Nitrate	EPA 300.0 A	
Nitrate	EPA 353.2	
Nitrate + Nitrite	EPA 353.2	
Nitrate + Nitrite	EPA 300.0 A	
Nitrite	EPA 353.2	2
Nitrite	EPA 300.0 A	2
Nitrogen Total Kjeldahl	EPA 351.4	
Oil & Grease	EPA 413.1	
Oil & Grease	EPA 413.2	
Orthophosphate	EPA 365.2	
pH	EPA 150.1	
Phenolics Total Recoverable	EPA 420.1(8.2)	
Phosphorus Total	EPA 365.2	
Potassium	EPA 200.7/6010A	
Silica Dissolved Low Conc	EPA 370.1	2
Sodium	EPA 200.7/6010A	
Solids Total	EPA 160.3	2
Solids Total Dissolved	EPA 160.1	

PARAMETER	METHOD	NOTES
Solids Total Suspended	EPA 160.2	
Specific Conductance	EPA 120.1	1
Sulfate	EPA 300.0 A	
Sulfide	EPA 376.1	2
Total Organic Carbon	EPA 415.1	
Total Organic Carbon	EPA 415.2	
Total Organic Halides	EPA 9020B	2
Total Pet Hydrocarbons	EPA 418.1	2
Turbidity	EPA 180.1	2
Aluminum	EPA 200.7/6010A	
Antimony	EPA 204.2/7041	
Antimony	EPA 200.7/6010A	
Arsenic	EPA 206.2/7060A	
Arsenic	EPA 200.7/6010A	
Barium	EPA 200.7/6010A	2
Beryllium	EPA 200.7/6010A	
Cadmium	EPA 213.2/7131A	
Cadmium	EPA 200.7/6010A	
Chromium	EPA 200.7/6010A	
Cobalt	EPA 200.7/6010A	
Copper	EPA 220.2/7211	
Copper	EPA 200.7/6010A	
Iron	EPA 200.7/6010A	
Lead	EPA 239.2/7421	
Lead	EPA 200.7/6010A	
Manganese	EPA 200.7/6010A	
Mercury	EPA 245.2	
Molybdenum	EPA 200.7/6010A	
Nickel	EPA 249.2/7521	
Nickel	EPA 200.7/6010A	
Selenium	EPA 270.2/7740	
Selenium	EPA 200.7/6010A	
Silver	EPA 200.7/6010A	
Strontium	EPA 200.7	
Thallium	EPA 279.2/7841	
Tin	EPA 200.7	2
Tin	EPA 6010A MOD	2
Titanium	EPA 200.7	
Titanium	EPA 6010A MOD	3
Vanadium	EPA 200.7/6010A	
Zinc	EPA 200.7/6010A	

PARAMETER	METHOD	NOTES
Chlorinated Herbicides	EPA 615/8150B	2
Organochlorine Pesticides	EPA 608/8080A	
Polychlorinated Biphenyls	EPA 608/8080A	
Purgeable Aromatics	EPA 602/8020A	1
Purgeable Halocarbons	EPA 601/8010B	1
Purgeable (Volatile) Organics	EPA 624/8260A	1

NOTES:
1. Provisional pending receipt of acceptable performance evaluation sample analysis results (WAC 173-50-110).
2. Interim pending ability of Ecology to identify a readily available performance evaluation sample (WAC 173-50-100).
3. EPA method modified to assure quantification of metal which is not included in the method.

AUTHENTICATION: Cliff J. Kirchmer

Cliff J. Kirchmer, Ph.D.
Quality Assurance Officer

January 20, 1998
Expiration date

STATE OF WASHINGTON
DEPARTMENT OF HEALTH

DRINKING WATER TESTING LABORATORY CERTIFICATION PROGRAM

SVL ANALYTICAL, INC.
ONE GOVERNMENT GULCH / P.O. BOX 929
KELLOGG, IDAHO 83837-0929
WASHINGTON CODE #050

having met the requirements of the Regulations Governing Laboratory Certification and Standard of Performance for WAC 246-390 et. seq.

is hereby approved as a

STATE CERTIFIED DRINKING WATER LABORATORY

(per reciprocity agreement)
to perform drinking water analyses as indicated on the Annual Certified Parameter list which must accompany this contract to be valid

ISSUED AT SEATTLE on April 17, 1996

BY _____
GEORGE HILTON, OFFICE DIRECTOR
DRINKING WATER LABORATORY CERTIFICATION PROGRAM

EXPIRATION DATE July 31, 1997

THIS CONTRACT IS ACCEPTED FOR LABORATORY BY

_____

Washington State Department of Health

DATE _____

TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST

STATE OF WASHINGTON
DEPARTMENT OF HEALTH

DRINKING WATER TESTING LABORATORY CERTIFICATION PROGRAM

ANNUAL CERTIFIED PARAMETER LIST

(per reciprocity agreement)
FOR

SVL ANALYTICAL, INC.
ONE GOVERNMENT GULCH / P.O. BOX 929
KELLOGG, IDAHO 83837-0929
(208) 784-1258

CHEMISTRY Parameters as per WAC 246-290-300 & 310 See attached list for individual contaminants	CHEMISTRY ADDITIONAL ANALYTES	
ALL INORGANICS VOCs TRIHALOMETHANES	pH UNITS ALKALINITY CORROSIVITY	ALUMINUM CALCIUM

Effective Date April 17, 1996

Expiration Date July 31, 1997

THIS FORM MUST ACCOMPANY DRINKING WATER TESTING LABORATORY PROGRAM CERTIFICATION CONTRACT

Washington State Department of Health

Volatile Organic Chemicals (VOCs) with MCLs

(WAC 246-290-300 and 310 & includes Phase II & V analytes)

Substance	MCL (mg/L)	Method[1]
Benzene	.005	502.2,524.2
Carbon Tetrachloride	.005	502.2,524.2
1,2-Dichloroethane	.005	502.2,524.2
Trichloroethylene	.005	502.2,524.2
para-Dichlorobenzene	.075	502.2,524.2
1,1-Dichloroethylene	.007	502.2,524.2
1,1,1-Trichloroethane	.200	502.2,524.2
Vinyl Chloride	.002	502.2,524.2
Chlorobenzene	0.1	502.2,524.2
1,2-Dichlorobenzene	0.6	502.2,524.2
C 1,2-Dichloroethylene	0.07	502.2,524.2
T 1,2-Dichloroethylene	0.1	502.2,524.2
1,2-Dichloropropane	0.005	502.2,524.2
Ethylbenzene	0.7	502.2,524.2
Styrene	0.1	502.2,524.2
Tetrachlorethylene	0.005	502.2,524.2
Toluene	1.0	502.2,524.2
Total Xylenes	10.0	502.2,524.2
Ethylene Dibromide (EDB)	0.00005	504.1,551
1,2-Dibromo-3-Chloropropane (DBCP)	0.0002	504.1,551
Dichloromethane	0.005	502.2,524.2
1,2,4-Trichlorobenzene	0.07	502.2,524.2
1,1,2-Trichloroethane	0.005	502.2,524.2
Total Trihalomethanes	0.100	502.2,524.2,& 551

VOCs without MCLs

(Methods 502.2 & 524.2)

Bromobenzene
Bromomethane
Chloroethane
Chloromethane
o-Chlorotolune
p-Chlorotoluene
Dibromomethane
m-Dichlorobenzene
1,1-Dichloroethane
1,1-Dichloropropene
1,3-Dichloropropane
1,3-Dichloropropene
2,2-Dichloropropane
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane

Bromochloromethane
n-Butylbenzene
Dichlorodifluoromethane
Fluorotrichloromethane
Hexachlorobutadiene
Isopropylbenzene
p-Isopropyltoluene
Naphthalene
n-Propylbenzene
Sec-butylbenzene
Tert-butylbenzene
1,2,3-Trichlorobenzene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
1,2,3-Trichloropropane-504.1

Asbestos

Substance	MCL	Method
Asbestos	7MFL	EPA 600/4-83-043

[1]EPA 600/4-88-039, EPA 600/4-90-020, and other 500 series EPA approved methods.

Washington State Department of Health

Inorganic Chemical Characteristics

(WAC 246-290-300 and 310 & includes Phase II & V analytes)

Substance	Primary MCLs (mg/L)
Arsenic (As)	0.05
Barium (Ba)	2.0
Cadmium (Cd)	0.005
Chromium (Cr)	0.1
Fluoride (F)	4.0
Lead (Pb)	0.015*
Mercury (Hg)	0.002
Nitrate (as N)	10.0
Selenium (Se)	0.05
Sodium (Na)	**

Substance	Secondary MCLs (mg/L)
Chloride (Cl)	250.0
Copper (Cu)	1.3*
Fluoride (F)	2.0
Iron (Fe)	0.3
Manganese (Mn)	0.05
Sulfate (SO_4)	250.0
Silver (Ag)	0.05
Zinc (Zn)	5.0

*Note: Federal Action Levels are 0.015 mg/L for lead and 1.3 mg/L for copper.

**Note: Although the State Board of Health has not established an MCL for sodium, there is enough public health significar connected with sodium levels to require inclusion in inorganic chemical and physical monitoring.

