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**QUALITY ASSURANCE PROJECT PLAN  
FOR THE  
UMTRA TECHNICAL ASSISTANCE CONTRACTOR  
HYDROCHEMISTRY FACILITY**

**FINAL**

**JULY 1993**

**Work Performed Under Contract No. DE-AC04-91AL62350**

**Prepared for  
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**MASTER**

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## LIST OF ACRONYMS AND ABBREVIATIONS

<u>Acronym</u>	<u>Definition</u>
ACS	American Chemical Society
AOM	Albuquerque Operations Manual
ASTM	American Society for Testing and Materials
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
MSDS	Material Safety Data Sheet
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SOP	standard operating procedure
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
VOA	volatile organic acid

## 1.0 INTRODUCTION

The Uranium Mill Tailings Remedial Action (UMTRA) hydrochemistry facility is used to perform a limited but important set of services for the UMTRA Project. Routine services include support of field-based hydrological and geochemical operations and water sampling activities. Less commonly, the hydrology and geochemistry staff undertake special studies and site characterization studies at this facility. It is also used to train hydrologists, geochemists, and groundwater sampling crews.

A review of this *Quality Assurance Project Plan* (QAPP) shall be accomplished once each calendar year. This review will be targeted to be accomplished not sooner than 6 months and not later than 18 months after the last review.

### 1.1 OBJECTIVES

This QAPP describes the services that are routinely performed at the facility and the procedures that are employed to ensure that data quality [*i.e.*, quality assurance/quality control (QA/QC)] and health and safety objectives are met.

### 1.2 MANAGEMENT RESPONSIBILITIES

The following individuals have areas of responsibility in the routine operation of the Technical Assistance Contractor (TAC) hydrochemistry facility.

#### 1.2.1 Geochemistry Manager

The Geochemistry Manager is responsible for the geochemistry operations in the geochemistry section of the facility (including waste management) and geochemical investigation (*e.g.*, column studies). The Geochemistry Manager's responsibilities also include the procurement of geochemistry laboratory supplies and equipment. The Geochemistry Manager shall have 1) the appropriate academic qualifications and laboratory experience to supervise these operations, and 2) the proper hazardous materials and Occupational Safety and Health Administration (OSHA) training.

#### 1.2.2 Water Sampling Manager

The Water Sampling Manager is responsible for all nongeochemical activities in the water sampling staging area and the storage bay. The Water Sampling Manager is also responsible for the storage and use of water sampling supplies and equipment.

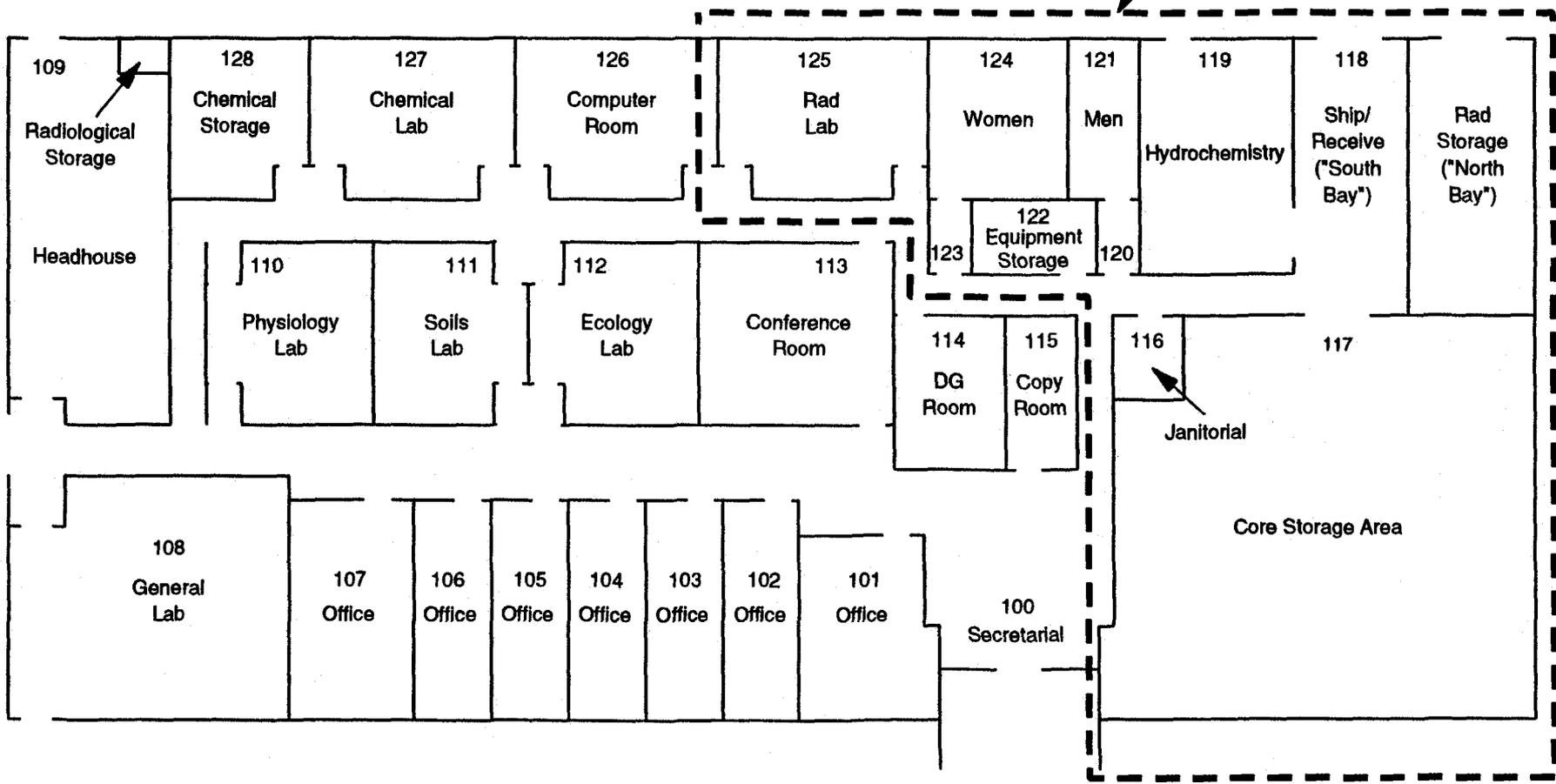
### 1.3 LOCATION, DESCRIPTION, AND ACCESS