Physical Characteristics

Substance	Primary MCL
Turbidity	1 NTU

Substance	Secondary MCLs
Color	15 Color Units
Hardness	None established
Specific Conductivity	700 umhos/cm
Total Dissolved Solids (TDS)	500 mg/L

Other Inorganic Analytes in EPA's Phase II & V Rules

Substance	MCL (mg/L)
Nitrite-N	1.0
Antimony	0.006
Beryllium	0.004
Cyanide	0.2
Nickel	0.1
Thallium	0.002

Note: Inorganic methods reference:

1) Annual Book of ASTM Standards, Vols. 11.01 and 11.02, American Society for Testing and Materials, 1916 Race Stre Philadelphia, PA 19103.

2) 18th edition of Standard Methods for the Examination of Water and Wastewater, 1992, American Public Hea Association, 1015 Fifteenth Street NW, Washington, D.C. 20005.

3) "Methods for the Determination of Metals in Environmental Samples - Supplement I," EPA-600/R-94-111, May . Available at NTIS, PB94-184942.

4) "Methods for the Determination of Inorganic Substances in Environmental Samples," EPA-600/R-93-100, August 19 Available at NTIS, PB94-121811.

OREGON
HEALTH DIVISION
CERTIFICATE OF APPROVAL
FOR DRINKING WATER

SVL ANALYTICAL, INC.
State Lab. No. ID019
One Government Gulch
Kellogg ID 83837

IS GRANTED OREGON HEALTH DIVISION APPROVAL TO PERFORM ANALYSIS ON PUBLIC DRINKING WATER BY THE METHOD(S) SPECIFIED UNDER OAR CHAPTER 333-63-005 THROUGH 63-140 FOR:

INORGANIC CHEMISTRY

ORGANIC CHEMISTRY

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES AND METHODS ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

Michael R. Skeels, PhD, MPH
Director
Oregon State Public Health Laboratory

Irene E. Ronning, PhD
Drinking Water Laboratory
Certification Coordinator

Center for Public Health Laboratories
PO Box 275
Portland OR 97207-0275

ISSUE DATE : September 24, 1996
EXPIRATION DATE : June 30, 1997

09/24/1996

OREGON HEALTH DIVISION
DRINKING WATER LABORATORY CERTIFICATION
List of Approved Analytes and Methods

16:15:11

NAME: **SVL ANALYTICAL, INC.**
ADDRESS: ONE GOVERNMENT GULCH
KELLOGG, ID 83837

PHONE #: (208)784-1258 FAX # : (208)783-0891

LAB #: **ID019**

ISSUE DATE : 09/24/1996
EXPIRATION DATE : 06/30/1997
(or until List is reissued)

1. Inorganic Chemistry

		Method	Alt Method
1.01 Antimony	APPROVED	200.9	
1.02 Arsenic	APPROVED	200.9	
1.03 Asbestos	NOT APPROVED		
1.04 Barium	APPROVED	200.7	
1.05 Beryllium	APPROVED	200.7	
1.06 Cadmium	APPROVED	200.9	
1.07 Chromium	APPROVED	200.7	
1.08 Copper	APPROVED	200.7	
1.09 Cyanide	APPROVED	4500CN-C/E	
1.10 Fluoride	APPROVED	300.0	
1.11 Lead	APPROVED	200.9	
1.12 Mercury	APPROVED	245.1	
1.13 Nickel	APPROVED	200.7	
1.14 Nitrate	APPROVED	300.0	
1.15 Nitrite	APPROVED	300.0	
1.16 Selenium	APPROVED	200.9	
1.17 Thallium	APPROVED	200.9	

2. Microbiology

2.01 Fecal Coliforms by EC	NOT APPROVED
2.02 E. coli by EC + MUG	NOT APPROVED
2.03 Heterotrophic Plate Count	NOT APPROVED
2.04 Total Coliforms by Membrane Filter Method	NOT APPROVED
2.05 Total Coliforms/E. coli by MMO-MUG	NOT APPROVED
2.06 Total Coliforms by Multiple Tube Fermentation	NOT APPROVED
2.07 N Agar + MUG	NOT APPROVED
2.08 Total Coliforms by Presence/Absence Medium Method	NOT APPROVED

3. Organic Chemistry - Part I

3.01 Adipates as di(ethylhexyl)adipate	NOT APPROVED		
3.02 Dibromochloropropane (DBCP)	NOT APPROVED		
3.03 TCDD (Dioxin)	NOT APPROVED		
3.04 Ethylene Dibromide (EDB)	NOT APPROVED		
3.05 PAHs as benzo(a)pyrene	NOT APPROVED		
3.06 Total Polychlorinated Biphenyls (PCBs)	NOT APPROVED		
3.07 Phthalates as di(ethylhexyl)phthalate	NOT APPROVED		
3.08 Total Trihalomethanes (TTHMs)	PROVISIONAL	524.2	
3.09 Vinyl Chloride (VCs)	APPROVED	524.2	
3.10 Volatile Organic Compounds (VOCs)	APPROVED	524.2	

STATE OF UTAH

Department of Health

SVL Analytical

Kellogg, Idaho

having complied with the requirements of laws of the State of Utah
and the requirements of this Department, is hereby declared a certified

Environmental Testing Laboratory

approved to perform the analytical procedures on record at this office.
Issued this 15th day of September, 1994 Certificate Number: E-249

Charles Brokopp, Ph.D., Director

Utah Department of Health

DIVISION OF LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor
Rod L. Betit
Executive Director
Charles D. Brokopp, Dr. P.H.
Director

46 North Medical Driv
Salt Lake City, Utah 84113-110
Telephone: (801) 584-540
Fax: (801) 584-848

SEP 26 1994

JAMES B JOHNSON PHD
SVL ANALYTICAL
ONE GOVERNMENT GULCH - POB 929
KELLOGG, ID 83837-0829

Certificate No.: E-249
Account No: 2087841258

On the basis of your most recent audit results, the laboratory listed is hereby certified for environmental monitoring under the Safe Drinking Water Act and authorized to perform the following analytes, or groups of analytes by method:

METALS
- ALUMINUM 200.7
- ANTIMONY 204.2
- ARSENIC 200.7A
- ARSENIC 206.2
- BARIUM 200.7
- BERYLLIUM 200.7
- CADMIUM 200.7
- CADMIUM 213.2
- CHROMIUM 200.7
- COPPER 200.7
- COPPER 220.2
- IRON 200.7
- LEAD 239.2
- MANGANESE 200.7
- MERCURY 245.2
- NICKEL 200.7
- SELENIUM 270.2
- SILVER 200.7
- THALLIUM 279.2

MINERALS
- ALKALINITY 310.1
- CALCIUM 200.7
- CONDUCTIVITY 120.1
- SODIUM 200.7

NUTRIENTS
- NITRATE 300.0A
- NITRATE 353.2
- NITRITE 300.0A
- NITRITE 353.2

MISCELLANEOUS
- CORROSIVITY/LANGLER INDEX
- CYANIDE 335.2
- TURBIDITY 180.1

The effective date for this certification is SEP 15 1994 through DEC 31 1995.

The analytes for which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. Please review for completeness and accuracy. Any discrepancies must be documented and notice received by this Bureau within 15 days of receipt. Copies of this letter will be on file in (1) the Bureau of Laboratory Improvement, Division of Laboratory Services and (2) in the Department of Environmental Quality. The certification will be recalled in the event that your Laboratory's certification is revoked.

Respectfully,

C. Brokopp

Charles Brokopp, Dr. P.H.
Director

cc. Richard Denton - DEQ (cc. electronic)
Kenneth Bousfield - DEQ (cc. electronic)
U.S. EPA Region VIII QAO
Management Services Coordinator (cc. electronic)

Utah Department of Health

DIVISION OF LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor
Rod L. Betit
Executive Director
Charles D. Brokopp, Dr. P.H.
Director

46 North Medical D
Salt Lake City, Utah 84113-1
Telephone: (801) 584-8
Fax: (801) 584-8

SEP 23 1994

JAMES B JOHNSON PHD
SVL ANALYTICAL
ONE GOVERNMENT GULCH - POB 929
KELLOGG, ID 83837-0829

Certificate No.: E-249
Account No: 2087841258

On the basis of your most recent audit results, the laboratory listed is hereby certified for environmental monitoring under the Clean Water Act and authorized to perform the following analytes, or groups of analytes by method:

METALS
- ALUMINUM 200.7
- ANTIMONY 200.7
- ANTIMONY 204.2
- ARSENIC 200.7
- ARSENIC 206.2
- BARIUM 200.7
- * BERYLLIUM 200.7
- CADMIUM 200.7
- CADMIUM 213.2
- CHROMIUM 200.7
- CHROMIUM 218.2
- COBALT 200.7
- COPPER 200.7
- COPPER 220.2
- GOLD 231.2
- IRON 200.7
- LEAD 200.7
- LEAD 239.2
- MANGANESE 200.7
- MERCURY 245.2
- * MOLYBDENUM 200.7
- NICKEL 200.7
- SELENIUM 200.7
- SELENIUM 270.2
- SILVER 200.7
- THALLIUM 200.7
- THALLIUM 279.2
- VANADIUM 200.7
- ZINC 200.7

MINERALS
- ALKALINITY 310.1
- BORON 200.7
- CALCIUM 200.7
- MAGNESIUM 200.7
- PH 150.1
- POTASSIUM 200.7
- SILICA 200.7
- SODIUM 200.7
- SPECIFIC CONDUCTANCE 120.1

NUTRIENTS
- AMMONIA 350.1
- * NITRATE/NITRITE 353.2
- ORTHOPHOSPHATE 365.2
- PHOSPHORUS 365.2
- TKN 351.4

RESIDUE
- RESIDUE FILTERABLE 160.1
- RESIDUE NONFILTER TSS 160.2

INORGANIC
- CYANIDE 335.2
- OIL AND GREASE 413.1
- TURBIDITY 180.1

* Provisional Certification

UTAH CENTENNIAL

The effective date for this certification is SEPT 15 1994 through DEC 31 1995.

The analytes for which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. Please review for completeness and accuracy. Any discrepancies must be documented and notice received by this Bureau within 15 days of receipt. Copies of this letter will be on file in (1) the Bureau of Laboratory Improvement, Division of Laboratory Services and (2) in the Department of Environmental Quality. The certification will be recalled in the event that your Laboratory's certification is revoked.

Respectfully,

C. Brokopp

Charles Brokopp, Dr. P.H.
Director

cc. Richard Denton - DEQ (cc. electronic)
Dennis Downs - DEQ (cc. electronic)
U.S. EPA Region VIII QAO
Management Services Coordinator (cc. electronic)

Utah Department of Health

DIVISION OF LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor
Rod L. Betit
Executive Director
Charles D. Brokopp, Dr. P.H.
Director

46 North Medical Dri
Salt Lake City, Utah 84113-11
Telephone: (801) 584-84
Fax: (801) 584-84

SEP 23 1994

JAMES B JOHNSON PHD
SVL ANALYTICAL
ONE GOVERNMENT GULCH - POB 929
KELLOGG, ID 83837-0829

Certificate No.: E-249
Account No: 2087841258

On the basis of your most recent audit results, the laboratory listed is hereby certified for environmental monitoring under the Resource Conservation and Recovery Act and authorized to perform the following analytes, or groups of analytes by method:

METALS
- ARSENIC 6010
- ARSENIC 7060
- BARIUM 6010
- CADMIUM 6010
- CHROMIUM 6010
- LEAD 6010
- LEAD 7421
- MERCURY 7471
- SELENIUM 6010
- SELENIUM 7740
- SILVER 6010

MISCELLANEOUS
- IGNITABILITY 1010
- SEMIVOLATILES 8270

The effective date for this certification is SEPT 15 1994 through DEC 31 1995.

The analytes for which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. Please review for completeness and accuracy. Any discrepancies must be documented and notice received by this bureau within 15 days of receipt. Copies of this letter will be on file in (1) the Bureau of Laboratory Improvement, Division of Laboratory Services and (2) in the Department of Environmental Quality. The certification will be recalled in the event that your Laboratory's certification is revoked.

Respectfully,

C. Brokopp

Charles Brokopp, Dr. P.H.
Director

cc. Richard Denton - DEQ (cc. electronic)
Dennis Downs - DEQ (cc. electronic)
U.S. EPA Region VIII QAO
Management Services Coordinator (cc. electronic)

UTAH CENTENNIAL

Utah Department of Health

DIVISION OF LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor

Rod L. Betit
Executive Director

Charles D. Brokopp, Dr. P.H.
Director

46 North Medical Drive
Salt Lake City, Utah 84113-110
Telephone: (801) 584-840
Fax: (801) 584-848

SEP 27 1994

JAMES B JOHNSON PHD
SVL ANALYTICAL
ONE GOVERNMENT GULCH - POB 929
KELLOGG, ID 83837-0829

Account No: 2087841258

Dear Director:

Your facility, holding certificate number E-249 has requested a review of EPA non-approved methodologies to provide data outside of the Utah Certification Program.

The facility's resources and procedures have been reviewed for the parameters listed below. It is the opinion of this Quality Assurance Officer that this facility has the capabality to produce valid data by the described methodologies:

HARDNESS STD MTH 17TH 2340B TPH 418.1
* TOC 415.2

* Provisional

This letter is not a certificate, but a review, and shall remain valid no longer than next DEC 31 1995.

Respectfully,

QA Chemis
Bureau of Laboratory Improvement

cc. Richard Denton
Dennis Downs
U.S. EPA Region VIII QAO
Management Services Coordinator

PETER C. MORROS, Director
L.H. DODGION, *Administrator*
(702) 687-4670
ᵀD 687-4678
ₐministration
Mining Regulation and Reclamation
Water Pollution Control
Facsimile 687-5856
Address Reply to:
Capitol Complex
Carson City, NV 89710

STATE OF NEVADA
BOB MILLER
Governor

Waste Management
Corrective Actions
Federal Facilities
Air Quality
Water Quality Planning
Facsimile 687-6396
Located at:
333 W. Nye Lane
Carson City, NV 89710

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

Capitol Complex
Carson City, Nevada 89710

December 18, 1996

Contact: Anne Boschert ID00019

SVL Analytical Labs, Inc.
One Government Gulch
Kellogg, ID 83837-0929

Pursuant to regulations adopted by the State Environmental Commission, the State of Nevada will accept data from this laboratory for the following contaminants under the Clean Water Act based performance evaluation sample resul from the following studies: WP 35 and WP 36

This certification is effective through June 30, 1997, or until WP 37 is evaluated.

Metals	Mineral	Nutrients	Demands	Organics	Miscellaneous
Aluminum	pH	Ammonia Nitrogen	N/A	*PCBs in Water	Total Cyanide
Arsenic	*Spec. Cond.	Nitrate-Nitrogen		PCBs in Oil	NFR
Beryllium	TDS @ 180ᶜ	Orthophosphate		Pesticides	
Cadmium	Total Hardness	Kjeldahl Nitrogen		V Halocarbons	
Cobalt	Calcium	Total Phosphorous		V Aromatics	
Chromium	Magnesium				
Copper	Sodium				
Iron	Potassium				
Mercury	Total Alkalinity				
Manganese	Chloride				
Nickel	Fluoride				
Lead	Sulfate				
Selenium					
Vanadium					
Zinc					
Antimony					
Silver					
Thallium					
Molybdenum					
Strontium					
Titanium					

* Provisional Acceptance

Recommended: 12/18/96
Date

Jack Ruckman
Health Surveyor II
Nevada State Division of Health

Approved: 12/18/96
Date

Wendell McCurry, Chief
Water Quality Planning
Division of Environmental Protection

depcwa

(O)-1991

BOB MILLER
Governor

CHARLOTTE CRAWFORD
Acting Director

YVONNE SYLVA
Administrator

DONALD S. KWALICK, MD, MPH
State Health Officer

STATE OF NEVADA

DEPARTMENT OF HUMAN RESOURCES

HEALTH DIVISION

BUREAU OF LABORATORY SERVICES

SVL ANALTICAL, INC. ID019
ONE GOVERNMENT GULTCH, PO BOX 929
KELLOGG, ID 83837

CONTACT ANNE P. BOSCHERT

PHONE (208) 784-1258

Pursuant to regulations adopted by the State Board of Health, the State of Nevada will accept data from this laboratory for the following contaminants under the Safe Drinking Water Act based performance evaluation sample results from EMSL-LV radiochemistry and the following studies:

WS034 WP032
WS035 WP033

THIS CERTIFICATE IS EFFECTIVE THRU JULY, 1996, OR UNTIL WP034 AND WS036 ARE EVALUATED.

INORGANICS		ORGANICS
PRIMARY	SECONDARY	TRIHALOMETHANES (THMs)
ANTIMONY	pH	
ARSENIC	* SPEC. COND.	
BARIUM	TDS @ 180C	
BERYLLIUM	* HARDNESS	
CADMIUM	CALCIUM	
CHROMIUM	MAGNESIUM	
COPPER	* SODIUM	
	POTASSIUM	
MERCURY	ALKALINITY	
NICKEL	CHLORIDE	
	SULFATE	
	IRON	
NITRATE-N	MANGANESE	
NITRITE-N	ZINC	
FLUORIDE	ALUMINUM	
	SILVER	

* TURBIDITY
TOTAL CYANIDE

LAST ON-SITE

* PROVISIONAL ACCEPTANCE

Robert Q Vick 7-9-96
RECOMMENDED: CHEMISTRY CERTIFICATION OFFICER DATE

Laurene Wilson 7-9-96
APPROVED: LABORATORY CERTIFICATION OFFICER DATE

1660 N. Virginia Street, Reno, Nevada 89503 • Phone: (702) 688-1335 • Fax: (702) 688-1460

Arizona Department of Health Services

ENVIRONMENTAL LABORATORY LICENSE

Issued to:

Laboratory Director: J. BLAKE JOHNSON
Owner/Respresentative: WAYNE SORENSON

SVL ANALYTICAL, INC.

AZ0538

is in compliance with Environmental Laboratory's applicable standards for the State of Arizona and maintains on file a List of Parameters for which the laboratory is certified to perform analysis.

PERIOD OF LICENSURE: FROM April 22, 1996 TO April 22, 1997

Wynand H. Nimmo, M.T.
Chief - Laboratory Licensure,
Certification, and Technical Services & Training

GREAT SEAL OF THE STATE OF ARIZONA
DITAT DEUS
1912

Jack Dillenberg, D.D.S., M.P.H.
Director
Department of Health Services

NORTH DAKOTA STATE DEPARTMENT OF HEALTH
AND CONSOLIDATED LABORATORIES

RECIPROCAL CERTIFICATION

SVL ANALYTICAL

meets acceptable standards for the performance of the following procedures:

All parameters for which you are certified by the states of Idaho and Washington and for which you continue to meet all of their certification requirements.

Director, Consolidated Laboratories — *Certification Officer*

This certificate remains the property of the North Dakota State Department of Health and Consolidated Laboratories, and may be removed for cause, at any time by the department.