The hydrochemistry facility is located at the U.S. Department of Agriculture Forest Service Rocky Mountain Experiment Station, 2205 Columbia SE, Albuquerque, New Mexico. Figures 1.1 and 1.2 show the location of the UMTRA hydrochemistry facility within the Forest Service building. The facility consists of three rooms (Figure 1.3). One room (the hydrochemistry work area) shall be used to conduct limited geochemical analyses, such as the calibration of field analytical instruments and the preparation of chemical or reagent solutions. The second room (the south bay) and a portion of the core storage area shall be used to maintain and store water sampling equipment, receive or ship samples, conduct batch and column experiments, and store supplies. The third room (the core storage/equipment area) shall be used to store core samples, water sampling supplies, and equipment. Samples that exhibit gamma radioactivity of less than 35 microroentgens per hour ( $\mu\text{R/hr}$ ) above background shall be stored in open shelves.

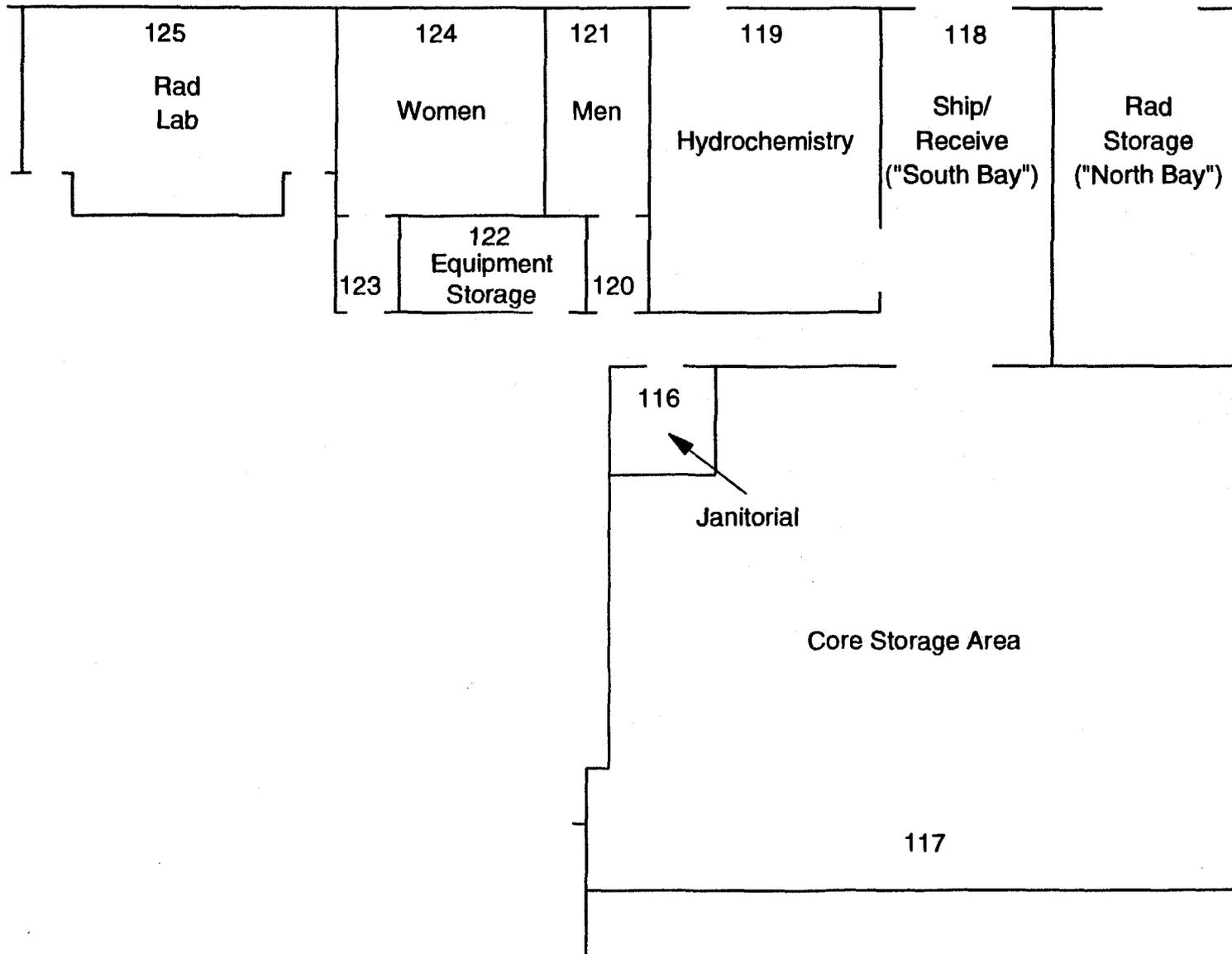
Routine access to the hydrochemistry facility is restricted to qualified TAC personal and water samplers. TAC personnel may gain access to the building by signing out a key from the Geochemistry Manager or Water Sampling Manager. Lockup shall be monitored by users and enforced by supervisory personnel.

1-3

TAC UMTRA HYDROCHEMISTRY  
AND RAD FACILITIES  
(SEE FIGURE 1.2)



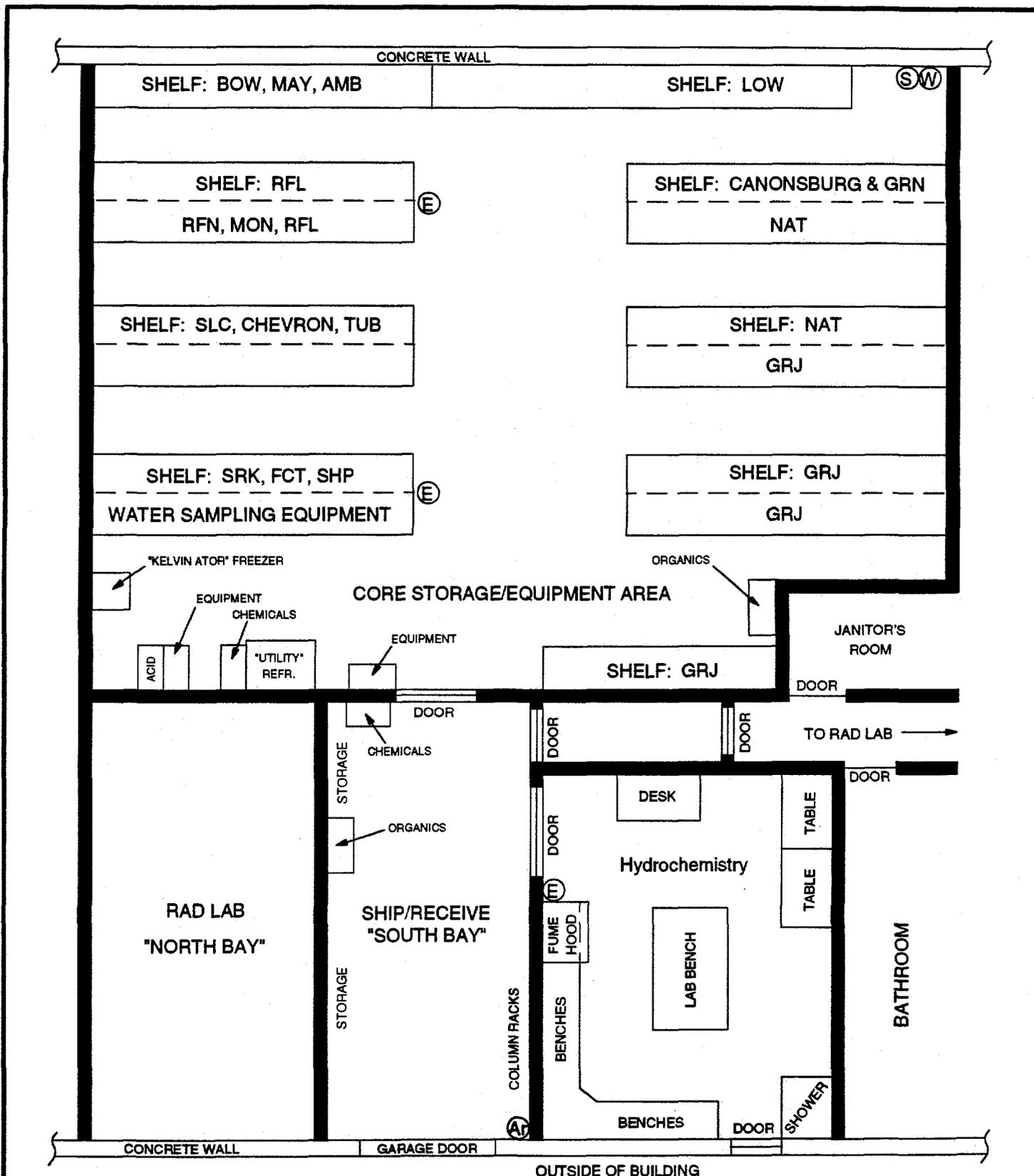
**FIGURE 1.1**  
**U.S. FOREST SERVICE BUILDING**



Inset from Figure 1.1

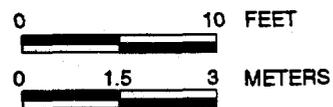
**FIGURE 1.2**  
**TAC UMTRA RAD AND HYDROCHEMISTRY FACILITIES**





LEGEND

- (E) FIRE EXTINGUISHERS
- (S) SPRINKLER SYSTEM VALVES
- (W) WATER CUTOFF VALVE
- (A) ARGON GAS CYLINDER



**FIGURE 1.3**  
**TAC UMTRA HYDROCHEMISTRY FACILITY**

## 2.0 HYDROCHEMISTRY FACILITY STAFF TECHNICAL RESPONSIBILITIES

The following operations are provided for the technical assistance and support to the TAC water sampling crews, hydrogeologists, and geochemists:

- Calibration checks of instruments and water sampling equipment.
- Preparation of chemical and test solutions, including calibration solutions used in field analytical techniques.
- Column and batch tests of soil, sediment, and tailings.
- Analysis of water and soil, sediment, or tailings leachate samples for parameters that could change during shipment to a subcontract laboratory.
- Sample handling: processing (mixing, aliquotting) or shipment of samples to a subcontract laboratory. This shall also include classifying, storing, retrieving, or preparing core samples for laboratory work.
- Storage and shipment of solid or liquid wastes to an authorized disposal site.

### 3.0 QUALITY ASSURANCE AND CONTROL PROCEDURES

The TAC QA Department and hydrochemistry management shall monitor and evaluate the facility operations for compliance with QA/QC objectives and regulations. QA objectives for facility operations shall be achieved by implementing the following:

- Personnel shall be properly trained before they are allowed to work in the hydrochemistry facility.
- Approved standard operating procedures (SOP) (JEG, nd) and QC procedures shall be used when performing procedures or analyses.
- Data assessment shall be an integral part of data acquisition.