Certificate Number: R-70 *Expiration Date:* May 31, 1995

Date Of Issue: May 3, 1993

Montana Department of Health and Environmental Sciences

certifies that

SVL Analytical
One Government Gulch
PO Box 929
Kellog, Idaho 83837-0929

Has completed the requirements of ARM 16.38.101-126 and is licensed to analyze Montana's Public Water Supplies for the listed parameters.

John D Hawthorne

John D. Hawthorne, Laboratory Evaluation Officer

SVL Analytical
One Government Gulch
PO Box 929
Kellog, Idaho 83837-0929

Attention: Blake Johnson

Phone: (208)784-1258

Inorganics

(x) Alkalinity	(x) Antimony	(x) Arsenic	( ) Asbestos	(x) Barium
(x) Beryllium	(x) Cadmium	(x) Calcium	(x) Chromium	(x) Conductivity
(x) Copper	(x) Cyanide	(x) Fluoride	(x) Lead	(x) Mercury
(x) Nickel	(x) Nitrate	(x) Nitrite	( ) O-Phosphate	(x) pH
(x) Selenium	( ) Silica	(x) Sodium	(x) Thallium	

Non-Volatile SOC's

( ) Adipates	( ) Diquat	( ) Oxamyl
( ) Alachlor	( ) Endothall	( ) PAH's(Benzo(a)pyrene)
( ) Aldicarb	( ) Endrin	( ) Pentachlorophenol
( ) Aldicarb Sulfoxide	( ) Ethylene Dibromide	( ) Phthalates
( ) Aldicarb Sulfone	( ) Glyphosate	( ) Picloram
( ) Atrazine	( ) Heptachlor	( ) Polychlorinated Biphenyls
( ) Carbofuran	( ) Heptachlor Epoxide	( ) Simazine
( ) Chlordane	( ) Hexachlorobenzene	( ) Toxaphene
( ) Dalapon	( ) Hexachlorocyclopentadiene	( ) 2,3,7,8-TCDD
( ) Dibromochloropropane	( ) Lindane	( ) 2,4,5-TP
( ) 2,4-D	( ) Methoxychlor	( ) Decachlorobiphenyl
( ) Dinoseb		

Volatile Organic Contaminants

(x) Benzene	(x) t-1,2-Dichloroethylene	(x) 1,1,1-Trichloroethane
(x) Carbon Tetrachloride	(x) Dichloromethane	(x) 1,1,2-Trichloroethane
(x) Chlorobenzene	(x) 1,2-Dichloropropane	(x) Trichloroethylene
(x) p-Dichlorobenzene	(x) Ethylbenzene	(x) Vinyl Chloride
(x) o-Dichlorobenzene	(x) Styrene	(x) Total Xylenes
(x) 1,2-Dichloroethane	(x) Tetrachloroethylene	(x) Total Trihalomethanes
(x) 1,1-Dichloroethylene	(x) Toluene	
(x) c-1,2-Dichloroethylene	(x) 1,2,4-Trichlorobenzene	

Other Constituents

( ) Iron	( ) Potassium	( ) Chloride
( ) Manganese	( ) Sulfate	( ) Total Hardness
( ) Magnesium	(x) TDS	

Expires: April 30, 1995

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80222-1530
Phone (303) 692-2000

Laboratory Building
4210 E. 11th Avenue
Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department
of Public Health
and Environment

July 1, 1996

Dr. J. Blake Johnson
SVL Analytical, Inc.
P.O. Box 929
Kellogg, Idaho 83837-0929

Dear Dr. Johnson,

Pursuant to the Safe Drinking Water Act and the requirements of the National Primary Drinking Water Regulations (40 CFR Part 141),

SVL Analytical, Inc.
One Government Gulch
Kellogg, Idaho 83837

is certified to perform analyses of drinking water as indicated on the attached list. This is a reciprocal certification based on the findings of your resident state, Idaho, and successful participation in the Water Supply (WS) audits.

Certification is effective through June 30, 1997.

If you have any questions, or if there are changes which may affect your certification status, please contact Carla J. Lenkey in the Laboratory Improvement Unit at (303) 691-4721.

Sincerely,

Ronald L. Cada, Dr.P.H., Director
Division of Laboratories

CERTIFICATION STATUS (CHEMISTRY)
SAFE DRINKING WATER ACT

SVL Analytical, Inc.
One Government Gulch
Kellogg, Idaho 83837

Date: July 1, 1996

LISTING OF ANALYTES	CERTIFICATION STATUS	METHODS
TRACE METALS		
TM1		
Arsenic	C	EPA200.9
Barium	C	EPA200.7
Cadmium	C	EPA200.9
Chromium	C	EPA200.7
Lead	C	EPA200.9
Mercury	C	EPA245.2
Selenium	C	EPA200.9
TM2		
Antimony	C	EPA200.9
Beryllium	C	EPA200.7
Copper	C	EPA200.7
Nickel	C	EPA200.7
Thallium	C	EPA200.9
NITRATE/NITRITE/FLUORIDE		
N/N/F		
Nitrate-N	C	EPA300.0
Nitrite-N	C	EPA300.0
Fluoride-F	C	EPA300.0
PESTICIDES		
P1		
Endrin	NC***	
Lindane	NC***	
Methoxychlor	NC***	
Toxaphene	NC***	

SVL Analytical, Inc.
Kellogg, Idaho

Date: July 1, 1996

PESTICIDES

P2

Alachlor	NC***
Atrazine	NC***
Chlordane	NC***
Heptachlor	NC***
Heptachlor Epoxide	NC***
Hexachlorobenzene	NC***
Hexachlorocyclopentadiene	NC***
Simazine	NC***

CARBAMATES AND VYDATE

C/V

Carbofuran	NC***
Oxamyl (vydate)	NC***

HERBICIDES

H1

2,4-D	NC***
2,4,5-TP	NC***

H2

Dalapon	NC***
Dinoseb	NC***
Pentachlorophenol	NC***
Picloram	NC***

PCB'S

PCB1

Decachlorobiphenyl	NC***

PAH'S

PAH1

Benzo(a)pyrene	NC***

ADIPATES/PHTHALATES

A/P1

Bis-(2-ethylhexyl) Adipate	NC***
Bis-(2-ethylhexyl) Phthalate	NC***

SVL Analytical, Inc.
Kellogg, Idaho

Date: July 1, 1996

THM's

THM1		
Bromodichloromethane	C	EPA524.2
Bromoform	C	EPA524.2
Chlorodibromomethane	C	EPA524.2
Chloroform	C	EPA524.2

REGULATED VOC's

V1		
Benzene	C	EPA524.2
Carbon Tetrachloride	C	EPA524.2
1,2-Dichlorobenzene	C	EPA524.2
1,2-Dichloroethane	C	EPA524.2
1,1-Dichloroethylene	C	EPA524.2
Trichloroethylene	C	EPA524.2
Vinyl Chloride	C	EPA524.2

V2		
Chlorobenzene	C	EPA524.2
1,4-Dichlorobenzene	C	EPA524.2
c-1,2-Dichloroethylene	C	EPA524.2
t-1,2-Dichloroethylene	C	EPA524.2
1,2-Dichloropropane	C	EPA524.2
Ethylbenzene	C	EPA524.2
Styrene	C	EPA524.2
Tetrachloroethylene	C	EPA524.2
Toluene	C	EPA524.2
1,1,1-Trichloroethane	C	EPA524.2
Xylene (Total)	C	EPA524.2
Dichloromethane	C	EPA524.2
1,2,4-Trichlorobenzene	C	EPA524.2
1,1,2-Trichloroethane	C	EPA524.2

V3	
1,2-Dibromo-3-chloropropane	NC***
Ethylene Dibromide	NC***

SVL Analytical, Inc.
Kellogg, Idaho

Date: July 1, 1996

MISCELLANEOUS

	M
Diquat	NC***
Endothall	NC***
Glyphosate	NC***
Asbestos	NC***
Dioxin	NC***
Total Cyanide	NC***

C = CERTIFIED

PC = PROVISIONALLY CERTIFIED

NC = NOT CERTIFIED

* Not acceptable or nonperformance on WS audits

** Not certified by resident state or substitute state that has conducted on-site audit

*** Certification not requested

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY

PETE WILSON, Governor

DEPARTMENT OF HEALTH SERVICES
2151 BERKELEY WAY
BERKELEY, CA 94704-1011
(510)540-2800

August 21, 1995

Mr. Blake Johnson
SVL Analytical, Inc.
P.O. Box 929
Kellogg, ID 83837

Certificate No.: 2080

Mr. Johnson:

This is to advise you that the laboratory named above has been certified/registered as an environmental testing laboratory pursuant to the provisions of the California Environmental Laboratory Improvement Act of 1988 (Health and Safety Code, Division 1, Part 2, Chapter 7.5, commencing with Section 1010).

The fields of testing for which this laboratory has been certified/registered under this Act are indicated in the enclosed "List of Approved Fields of Testing and Analytes." Certification/registration shall remain in effect until August 31, 1997 unless revoked. This certificate is subject to an anual fee as prescribed by Section 1017(a), Health and Safety Code, on the anniversary date of the certificate.

Please note that your laboratory is required to notify the Environmental Laboratory Accreditation Program of any major changes in the laboratory such as the transfer of ownership, change of laboratory director, change in location, or structural alterations which may affect adversely the quality of analyses (Section 1014(b), California Health & Safety Code).