#### 3.1 TRAINING AND PERSONNEL

Any work performed in the hydrochemistry facility shall be carried out by members of the TAC Data Management Services and Design and Evaluation departments. To reduce human error during activities in the water sampling staging area and geochemistry area, the Geochemistry Manager and Water Sampling Manager shall authorize only personnel who have been qualified by orientation, training, or experience to work in the facility. Any training shall be documented and maintained as required. The TAC Radiation Protection Officer (or a designee) or the QA Department, Water Sampling, or Geochemistry Manager shall conduct safety orientation and training to enable personnel to correctly respond to emergencies (fire, evacuation, spills, and the like). Other training shall include the following:

- An introduction to Total Quality Management principles. Employees shall be encouraged to provide feedback by asking questions, making suggestions, or providing comments.
- An introduction to the *Chemical Hygiene Plan* (currently being written). The plan shall be located in the geochemistry area bookcase.
- Examination and use of Material Safety Data Sheets (MSDS). The MSDSs are contained in an MSDS notebook located in the geochemistry area bookcase.
- Personnel briefings on current findings related to toxic and hazardous chemicals in use in the facility and on work safety practices. A member of the TAC safety group or the Geochemistry Manager shall conduct the briefings as necessary.
- An introduction to analytical equipment and SOPs applicable to work and to sediment, core, and water sampling.
- An introduction to the use of portable radiological monitoring instruments.

Once properly trained, qualified TAC personnel shall be responsible for the following duties:

- Following the posted list of chemical hygiene and safety rules when handling or storing samples, chemicals, toxic and hazardous substances, samples containing radioactive materials, and wastes.
- Following the rules or procedures in this QAPP and the Albuquerque Operations Manual (AOM) [JEG, no date (nd)].
- Posting proper fire, safety, radiation, or chemical signs for work areas or as required by the Geochemistry Manager.

### 3.2 HYDROCHEMISTRY FACILITY PROCEDURES

This section summarizes the methods, analytical equipment, and procedures that shall be used in the hydrochemistry facility.

#### 3.2.1 Sampling activities and protocols

Samples used for experiments in the hydrochemistry facility shall be collected by trained personnel from the TAC Technical Services Department. Samples shall be collected in the field in accordance with SOP 16.2.1, *Sample Collection, Preservation and Shipment of Water Samples* (JEG, nd). Each sample shall be identified by a unique sample identification number. The samples shall be shipped directly from the field to a subcontractor laboratory or transported to the facility by the sampling personnel. Samples shipped from the facility to a contract laboratory shall follow SOP 16.2.1 (JEG, nd) guidelines.

Special UMTRA Project samples that require detailed geochemical studies shall be shipped to the facility for physical examination, storage, and geochemical studies (when required). Samples derived from the batch and column method or other geochemical experiments shall also be subject to the requirements in the following sections and subsections. Sample containers, handling, preservation, packaging, and shipping are described in SOP 16.2.1 (JEG, nd).

#### Sample labels

Sample labels shall be filled out in black indelible ink and shall provide, at a minimum, the following information:

- Four-character sample identification number.
- Date and time of sample collection.
- Technician's signature.

Samples containing radionuclide or toxic and hazardous materials shall be labeled with radioactive or toxic and hazardous labels. In addition to the above information, labels shall be further inscribed with the following:

- Approximate pollutant concentration.
- Special handling and storage instructions, as required.

All glassware or other containers used to process or contain samples during an experiment shall be labeled.

### Sample custody

Essential to any sampling and analytical program is the integrity of samples from the time the samples are collected until they are analyzed and either exhausted or disposed of. Because of the potential evidentiary nature of analytical data, the possession and handling of samples shall be documented so their custody can be traceable. Samples will be sent in accordance with chain-of-custody procedures outlined in SOP 16.2.1 (JEG, nd). This SOP shall be used to maintain and document sample possession for monitoring purposes.

Chain-of-custody procedures shall be strictly followed during the following activities:

- All routine sample collection, shipment, subcontract laboratory activities, and sample storage and disposal.
- Special UMTRA sample collection, storage, and disposal.

Chain-of-custody procedures shall be followed for UMTRA samples derived from batch and column or other geochemical experiments.

### Sample identification documents

The principal records that shall be used to identify samples and to document sample possession are as follows:

- Chain-of-custody records.
- Air bills or shipping records.
- Field and experiment notebooks and photographs.

The original identification documents shall be deposited with the Data Validation Group and copies filed with the geochemist assigned to the task. The Technical Manager or a designee shall be responsible for assigning these documents to specific experiments. All unused and blank identification documents shall be returned to the filing cabinet at the end of the analytical work.

A sample identification numbering system shall be used to uniquely identify each sample and the associated duplicates and blanks in accordance with SOP 16.3.3, *Data Management* (JEG, nd). This system shall provide a tracking identification number to allow retrieval and cross-referencing of sample information for QC samples. A list of the sample identification numbers shall be maintained in the sample logbook.

The sample identification system for the UMTRA Project shall identify the site, sample medium, sample location, sampling event number, and a serial number containing information on whether the sample is a duplicate or a blank. Preprinted TAC sampling labels are available for both soil and water samples.

### **Sample chain of custody**

The following procedures shall be followed to document sample custody or possession. A sample shall be in custody if at least one of the following criteria is met:

- It is in one's physical possession or view and has not been tampered with (*i.e.*, under lock or official seal).
- It is retained in a secure area with restricted access.
- It is placed in a container and secured with an official seal in such a manner that the sample cannot be reached without breaking the seal.

### **Sample custody procedure**

The Technical Manager or a designee shall be responsible for the care and custody of samples from the time they are received until the sample is exhausted, disposed of at an authorized disposal area, or transferred off the site.

The individual shall accept custody of the samples and verify that the samples received match those on the chain-of-custody records. Pertinent information about shipment, pickup, and courier shall be entered in the remarks section of the chain-of-custody form.

The individual shall use the sample identification number to enter the sample numbers into a sample logbook. The individual shall see that all unused samples are stored in the core storage area until disposal is required.

For samples derived from experiments conducted in the facility, the technician shall record the sample information in the experiment logbook and on the sample bottle label. The sample(s) shall be shipped to a subcontract laboratory for required analyses. Chain-of-custody procedure shall be followed.

All data sheets and records shall be retained in the Project Document Control Center as part of the permanent documentation. Sample containers and remaining sample material shall be disposed of in accordance with authorized waste management SOPs.

### **Subcontract laboratory custody procedure**

A subcontract laboratory shall use established SOPs, unique to its own operations, that address the following concerns:

- Proper care and custody of the UMTRA samples from the time they are received until the samples are exhausted or disposed of in a legal manner.
- Use of a sample tracking system.
- Documentation of information (sample identification, shipment, pickup, courier, and sample analysis date).
- Retention of all identifying stickers, data sheets, and subcontract laboratory records.

### **Transfer-of-custody procedure**

Samples shall be accompanied by a chain-of-custody record in accordance with SOP 16.2.10. When transferring samples, the individuals relinquishing and receiving them shall sign, date, and note the time on the record. This record documents sample custody transfer from the sampler (sender) to the technician (receiver).

Whenever samples are split, it shall be noted in the remarks section of the chain-of-custody record. The note shall indicate with whom the samples are being split and shall be signed by both the sampler and recipient. If the split is refused, this shall be noted and signed by both parties. If a representative is unavailable or refuses to sign, this shall be noted in the remarks section of the chain-of-custody record. When appropriate, as in the case where the representative is unavailable, the chain-of-custody record should contain a statement that the samples were delivered to the designated location at the designated time.

Samples to be sent to a subcontract laboratory for analysis shall be packaged properly for shipment. A separate chain-of-custody record shall accompany each shipping container. The shipping containers shall be sealed with custody seals for shipment to the subcontract laboratory. The method of shipment, courier name(s), and other pertinent information shall be entered in the remarks section of the chain-of-custody record.

Each shipment shall be accompanied by the chain-of-custody record identifying its contents. If sent by mail, the package shall be registered with return receipt requested. If sent by common carrier, a bill of lading shall be used. Air freight shipments shall be sent collect when appropriate. Freight bills, postal service receipts, and bills of lading shall be retained as part of the permanent documentation.

### **Custody seals procedure**

Samples shipped from the field to a subcontract laboratory or from the field to the hydrochemistry facility shall be placed in containers and sealed with custody seals. A seal shall be placed on two sides of each shipping container (cooler). The custody seals shall be signed and dated by the individual relinquishing custody of the samples. Clear tape shall be placed over the seals to prevent accidental seal breakage during shipment.

Custody seals shall not be placed over the septa of a volatile organic acid (VOA) vial.

Sample bottles, cleaned by a vendor in accordance with U.S. Environmental Protection Agency (EPA) guidelines, shall be purchased from the vendor by the TAC Water Sampling Manager and shipped to the hydrochemistry facility. The sample bottles shall be sealed in a box or other container with custody seals to ensure bottle cleanliness. Custody seals broken upon removal of bottles for sampling will be resealed with custody seals and initialed by the sampler.

### **3.2.2 Analytical procedures and instruments**

When needed, analyses shall be performed by properly trained personnel using approved SOPs and analytical equipment to support special studies or UMTRA Project site studies, to meet sample holding time deadlines, or to monitor the facility. The frequency and manner of instrument calibration checks are also described in this section where applicable (Table 3.1). Calibration checks shall be documented in a notebook assigned to each instrument. Documentation shall include name, date, and calibration values. In the event of instrument calibration failure, previous data shall be reviewed.

The frequency of calibration shall be determined by the primary investigator and detailed in the work plan for each experiment. The work plan shall be reviewed by a geochemist to ensure that calibration frequency satisfies quality control guidelines stipulated by the manufacturer or TAC SOPs.

Relevant SOPs are written, reviewed, and approved in accordance with established UMTRA Project policies and procedures.

- Analytical methods are contained in SOPs, which in turn are incorporated in the AOM (JEG, nd).
- The SOPs shall be reviewed annually and revised as required. Such review and revision shall be monitored by the QA Department.
- Instruments and equipment that fail calibration checks shall be taken off-line and sent back to the manufacturer for repair.

Each analysis is cited in the following paragraphs by SOP number.

**Table 3.1 Quality control program for instruments/equipment**

Description	QC description	Frequency	Comments
Temperature: Thermometer(s)	Calibration check with ASTM thermometer (water temperatures with ice cold, room temperature, and hot). QC blank (distilled water).	Semiannually, monthly	Based on QC checks
Conductivity: Conductivity meter and electrode	Calibration check with KCl standard reference solutions. Mid-range check. QC blank (distilled water).	Semiannually, monthly	Based on QC checks
pH: pH meter and electrode	Calibration check with certified pH buffer solutions, slope check, temperature check. Mid-range check. QC blank (distilled water).	Semiannually, monthly	Based on QC checks
Alkalinity: pH meter with electrode and titrator	Use pH meter calibration check. Use titrator calibration check. Technician repeats titration. QC solution (Chem-Nuclear Geotech). QC blank (distilled water).	Semiannually, monthly	Based on QC checks
Total acid: same as alkalinity	Same as alkalinity above.	Semiannually, monthly	Based on QC checks
Dissolved oxygen: DO meter and electrode	Calibration check with CoCl <sub>2</sub> solution. QC blank (distilled water).	Semiannually, monthly	Based on QC checks
Oxidation/reduction potential: pH meter and ORP electrode	Calibration check with potassium ferrocyanide/ferricyanide solutions. QC blank (distilled water).	Semiannually, monthly	Based on QC checks
Spectrophotometer: Hach DR 3000	Five-pt calibration check. Standard addition. Mid-range check. QC blank.	Semiannually, monthly	Based on QC checks
Analytical and top loading balance	Internal/external calibration check. Use certified weights. Annual cleaning and certification.	Semiannually, monthly	Based on QC checks
Titrator	Titration check with ref. std. solutions (NaOH, KOH, H <sub>2</sub> SO <sub>4</sub> , HCl). Weigh titrated amounts.	Semiannually, monthly	Based on QC checks
Mechanical pipette	Pipette four to seven aliquots of distilled water and weigh. Weigh pipetted amounts.	Semiannually, monthly	Based on QC checks
Volumetric pipettes	Pipette four to seven aliquots of distilled water and weigh. Weigh pipetted amounts.	Semiannually, monthly	Based on QC checks
Glassware	Discard broken or chipped wares. Check volumes with Class A graduated cylinders.	Semiannually, monthly	Based on QC checks