Please note that the new regulations pertaining to environmental laboratories were adopted on December 5, 1994 and may be found in the California Code of Regulations, Title 22, Division 4, Chapter 19 Sections 64801 through 64827.

Your continued cooperation is essential in order to establish a reputation for the high quality of the data produced by environmental laboratories certified by the State of California.

If you have additional questions, please contact Aida Dente at (510) 540-2800.

Sincerely,

George C. Kulasingam

George C. Kulasingam, Ph.D., Manager
Environmental Laboratory
Accreditation Program

Enclosure

ENVIRONMENTAL LABORATORY ACCREDITATION/REGISTRATION
List of Approved Fields of Testing and Analytes

SVL Analytical, Inc.
One Government Gulch
Kellogg, ID

TELEPHONE No: (208) 784-1258

CERTIFICATE NUMBER: 2080
EXPIRATION DATE: 8/31/97

1 Microbiology of Drinking Water and Wastewater (--------)

1.1	Total Coliforms in Drinking Water by Multiple Tube Fermentation	N
1.2	Fecal Coliforms/E. Coli in Drinking Water by MTF	N
1.3	Total Coliforms in Drinking Water by Membrane Filter Technics	N
1.4	Fecal Coliforms/E. Coli in Drinking Water by Membrane Filter Technics	N
1.5	Total Coliforms and E. Coli in Drinking Water by MMO-MUG	N
1.6	Total Coliforms in Drinking Water by Clark's Presence/Absence	N
1.7	Fecal Coliforms/E. Coli in Drinking Water by Clark's Presence/Absence	N
1.8	Heterotrophic Plate Count	N
1.9	Total Coliforms in Wastewater by Multiple Tube Fermentation	N
1.10	Fecal Coliforms in Wastewater by MTF	N
1.11	Total Coliforms in Wastewater by Membrane Filter Technics	N
1.12	Fecal Coliforms in Wastewater by Membrane Filter Technics	N
1.13	Fecal Streptococci or Enterococci by Multiple Tube Technics	N
1.14	Fecal Streptococci or Enterococci by Membrane Filter Technics	N

2 Inorganic Chemistry and Physical Properties of Drinking Water excluding Toxic Chemical Elements (--------)

2.1	Alkalinity	N
2.2	Calcium	N
2.3	Chloride	N
2.4	Corrosivity	N
2.5	Fluoride	N
2.6	Hardness	N
2.7	Magnesium	N
2.8	MBAS	N
2.9	Nitrate	N
2.10	Nitrite	N
2.11	Sodium	N
2.12	Sulfate	N
2.13	Total Filterable Residue and Conductivity	N
2.14	Iron (Colorimetric Methods Only)	N
2.15	Manganese (Colorimetric Methods Only)	N
2.16	Phosphate, ortho	N
2.17	Silica (Colorimetric Methods Only)	N
2.18	Cyanide	N

3 Analysis of Toxic Chemical Elements in Drinking Water (--------)

3.1	Arsenic	N
3.2	Barium	N
3.3	Cadmium	N
3.4	Chromium, total	N
3.5	Copper	N
3.6	Iron	N
3.7	Lead	N
3.8	Manganese	N
3.9	Mercury	N
3.10	Selenium	N
3.11	Silver	N
3.12	Zinc	N
3.13	Aluminum	N
3.14	Asbestos	N
3.15	EPA Method 200.7	N
3.16	EPA Method 200.8 (Unregulated Elements and Lead Only)	N
3.17	Antimony	N
3.18	Beryllium	N
3.19	Nickel	N
3.20	Thallium	N

4 Organic Chemistry of Drinking Water (measurement by GC/MS combination) (--------)

4.1	EPA Method 501.3	N
4.2	EPA Method 524.2	N
4.3	EPA Method 525	N
4.4	EPA Method 513	N

5 Organic Chemistry of Drinking Water (excluding measurements by GC/MS combination) (--------)

5.1	EPA Method 501.1	N
5.2	EPA Method 501.2	N
5.3	EPA Method 502.1	N
5.4	EPA Method 502.2	N
5.5	EPA Method 503.1	N
5.6	EPA Method 504	N
5.7	EPA Method 505	N
5.8	EPA Method 506	N
5.9	EPA Method 507	N
5.10	EPA Method 508	N
5.11	EPA Method 508A	N
5.12	EPA Method 510.1	N
5.13	EPA Method 515.1	N
5.14	EPA Method 531.1	N
5.15	EPA Method 547	N
5.16	EPA Method 548	N
5.17	EPA Method 549	N
5.18	EPA Method 550	N
5.19	EPA Method 550.1	N
5.20	EPA Method 551	N
5.21	EPA Method 552	N

CERTIFICATE NUMBER: 2080
EXPIRATION DATE: 8/31/97

6 Radiochemistry (--------)

6.1 Gross Alpha and Beta Radiation ----- N
6.2 Total Radium ----- N
6.3 Radium 226 ----- N
6.4 Uranium ----- N
6.5 Radon 222 ----- N
6.6 Radioactive Cesium ----- N
6.7 Iodine 131 ----- N
6.8 Radioactive Strontium ----- N
6.9 Tritium ----- N
6.10 Gamma and Photon Emitters ---------- N
6.11 Gross Alpha by Co-precipitation --------- N
6.12 Radium 228 ----- N
6.13 Radioactive Iodine ----- N
6.14 Gross Alpha & Beta in Hazardous Wastes -- N
6.15 Alpha Emitting Radium Isotopes in Haz. Wastes ----- N
6.16 Radium 228 in Hazardous Wastes ---------- N

7 Shellfish Sanitation (--------)

7.1 Shellfish meat Microbiology ----- N
7.2 Paralytic Shellfish Poison ----- N
7.3 Domoic Acid ----- N

8 Aquatic Toxicity Bioassays (------)

8.1 Hazardous Waste Aquatic Toxicity Bioassay (Title 22, CCR, 66261.24(a)(6)) ----- N
8.2 Wastewater Testing According to Kopperdahl (1976) using Freshwater Fish. ----- N
8.3 Wastewater Testing According to EPA/600/4-85/013 using Freshwater and/or Marine Organisms --------- N
8.4 Wastewater Testing by EPA Method 1000.0 ----- N
8.5 Wastewater Testing by EPA Method 1002.0 ----- N
8.6 Wastewater Testing by EPA Method 1003.0 ----- N
8.7 Wastewater Testing by EPA Method 1006 ----- N
8.8 Wastewater Testing by EPA Method 1007 ----- N
8.9 Wastewater Testing by EPA Method 1009 ----- N
8.10 Wastewater Testing According to Anderson, et. al. (1990) using Giant Kelp (Macrocystis pyrifera) -- N
8.11 Wastewater Testing According to Anderson, et. al. (1990) using Red Abalone (Haliotus rufescens) --- N
8.12 Wastewater Testing According to Dinnel and Stober (1987) using Purple Sea Urchin (Strongylocentrotus purpuratus) ----- N
8.13 Wastewater Testing According to Dinnel and Stober (1987) using Red Sea Urchin (Strongylocentrotus franciscanus) ----- N
8.14 Wastewater Testing According to Dinnel and Stober (1987) using Sand Dollar (Dendraster excentricus) ----- N
8.15 Wastewater Testing According to procedure E 724-89 (ASTM, 1989) using Pacific Oyster (Crassostrea gigas) ----- N
8.16 Wastewater Testing According to procedure E 724-89 (ASTM, 1989) using California Bay Mussel (Mytilus edulis) ----- N
8.17 Wastewater Testing According to Standard Methods (APHA, 1989) using an alga (Skeletonema costatum) ----- N
8.18 Wastewater Testing According to EPA/600/4-90/027 using Freshwater and/or Marine Organisms --------- N

9 Physical Properties Testing of Hazardous Waste (--------)

9.1 Ignitability by Flashpoint determination (Title 22, CCR, 66261.21) ----- N
9.2 Corrosivity - pH determination (Title 22, CCR, 66261.22) ----- N
9.3 Corrosivity - Corrosivity towards steel (Title 22, CCR, 66261.22) ----- N
9.4 Reactivity (Title 22, CCR, 66261.23) ----- N

10 Inorganic Chemistry and Toxic Chemical Elements of Hazardous Waste

10.1 Antimony
7040(--------) ----- N
7041(--------) ----- N
10.2 Arsenic
7060(--------) ----- N
7061(--------) ----- N
10.3 Barium
7080(--------) ----- N
7081(--------) ----- N
10.4 Beryllium
7090(--------) ----- N
7091(--------) ----- N
10.5 Cadmium
7130(--------) ----- N
7131(--------) ----- N
10.6 Chromium, total
7190(--------) ----- N
7191(--------) ----- N
10.7 Cobalt
7200(--------) ----- N
7201(--------) ----- N
10.8 Copper
7210(--------) ----- N
7211(--------) ----- N
10.9 Lead
7420(--------) ----- N
7421(--------) ----- N
10.10 Mercury
7470(--------) ----- N
7471(--------) ----- N
10.11 Molybdenum
7480(--------) ----- N
7481(--------) ----- N
10.12 Nickel
7520(--------) ----- N

10.13 Selenium
7740(--------) ---------- N
7741(--------) ---------- N
10.14 Silver
7760(--------) ---------- N
7761(--------) ---------- N
10.15 Thallium
7840(--------) ---------- N
7841(--------) ---------- N
10.16 Vanadium
7910(--------) ---------- N
7911(--------) ---------- N
10.17 Zinc
7950(--------) ---------- N
7951(--------) ---------- N
10.18 Chromium (VI)
7195(--------) ---------- N
7196(--------) ---------- N
7197(--------) ---------- N
7198(--------) ---------- N