KCl = potassium chloride  
CoCl<sub>2</sub> = cobalt chloride  
NaOH = sodium hydroxide  
KOH = potassium hydroxide  
H<sub>2</sub>SO<sub>4</sub> = sulfuric acid  
HCl = hydrochloric acid

ASTM = American Society for Testing and Materials  
DO = dissolved oxygen  
ORP = oxidation/reduction potential

### Temperature

The temperature of a solution sample shall be measured with a thermometer. The data shall be recorded in a logbook. Refer to SOP 16.1.1 of the AOM (JEG, nd). Thermometer calibration shall be checked semiannually using an American Society for Testing and Materials (ASTM) thermometer unless changes in accuracy and calibration checks warrant monthly review. Thermometer(s) deviating from the standard by  $\pm 1^{\circ}$  C shall be replaced. ASTM thermometers that have been calibrated in accordance with ASTM E-11 (ASTM, 1991) shall be purchased from laboratory supply firms and used.

### Specific conductivity

The specific conductivity of a water sample shall be measured with a conductance meter and electrode. The data shall be recorded in a logbook. Refer to SOP 16.1.10 of the AOM, *Field Measurement of Water Samples for Temperature, Conductivity, pH, Alkalinity, and Total Acid* (JEG, nd).

Conductance meter calibration shall be checked with certified potassium chloride solutions each time the meter is used and when the data are recorded.

### pH

The pH of a water sample shall be measured with a pH meter and electrodes. The data shall be recorded in a logbook. Refer to SOP 16.1.10 of the AOM (JEG, nd).

The pH meter calibration shall be checked with certified pH buffer solutions each time the meter is used to obtain sample data.

### Alkalinity

The alkalinity of a sample shall be determined by titrating a calibrated sulfuric acid solution into a measured volume of water sample to a pH of 4.00 (4.50 is the recorded end point, but the solution is titrated down to 4.00 to obtain the tail end of the titration curve). Alkalinity titrations shall be performed and repeated by the technician. Data shall be recorded. Alkalinity shall be calculated from the acid volume used and the acid normality. Refer to SOP 16.1.10 of the AOM (JEG, nd).

A QC alkalinity solution prepared by a contract laboratory shall also be titrated at a frequency determined by the prime investigator, or an appointee, of the experiment. Frequency depends on the extent of the experiment and the number of samples.

Data from the QC sample titrations shall be sent to the contract laboratory that prepared the known alkalinity sample for comparison with the true values. Titrant shall be certified by the Hach Company upon request.

### Total acid

The total acid of a sample shall be determined by titrating a calibrated sodium hydroxide solution into a measured volume of sample to pH 7. Data shall be recorded in a logbook. Total acid shall be calculated from the NaOH volume used and the sodium hydroxide normality. Refer to SOP 16.1.10 of the AOM (JEG, nd).

Total acid titration of a sample shall be performed and repeated by the technician. The data shall be recorded. A QC total acid solution prepared by a contract laboratory shall also be titrated at a frequency determined by the prime investigator or an appointee. The frequency depends on the extent of the experiment and number of samples.

### Dissolved oxygen (DO)

The DO in a sample shall be measured with a DO meter and electrode or spectrophotometrically (Hach, 1989). The data shall be recorded in a logbook. Refer to SOP 16.1.16 of the AOM, *Field Determination of Dissolved Oxygen in Water Samples (Alternate Method)* (JEG, nd).

DO meter calibration shall be checked each time the meter is used to obtain sample data. The calibration data shall be reviewed semiannually, unless changes in accuracy and calibration checks warrant monthly review.

### Oxidation/reduction potential (ORP)

The ORP of a sample shall be measured with a pH meter and ORP platinum combination electrode. The data shall be recorded in a logbook. Refer to SOP 16.1.13 of the AOM, *Field Measurement of Oxidation/Reduction Potential (ORP) In Water Samples* (JEG, nd).

The pH meter and ORP electrode performance shall be checked with Zobell solutions each time the meter is used to obtain sample data. This procedure is detailed in SOP 16.1.13. Zobell solution is a check solution containing reagent-grade potassium ferricyanide and ferrocyanide and potassium fluoride. The check data shall be reviewed quarterly, unless changes in accuracy and calibration checks warrant a monthly review.

### Soil moisture content

When required, moisture shall be determined and reported for each soil or sediment sample. Procedures for determining soil moisture can be found in SOP 16.1.9, *Method for Determining Gravimetric Moisture Content of Drill-Bit Cuttings from the Unsaturated Zone* (JEG, nd). The equation for moisture content given in D-2216 of ASTM (1987) shall be modified as follows:

$$W = \frac{(W1 - W2)}{(W1 - WC)} \times 100 \quad (1)$$

where  $W$  = moisture content, in weight percent,  
 $W1$  = weight of container and sample as received,  
 $W2$  = weight of container and oven-dried sample, and  
 $WC$  = weight of container.

### **Batch and column tests**

Batch and column experiments shall be performed with an UMTRA Project sediment or soil sample to determine solution or sediment interactions as detailed in SOP 16.1.8, *Batch and Column Testing* (JEG, nd).

Since "blank" soil samples are nonexistent, replicate aliquots of a blended sample shall be used for QC purposes, where appropriate.

If necessary, a small portion of the column eluate and filtrate can be analyzed in the facility for parameters such as alkalinity or pH. The remaining portion of the sample shall be shipped to a subcontract laboratory for determination of analytes of interest. Refer to SOP 16.1.8 of the AOM (JEG, nd).

### **Other approved methods**

Other analytical procedures that may be performed in the facility shall use a spectrophotometer (Hach DR 2000 or 3000) according to Hach instrument operational manuals (Hach, 1989). These other analyses may include the following:

- Ammonia.
- Nitrate.
- Ferrous iron.
- Total iron.
- Sulfate.
- Sulfide.
- Molybdenum.
- Manganese.