10.19 Cyanide
9010(--------) ---------- N
10.20 Fluoride
300.0(-------) ---------- N
340.1(-------) ---------- N
340.2(-------) ---------- N
340.3(-------) ---------- N
10.21 Sulfide
9030(--------) ---------- N
10.22 Total Organic Lead
(--------) ---------- N
10.23 EPA Method 6010(--------) ---------- N
10.24 EPA Method 6020(--------) ---------- N

11 Extraction Tests of Hazardous Waste (08-18-95)

11.1 California Waste Extraction Test (WET) (Title 22, CCR, 66261.100, Appendix II) ---------- N
11.2 Extraction Procedure Toxicity ---------- N
11.3 Toxicity Characteristic Leaching Procedure (TCLP) All Classes ---------- Y
11.4 Toxicity Characteristic Leaching Procedure (TCLP) Inorganics Only ---------- N
11.5 Toxicity Characteristic Leaching Procedure (TCLP) Extractables Only ---------- N
11.6 Toxicity Characteristic Leaching Procedure (TCLP) Volatiles Only ---------- N

12 Organic Chemistry of Hazardous Waste (measurement by GC/MS combination)

12.1 EPA Method 8240(--------)---------- N
12.2 EPA Method 8250(--------)---------- N
12.3 EPA method 8270(--------)---------- N
12.4 EPA Method 8280(--------)---------- N
12.5 EPA Method 8290(--------)---------- N
12.6 EPA Method 8260(--------)---------- N

13 Organic Chemistry of Hazardous Waste (excluding measurements by GC/MS combination)

13.1 EPA Method 8010(08-18-95) ---------- Y
13.2 EPA Method 8015(--------) ---------- N
13.3 EPA Method 8020(08-18-95) ---------- Y
13.4 EPA Method 8030(--------) ---------- N
13.5 EPA Method 8040(--------) ---------- N
13.6 EPA Method 8060(--------) ---------- N
13.7 EPA Method 8080(08-18-95) ---------- Y
13.8 EPA Method 8090(--------) ---------- N
13.9 EPA Method 8100(--------) ---------- N
13.10 EPA Method 8120(--------) ---------- N
13.11 EPA Method 8140(--------) ---------- N
13.12 EPA Method 8150(--------) ---------- N

13.13 EPA Method 8310(--------) ---------- N
13.14 EPA Method 632 (--------) ---------- N
13.15 Total Petroleum Hydrocarbons
(LUFT Manual) (08-18-95)---------- Y
13.16 EPA Method 8011(--------) ---------- N
13.17 EPA Method 8021(08-18-95) ---------- Y
13.18 EPA Method 8070(--------) ---------- N
13.19 EPA Method 8110(--------) ---------- N
13.20 EPA Method 8141(--------) ---------- N
13.21 EPA Method 8330(--------) ---------- N

14 Bulk Asbestos Analysis (--------)

14.1 1% or Greater Asbestos Concentrations (Title 22, CCR, 66261.24(a)(2)(A)) ----------N

15 Substances Regulated Under the California Safe Drinking Water and Toxic Enforcement Act (Proposition 65) and Not Included in Other Listed Groups.

16 Wastewater Inorganic Chemistry, Nutrients and Demand (08-18-95)

16.1 Acidity ---------- Y
16.2 Alkalinity ---------- Y
16.3 Ammonia ---------- Y
16.4 Biochemical Oxygen Demand ---------- N
16.5 Boron ---------- N
16.6 Bromide ---------- N
16.7 Calcium ---------- Y
16.8 cBOD ---------- N
16.9 Chemical Oxygen Demand ---------- Y
16.10 Chloride ---------- Y
16.11 Chlorine Residual, total ---------- N
16.12 Cyanide ---------- Y

16.13 Cyanide amenable to Chlorination ------- N
16.14 Fluoride ---------- Y
16.15 Hardness ---------- Y
16.16 Kjeldahl Nitrogen ---------- Y
16.17 Magnesium ---------- Y
16.18 Nitrate ---------- Y
16.19 Nitrite ---------- Y
16.20 Oil and Grease ---------- Y
16.21 Organic Carbon ---------- Y
16.22 Oxygen, Dissolved ---------- N

16.23 pH ---------- Y
16.24 Phenols ---------- N
16.25 Phosphate, ortho- ---------- Y
16.26 Phosphorus, total ---------- Y
16.27 Potassium ---------- Y
16.28 Residue, Total ---------- Y
16.29 Residue, Filterable (TDS) ---------- Y
16.30 Residue, Nonfilterable (TSS) ---------- Y
16.31 Residue, Settleable (SS) ---------- N
16.32 Residue, Volatile ---------- N
16.33 Silica ---------- N
16.34 Sodium ---------- Y
16.35 Specific Conductance ---------- Y
16.36 Sulfate ---------- Y
16.37 Sulfide (includes total & soluble) - Y
16.38 Sulfite ---------- N
16.39 Surfactants (MBAS) ---------- N
16.40 Tannin and Lignin ---------- N
16.41 Turbidity ---------- Y
16.42 Iron (Colorimetric Only) ---------- N
16.43 Manganese (Colorimetric Only) ---------- N
16.44 Total Recoverable Petroleum Hydrocarbons ---------- Y
16.45 Total Organic Halides ---------- Y

17 Toxic Chemical Elements in Wastewater (08-18-95)

17.1 Aluminum ---------- N
17.2 Antimony ---------- Y
17.3 Arsenic ---------- Y
17.4 Barium ---------- N
17.5 Beryllium ---------- N
17.6 Cadmium ---------- Y
17.7 Chromium (VI) ---------- N
17.8 Chromium, total ---------- Y
17.9 Cobalt ---------- N
17.10 Copper ---------- Y
17.11 Gold ---------- N
17.12 Iridium ---------- N
17.13 Iron ---------- N
17.14 Lead ---------- Y
17.15 Manganese ---------- N
17.16 Mercury ---------- Y
17.17 Molybdenum ---------- N
17.18 Nickel ---------- Y
17.19 Osmium ---------- N
17.20 Palladium ---------- N
17.21 Platinum ---------- N
17.22 Rhodium ---------- N
17.23 Ruthenium ---------- N
17.24 Selenium ---------- Y
17.25 Silver ---------- Y
17.26 Strontium ---------- N
17.27 Thallium ---------- Y
17.28 Tin ---------- N
17.29 Titanium ---------- N
17.30 Vanadium ---------- N
17.31 Zinc ---------- N
17.32 EPA Method 200.7 ---------- Y
17.33 EPA Method 200.8 ---------- N
17.34 DCP ---------- N
17.35 Asbestos ---------- N

18 Organic Chemistry of Wastewater (measurements by GC/MS combination (08-18-95)

18.1 EPA Method 624 ---------- Y
18.2 EPA Method 625 ---------- Y
18.3 EPA Method 1613 ---------- N
18.4 EPA Method 1625 ---------- N
18.5 EPA Method 613 ---------- N

19 Organic Chemistry of Wastewater (excluding measurements by GC/MS combination) (08-18-95)

19.1 EPA Method 601 ---------- Y
19.2 EPA Method 602 ---------- Y
19.3 EPA Method 603 ---------- N
19.4 EPA Method 604 ---------- N
19.5 EPA Method 605 ---------- N
19.6 EPA Method 606 ---------- N
19.7 EPA Method 607 ---------- N
19.8 EPA Method 608 ---------- Y
19.9 EPA Method 609 ---------- N
19.10 EPA Method 610 ---------- N
19.11 EPA Method 611 ---------- N
19.12 EPA Method 632 ---------- N
19.13 EPA Method 619 ---------- N

20 Inorganic Chemistry and Toxic Chemical Elements of Pesticide Residues in Food (--------)

20.1 Processed Foods by One of the Following Methods
Atomic Absorption Spectrophotometry ---------- N
Inductively Coupled Plasma Atomic Emission Spectrophotometry ---------- N
Inductively Coupled Plasma/Mass Spectrometry ---------- N
Colorimetry ---------- N
20.2 Raw Commodities by One of the Following Methods
Atomic Absorption Spectrophotometry ---------- N
Inductively Coupled Plasma Atomic Emission Spectrophotometry ---------- N
Inductively Coupled Plasma/Mass Spectrometry ---------- N
Colorimetric ---------- N
20.3 Dairy Products by One of the Following Methods
Atomic Absorption Spectrophotometry ---------- N
Inductively Coupled Plasma Atomic Emission Spectrophotometry ---------- N
Inductively Coupled Plasma/Mass Spectrometry ---------- N
Colorimetry ---------- N

20.4 Feed Products by One of the Following Methods
- Atomic Absorption Spectrophotometry ---------- N
- Inductively Coupled Plasma Atomic Emission Spectrophotometry ---------- N
- Inductively Coupled Plasma/Mass Spectrometry ---------- N
- Colorimetry ---------- N

21 Organic Chemistry of Pesticide Residues in Food (measurements by GC/MS) (--------)

21.1 Gas Chromatographic/Mass Spectrometric Methods in Processed Foods ---------- N
21.2 Gas Chromatographic/Mass Spectrometric Methods in Raw Commodities ---------- N
21.3 Gas Chromatographic/Mass Spectrometric Methods in Dairy Products ---------- N
21.4 Gas Chromatographic/Mass Spectrometric Methods in Feed Products ---------- N

22 Organic Chemistry of Pesticide Residues in Food (Excluding Measurement by GC/MS Combination) (--------)

22.1 Halogenated Compounds in Processed Foods by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.2 Organophosphorous Compounds in Processed Foods by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.3 Carbamates in Processed Foods by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.4 Halogenated Compounds in Raw Commodities by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.5 Organophosphorous Compounds in Raw Commodities by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.6 Carbamates in Raw Commodities by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.7 Halogenated Compounds in Dairy Products by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.8 Organophosphorous Compounds in Dairy Products by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.9 Carbamates in Dairy Products by One of the Following Methods ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.10 Halogenated Compounds in Feed Products by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.11 Organophosphorous Compounds in Feed Products by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

22.12 Carbamates in Feed Products by One of the Following Methods
- Gas Chromatography ---------- N
- High Pressure Liquid Chromatography ---------- N
- Liquid Chromatography/Mass Spectrometry ---------- N

CHAIN OF CUSTODY RECORD

Page _____ of _____

Client:

Contact:

Address:

Phone Number:

NOTES:

1) Specify QC samples if desired.

2) Ensure proper container packaging.

3) Ship samples promptly following collection.

Table 1. -- Matrix Type

1 = Surface Water, 2 = Ground Water

3 = Soil/Sediment, 4 = Rinsate, 5 = Oil

6 = Waste, 7 = Other (Specify)

FOR SVL USE ONLY

SVL JOB #

_____

Lab Name: **SVL Analytical, Inc.** **(208) 784-1258** **FAX (208) 783-0891**

Address: **One Government Gulch, Kellogg, ID 83837-0929**

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)										
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						
10.																						

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received by:	Date:	Time:

SVL Analytical, Inc. Kellogg, ID 83837

SAMPLE LOCATION/DISPOSITION LOG

JOB NUMBER	BIN	DATE	INIT.	CHECK OUT DATE	CHECK OUT INIT.	CHECK IN DATE	CHECK IN INIT.	DISPOSITION DATE	DISPOSITION INIT.	DISPOSITION R/D

Form QA004

SVL Analytical, Inc. Kellogg, ID 83837

INORGANICS SAMPLE LOCATION

JOB NUMBER OR SAMPLE(S)	TYPE OF PRESERVATIVE	CHECK OUT DATE	CHECK OUT INIT.	CHECK IN DATE	CHECK IN INIT.

Form QA005

~ ~ ~ ~ NOTES ~ ~ ~ ~

LIST OF SVL SOPs

SERIES	SOP NUMBER	SOP TITLE	DATE REVIEWED
1000 Series:			
Safety and QA	SVL 1001	SAMPLE DISPOSAL	SEP 06, 94
	SVL 1002	STANDARD FORMAT FOR WRITING SOPs	JUN 20, 94
	SVL 1003	LOCKOUT PROCEDURE	NOV 11, 94
	SVL 1004	READING & CAL. OF THERMOMETERS	JUL 30, 94
	SVL 1005	QUALITY ASSURANCE AUDITS	AUG 15, 94
	SVL 1006	INTERNAL SAMPLE LOCATION	SEP 23, 94
	SVL 1007	SOIL STERILIZATION	MAR 01, 95
	SVL 1008	HAZARDOUS WASTE DISPOSAL	NOV 11, 94
2000 Series:			
Sample & Document	SVL 2001	SAMPLE RECEIVING	AUG 1, 94
Management	SVL 2002	DUTIES OF SAMPLE CUSTODIAN	JUL 1, 94
	SVL 2003	SVL JOB CREATION	JUL 31, 94
	SVL 2004	SAMPLE STORAGE & SECURITY	JUN 30, 94
	SVL 2005	TRACKING SAMPLE ANALYSIS	JUL 20, 94
	SVL 2006	DATA RECORDING & CORRECTIONS	AUG 13, 93
	SVL 2007	CASE FILE ASSEMBLY	AUG 13, 93
	SVL 2008	HANDLING CONFIDENTIAL DOCUMENTS	AUG 13, 93
	SVL 2009	TECHNICAL REVIEW OF DATA	AUG 13, 93
	SVL 2010	EPA DATA DELIVERABLES GENERATION	AUG 13, 93
	SVL 2011	DOCUMENT & DATA PACKAGE SHIPPING	AUG 13, 93
	SVL 2012	DATA MANAGMENT & HANDLING	AUG 13, 93
	SVL 2013	DATA PACKAGE PRODUCTION	AUG 13, 93
	SVL 2014	ACID BASE ACCNT'G/EXCELL PROGRAM	AUG 24, 94
	SVL 2015	LEVEL 3 - CLP DATA PACKAGE	AUG 13, 93
3000 Series:			
Organic	SVL 3001	GLASSWARE WASHING INSTRUCTIONS	JAN 01, 92
	SVL 3002	SAMP EXTRCT: TPH-HCID (<C12), TPH-G, BTEX	JAN 01, 92
	SVL 3003	SAMP EXTRCT: 8010, 8020	JAN 01, 92
	SVL 3004	SAMP EXTRCT: 502.2 & 524.2	JAN 01, 92
	SVL 3005	SAMP EXTRCT: TPH-HCID (C12+),TPH-D& MO	JAN 01, 92
	SVL 3006	SAMP EXTRCT: 8270	JAN 01, 92
	SVL 3007	SAMP EXTRCT: 8240 & 8260	JAN 01, 92
	SVL 3008	TCLP - 1311	JAN 01, 92
	SVL 3009	ANALYSIS: TPH-HCID (<C12), TPH-G, BTEX	JAN 01, 93
	SVL 3010	ANALYSIS: 8010	JAN 20, 93
	SVL 3011	ANALYSIS: 8020	JAN 20, 93
	SVL 3012	ANALYSIS: 524.2	FEB 20, 93
	SVL 3013	ANALYSIS: TPH-HCID (C12+),TPH-D& MO	JAN 01, 93
	SVL 3014	ANALYSIS: 8270	MAR 12, 93
	SVL 3015	ANALYSIS: 8240 & 8260	FEB 20, 93
	SVL 3016	QUALITY CONTROL CRITERIA FOR GC & GC/MS	JAN 28, 93
	SVL 3017	SAMP EXTRCT:TPH-IR(418.1 TOTAL RCVBLE PETRO-HC)	MAY 10, 93
	SVL 3018	DRINKING WATER - 502.2	JAN 01, 92
	SVL 3019	ANALYSIS: TPH-IR(418.1 TOTAL RCVBLE PETRO-HC)	MAY 10, 93
	SVL 3020	ANALYSIS:PCBs IN TRANSFORMER OIL BY GC	JUN 15, 93
	SVL 3021	STANDARDS PREPARATION & TRACEABILITY	JUL 12, 94
	SVL 3022	DATA REVIEW AND REPORTING	JUL 14, 94

SERIES	SOP NUMBER	SOP TITLE	DATE REVIEWED
Series 4000: Inorganic	SVL 4001	CONTAMINATION PREVENTION	AUG 25, 94
	SVL 4002	CALIBRATION OF MEASURING APPARATUS	AUG 13, 93
	SVL 4003	GLASSWARE CLEANING	AUG 25, 94
	SVL 4004	DETERMINING pH OF WATER SAMPLES	AUG 25, 94
	SVL 4005	DETERMINING PERCENT SOLIDS	AUG 13, 93
	SVL 4006	SAMPLE PREPARATION	AUG 13, 93
	SVL 4007	TRACEABILITY OF STANDARDS & STOCK SOLUTIONS	AUG 13, 93
	SVL 4008	OPERATION OF ICP	AUG 26, 94
	SVL 4009	OPERATION OF GRAPHITE FURNACE	AUG 26, 94
	SVL 4010	DETERMINATION OF MERCURY - CVAA	SEP 30, 94
	SVL 4011	CYANIDE BY MANUAL DISTILLATION	OCT 31, 94
	SVL 4012	CYANIDE BY MIDI DISTILLATION	SEP 09, 94
	SVL 4013	ACID WASHING	AUG 13, 93
	SVL 4014	SUMMARY OF LEVEL 1 DIGESTION	AUG 13, 93
	SVL 4015	TOTAL METALS LEVEL 1 DIGESTION (3030)	AUG 13, 93
	SVL 4016	SUMMARY OF LEVELS 2 & 3 DIGESTION	AUG 13, 93
	SVL 4017	TOTAL METALS LEVEL 2 & 3 DIGESTION (3030)	AUG 13, 93
	SVL 4018	DISSOLVED METALS (3030)	AUG 13, 93
	SVL 4019	SOIL DIGESTION (3050)	AUG 13, 93
	SVL 4020	US BUREAU OF MINES DIGESTION	AUG 13, 93
	SVL 4021	FILTER DIGESTION	AUG 13, 93
	SVL 4022	PERCENT MOISTURE/PERCENT SOLIDS (SVL 999)	AUG 13, 93
	SVL 4023	ICP SCAN (SVL METHOD)	AUG 13, 93
	SVL 4024	COLOR (110.2)	AUG 13, 93
	SVL 4025	CONDUCTIVITY (120.1)	AUG 13, 93
	SVL 4026	TURBIDITY (180.1)	AUG 13, 93
	SVL 4027	HARDNESS: CALC. & TITRIMETRIC (130.1 & 130.2)	AUG 13, 93
	SVL 4028	pH (150.1)	AUG 13, 93
	SVL 4029	SPECIFIC GRAVITY (2710)	AUG 13, 93
	SVL 4030	ALKALINITY (310.1)	AUG 13, 93
	SVL 4031	ACIDITY (305.1)	AUG 13, 93
	SVL 4032	SULFIDES (376.1)	AUG 13, 93
	SVL 4033	HYDROGEN SULFIDE GAS GENERATION (4500-S-F)	AUG 13, 93
	SVL 4034	SOLIDS: DISSOLVED & SUSPENDED (160.1 & 160.2)	AUG 13, 93
	SVL 4035	SOLIDS: TOTAL & VOLATILE (160.3 & 160.4)	AUG 13, 93
	SVL 4036	PARTICLE (GRAIN) SIZE (D-422)	AUG 13, 93
	SVL 4037	METHYLENE BLUE SUBSTANCES (425.1)	AUG 13, 93
	SVL 4038	PHENOLS (420.1)	AUG 13, 93
	SVL 4039	OIL AND GREASE (413.1)	AUG 13, 93
	SVL 4040	TOTAL PHOSPHOROUS: WATERS (4500-P)	AUG 13, 93
	SVL 4041	TOTAL PHOSPHOROUS: SOILS (24-2.3)	AUG 13, 93
	SVL 4042	ORTHO-PHOSPHOROUS: PHOSPHATE	AUG 13, 93
	SVL 4043	CHEMICAL OXYGEN DEMAND	DEC 02, 94
	SVL 4044	ORGANIC MATTER	AUG 13, 93
	SVL 4045	TOTAL KJELDAHL NITROGEN (TECATOR METHOD)	AUG 13, 93
	SVL 4046	AMMONIA AS NITROGEN (350.3)	AUG 13, 93
	SVL 4047	NITRATE-NITRITE (353.2)	AUG 13, 93
	SVL 4048	NITRATE AS N_3: AUTOMATED Cd REDUCTION (4500-NO_3)	AUG 13, 93
	SVL 4049	CATION EXCHANGE CAPACITY (9081)	AUG 13, 93
	SVL 4050	CYANIDE DISTILLATION (MANUAL)	AUG 13, 93
	SVL 4051	CYANIDE DISTILLATION (MIDI)	AUG 13, 93
	SVL 4052	TOTAL CYANIDE: COLORIMETRIC (335.3)	AUG 13, 93
	SVL 4053	TOTAL CYANIDE: TITRIMETRIC (335.2)	AUG 13, 93
	SVL 4054	CYANIDE AMENABLE TO CHLORINATION (335.1)	AUG 13, 93