The spectrophotometer shall be operated in conformance with instructions in the manual. The instrument manual lists actions to be taken to determine if calibration checks or maintenance is required. The unit shall be returned to the manufacturer for maintenance or repair in specified cases.

Reference standard solutions for instrument calibration checks or calibration verification purposes shall be purchased from the Hach Company and used. Calibration checks shall be recorded in the DR 3000 logbook.

### **Fisher scientific XRT analytical balance**

The XRT analytical balance has an internal calibration check mechanism. The manual lists actions to be taken to determine if factory adjustment, calibration, or maintenance is required.

Whenever sample or other weights are to be determined, balance calibration checks shall initially be performed with the internal calibration check protocol. Results shall be recorded in the balance logbook.

Balance weights (described below) shall be used to perform an external balance calibration check during each experiment or as determined by the prime investigator or an appointee. Calibration check and sample data shall be recorded in the XRT balance logbook.

The balance shall be inspected and certified annually by a qualified instrument maintenance and repair vendor. A sticker with the date of calibration inscribed on it shall be affixed to the outside of the balance.

### **Mettler PJ 3000 top loading balance**

This balance has an internal calibration check mechanism. The manual lists actions to be taken to determine if factory adjustment, calibration, or maintenance is required.

Whenever sample or other weights are to be determined, balance calibration checks shall initially be performed with the internal calibration check protocol. Results shall be recorded in the balance logbook.

Balance weights (described below) shall be used to perform an external balance calibration check during experiments as determined by the primary investigator or an appointee. Calibration check and sample data shall be recorded in the balance logbook.

The balance shall be inspected and certified annually by a qualified instrument maintenance and repair vendor. A sticker with the date of calibration inscribed on it shall be affixed to the outside of the balance.

### **Balance weights: Class S; 1 milligram (mg) to 100 grams (g)**

Class S reference weights are purchased from a laboratory supply firm and are used with the analytical balance. Each weight is assigned to a designated space to ensure that the right weight is in the proper space in the weight box.

The Class S weights shall be inspected and calibrated annually by a qualified instrument maintenance and repair vendor. A sticker with the calibration date inscribed on it shall be affixed to the inside cover of the weight box.

### **Top loader balance weights: 300 g, 500 g and 1000 g**

Reference weights are purchased from a laboratory supply firm and are used with the top loader balance. Each weight is assigned to its own box. A glove for weight-handling purposes is included with each weight so that the weight reliability is assured.

These weights shall be inspected and calibrated annually as described above. A sticker with the calibration date inscribed on it shall be affixed to the inside cover of each weight box.

### **Hach digital titrator**

The Hach digital titrator shall be operated in conformance with instructions in the manual.

Titrator calibration checks shall be performed semiannually. This shall be done by titrating a series of calibrated hydrochloric acid or sulfuric acid solutions with a calibrated sodium hydroxide solution or vice versa. Data (*e.g.*, volume of calibrated acid solution used, calibration value of acid solution, sodium hydroxide volume used) shall be recorded in the titrator logbook.

Data shall be calculated to determine accuracy and precision. Accuracy and precision of the titrator shall be evaluated. If the calibration check results are consistently outside of the control limits established for the titrator, the titrator shall be returned to the Hach Company for recalibration or maintenance.

### **Volumetric pipettes**

Class A volumetric glass pipettes are purchased from a laboratory supply firm. These pipettes are calibrated to industry-required standards after manufacture. The accuracy of calibration for these pipettes need not be checked.

### **Mechanical pipettes**

For calibrated mechanical pipettes with disposable tips, calibration checks shall be performed prior to sample analysis. The user shall refer to the instrument manual for operational procedures.

Acceptability of sample data measured with an out-of-tolerance mechanical pipette shall be evaluated by a qualified TAC staff member.

### **3.3 INTERNAL QUALITY CONTROL CHECKS AND PROCEDURES**

#### **3.3.1 Documentation**

In addition to sample identification documents, experiment documentation (including logbooks) and photographs shall be maintained by TAC personnel to provide a daily record of significant events, observations, and measurements during investigations.

##### **Logbooks and records**

Logbooks and records shall be used for recording data collection and other activities. Instructions regarding data entry and correction shall be placed inside the cover of the logbook.

Entries shall be made in ink and shall include sufficient detail to reconstruct experimental activities without reliance on memory. All samples and measurements shall be documented, along with a detailed description of the sample location. Logbook entries shall include the sample type, observed character of the sample, measurements to be performed, and other appropriate information. All entries shall be signed and dated by the person entering the data.

Samples shall be analyzed in accordance with this QAPP and the AOM (JEG, nd). The instrument used to analyze the sample, analysis time, sample description, sample type, sample volume (or weight), and number of sample containers shall be noted.

##### **Photographs**

Photographs may be taken of work areas with respect to the surrounding area and relative to objects used in the facility. The photographs shall be used to provide backup documentation of procedures, analytical setup, and unusual conditions encountered. The frame and roll numbers corresponding to the work area shall be logged in a notebook.

Logbooks and photographs are intended to 1) provide sufficient data and observations to enable participants to reconstruct events that occurred, and 2) refresh the memory of personnel if they are called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, shall be subject to cross-examination and shall be admissible as evidence.

##### **Corrections to documentation**

Corrections to documentation shall be performed as described in this section. All original data recorded in logbooks, sample identification labels, and chain-of-custody records shall be written using waterproof ink. These documents shall not be

thrown away or destroyed, even if they are illegible or contain inaccuracies that necessitate a replacement document.

If an error is made on a document, corrections shall be made by drawing a single line through the error and entering the correct information. The erroneous information shall not be obliterated. Any error discovered on a document shall be corrected by the person who made the entry whenever possible. All corrections shall be initialed and dated. Instructions regarding correction of erroneous data shall be placed inside the cover of each logbook.