SERIES	SOP NUMBER	SOP TITLE	DATE REVIEWED
	SVL 4055	WEAK & DISSOCIABLE CYANIDE (4500-CN I)	AUG 13, 93
	SVL 4056	FREE CYANIDE (4500-CN D)	AUG 13, 93
	SVL 4057	SPOT TEST FOR CYANIDE (4500-CN K)	AUG 13, 93
	SVL 4058	ELEMENTAL SULFUR (SVL METHOD)	AUG 13, 93
	SVL 4059	CHROMIUM-HEXAVALENT (218.4)	AUG 13, 93
	SVL 4060	LOSS ON IGNITION (SVL METHOD)	AUG 13, 93
	SVL 4061	ACID-BASE ACCOUNT & ACID POTENTIAL	AUG 13, 93
	SVL 4062	LEAD-EDTA TITRATION	AUG 13, 93
	SVL 4063	ZINC (SVL METHOD)	AUG 13, 93
	SVL 4064	JTS SAMPLES	AUG 13, 93
	SVL 4065	METEORIC WATER MOBILITY	AUG 13, 93
	SVL 4066	TCLP (1311)	AUG 13, 93
	SVL 4067	TCLP - MULTIPHASE (1311)	AUG 13, 93
	SVL 4068	SPLC (1312)	AUG 13, 93
	SVL 4069	Cs BY FLAME EMISSION (SVL 101)	AUG 13, 93
	SVL 4070	TOTAL SUSPENDED PARTICULATES	AUG 13, 93
	SVL 4071	HYDROLYZABLE AND TOTAL ORGANIC PHOSPHORUS	AUG 13, 93
	SVL 4072	ACID NEUTRALIZATION POTENTIAL	AUG 13, 93
	SVL 4073	ACID BASE ACCOUNT	AUG 13, 93
	SVL 4074	AMMONIA: BORATE TECATOR DISTILLATION	DEC 22, 94
	SVL 4075	WAD CYANIDE	JAN 27, 95
	SVL 4076	RFA BY COLORIMETRIC	MAY 26, 95
	SVL 4077	DIGESTION: METHOD 3040 - OILS, GREASE, & WAXES	MAR 20, 95
	SVL 4078	DIGESTION: METHOD 3020 - METALS BY GFAA	MAR 20, 95
	SVL 4079	DIGESTION: METHOD 3010 - METALS BY FLAA	MAR 20, 95
	SVL 4080	DIGESTION: METHOD 3005 - TOTAL RECOVERABLE AND DISSOLVED METALS	MAR 21, 95
	SVL 4081	CHROMIUM HEXAVALENT (Cr-VI) METHOD 1687	MAR 31, 95
	SVL 4082	ARSENIC SPECIATION	APR 10, 95
	SVL 4083	ION CHROMATOGRAPHY - METHOD 300.0	MAY 15, 95

APPENDIX D

AOC POINTS OF CONTACT

POINTS OF CONTACT
FOR AOC REMEDIAL INVESTIGATION

Title	Name	Address	Phone	Fax
NMED AOC Project Manager	George Schuman	New Mexico Environment Department P.O. Box 26110 1190 St. Francis Drive Santa Fe, New Mexico 87502	(505) 827-0072	(505) 234-8337
CMC AOC Project Manager	Tom L. Shelley	Chino Mines Company Environmental Services - AOC Office 210 Cortez Avenue Hurley, NM 88043	(505) 537-4226	(505) 537-7161
CMC AOC Data Administrator	Debbie Nelson	Chino Mines Company Environmental Services - AOC Office 210 Cortez Avenue Hurley, NM 88043	(505) 537-4227	(505) 537-7161
CMC Community Relations Representative	Robert J. Quintanar	Chino Mines Company Environmental Services - AOC Office 210 Cortez Avenue Hurley, NM 88043	(505) 537-4228	(505) 537-7161
CMC Analytical Laboratory Laboratory Director QA Officer Sample Custodian Bottle Shipment Coordinator	 Blake Johnson Anne Boschert Gordon Anthis Lee Haynes	SVL Analytical, Inc. One Government Gulch Kellogg, ID 83837 - 0929	(208) 784-1258	(208) 783-0891

POINTS OF CONTACT
FOR AOC REMEDIAL INVESTIGATION

Title	Name	Address	Phone	Fax
NMED Analytical Laboratory Laboratory Director QA Officer Sample Custodian Bottle Shipment Coordinator	 Charles Carter TBA Kevin Free Mary Ford	LAS Laboratories, Inc. 975 Kelly Johnson Drive Las Vegas, NV 89119-3705	(702) 361-0220	(702) 361-8146
Project QA Officer	Alan Roberts	Woodward Clyde Consultants Stanford Place 3, Suite 1000 4582 S. Ulster St. Denver, CO 80237	(303) 740-2766	(303) 694-3946
Lampbright IU Project Manager	Alan Roberts	Woodward Clyde Consultants Stanford Place 3, Suite 1000 4582 S. Ulster St. Denver, CO 80237	(303) 740-2766	(303) 694-3946
Lampbright IU QA Officer	To be assigned by CMC			
Hurley Soils IU Project Manager	Diane Crawford	Golder Associates, Inc. 4104-148th Ave., NE Redmond, WA 98052	(206) 883-0777	(206) 882-5498

POINTS OF CONTACT
FOR AOC REMEDIAL INVESTIGATION

Title	Name	Address	Phone	Fax
Hurley Soils IU QA Officer	To be assigned by CMC			
Hanover/Whitewater IU Project Manager	Kent Johnejack	Daniel B. Stephens & Assoc., Inc. 604 Spring Street Silver City, NM 88061	(505) 388-0103	(505) 388-0106
Hanover/Whitewater IU QA Officer	To be assigned by CMC			
Tailing Soils IU Project Manager	Craig Hunter	Golder Associates, Inc. 4104-148th Ave., NE Redmond, WA 98052	(206) 883-0777	(206) 882-5498
Tailing Soils IU QA Officer	To be assigned by CMC			

POINTS OF CONTACT FOR AOC REMEDIAL INVESTIGATION				
Title	**Name**	**Address**	**Phone**	**Fax**
Smelter IU Project Manager	Terry Braun	Steffen Robertson & Kirsten, Inc. 7175 W. Jefferson Ave. Suite 3000 Lakewood, CO 80235	(303) 985-1333	(303) 985-9947
Smelter IU QA Officer	Chris tenBraak	Steffen Robertson & Kirsten, Inc. 7175 W. Jefferson Ave. Suite 3000 Lakewood, CO 80235	(303) 985-1333	(303) 985-9947
Ecological IU Project Manager	Laurel Pye	Woodward Clyde Consultants Stanford Place 3, Suite 1000 4582 S. Ulster St. Denver, CO 80237	(303) 694-2770	(303) 694-3946
Ecological IU QA Officer	Alan Roberts	Woodward Clyde Consultants Stanford Place 3, Suite 1000 4582 S. Ulster St. Denver, CO 80237	(303) 694-2770	(303) 694-3946