### **Document control**

All information, records, or data obtained during investigations shall be sent to the UMTRA Project Document Control Center and shall be subject to all UMTRA Project document control and access procedures.

Logbooks or records shall be assigned by the UMTRA Project Document Control Center. Each logbook or record shall be identified by a document control number specifying the task order number, the type of logbook or record, and a unique serialized number. The cover of each logbook shall specify the following:

- Person or organization to whom the book is assigned.
- Book number.
- Start date.
- End date.

These documents shall be returned to the Project Document Control Center whenever any of the following occurs:

- The document has been filled with data and other experiment-related information and a new document is required.
- Document review is required.
- The facility is closed.

## **3.3.2 Records**

### **Core storage records**

TAC Design and Evaluation Department personnel shall provide documentation and maintain the core storage record. The core storage record shall contain information on stored core samples (site, location, depth, desired holding time or disposal date, responsible TAC hydrologist). The record shall be kept in the core storage area.

## **Records**

Record books shall be issued and controlled in accordance with the previous sections and kept in the facility.

Personnel shall perform documentation and maintain the following records:

- Chemical and reagent materials inventory—contains a list of chemicals and reagent materials.
- Equipment inventory—contains a list of equipment and supplies.
- MSDS book—contains health and safety information for chemicals.
- Sample logbook—contains a record of samples processed in the facility.
- Top loading balance logbook—contains balance calibration check data.
- Analytical balance logbook—contains balance calibration check data.
- Single beam balance logbook—contains balance calibration check data.
- pH logbook—contains pH meter calibration check data.
- Conductivity logbook—contains conductance meter calibration check data.

### **3.3.3 Reagents, primary standards or controls, and supplies**

The manager shall ensure that reagents, primary standards or controls, and supplies shall meet established quality criteria prior to their use in a procedure.

All reagents shall meet American Chemical Society (ACS) reagent-grade specifications or better. ACS-certified reagents shall be used unless otherwise specified.

Purchased reagents and primary standards or control solutions shall be dated 1) upon receipt in the facility, and 2) when opened for use. The expiration date shall be highlighted on the label.

Reagents and primary standards or control solutions whose expiration dates have elapsed shall be replaced with fresh or newer reagents and solutions. The older material shall be removed from the shelf and shall not be used for analysis. Disposal of such material or solution shall be in accordance with waste management SOP 16.3.6, *Storage and Disposal of Lab Wastes* (JEG, nd).

Standards and reagents shall be checked against past standards and commercial sources often enough to identify possible contamination or degradation. Records of this shall be maintained in a logbook and on the reagent bottles.

### **3.3.4 Preparation of reagent, primary standard or control solutions**

The manager or a designee shall prepare reagent solutions according to procedures outlined in a chemical reference handbook. The solutions shall meet required concentrations and other requirements as specified by a reliable chemistry handbook.

Reagents shall be prepared using grade II or better water.

Each prepared reagent bottle shall be labeled with reagent name, concentration, preparation formula, and preservative (if required) and shall be initialed by the preparer. The expiration date shall be recorded on the exterior of the bottle. All pertinent notes as to reagent preparation shall be recorded in a logbook.

Prepared reagents shall be stored in a pan (polyethylene) and refrigerated, if necessary. The pan shall be of sufficient volume to contain the reagent if it is spilled.

### **3.3.5 Labware cleaning**

Labware shall consist of laboratory equipment (glass, polyethylene, or metal) used to contain and process samples for analysis. All labware that comes in contact with samples or reagents containing inorganics or radioactive material shall be cleaned as follows:

- Items shall be washed thoroughly with a laboratory detergent (Alconox or equivalent) in tap water and rinsed three times in Type-3 water.
- If required by the work plan of an experiment, clean items shall be placed in an acid vat containing 4-normal nitric acid and allowed to soak 6 to 18 hours. After acid soaking, the items shall be rinsed thoroughly with deionized water and allowed to air dry. The primary investigator or an appointee shall decide whether to use an acid rinse.
- When appropriate, clean polyethylene containers shall also be placed in an acid vat (room temperature) and shall be removed after 4 to 6 hours.
- Items shall be returned to the storage cabinets until ready for use.
- The quality of the labware cleaning procedure shall be checked through the use of procedural blank preparations with each sample batch.

### **3.3.6 Quality control practices**

At a minimum, QC practices shall consist of the practices described in the following paragraphs.

- All procedures and analyses shall follow the methods spelled out in the appropriate SOPs.
- All samples shall be analyzed undiluted unless specified otherwise in the method or unless doing so will damage the analytical instrument. In addition, samples shall be analyzed after dilution, if necessary, to meet method requirements.
- Accuracy and precision measurements (where appropriate) shall be taken at a minimum of 1 in 20 or 1 per batch, whichever is more frequent.
- Procedure (experimental) blank measurements shall be taken at a minimum of 1 in 20 or 1 per batch, whichever is more frequent.
- Initial and continuing QC checks of instruments used in the facility shall be performed as summarized in this document (refer to Table 3.1) and defined in SOP 16.2.1 (JEG, nd).
- Data shall be reduced and reported in the appropriate units with an appropriate number of significant digits.

### **3.4 PREVENTIVE MAINTENANCE**

#### **3.4.1 Cleanliness**

Work areas shall be kept clean. Instruments shall be kept clean and ready for use at all times. This shall be done as follows:

- Clean instruments upon completion of work and store properly.
- Place a dust cover or other protection over the instruments.

#### **3.4.2 Reagent storage**

Reagents shall be stored in a secured area according to OSHA regulation guidelines. Access to reagents shall be limited to qualified TAC personnel.

#### **3.4.3 Instrument records**

Each instrument shall be used in conformance with instructions in the operating manual. Manuals contain instructions on instrument setup, operation, calibration checks, troubleshooting, parts, and service. Each manual shall be kept in a designated location.

Instrument logbooks shall be issued and kept in the facility at all times. The logbooks shall contain a recorded history of past maintenance, both routine and nonroutine.

#### **3.4.4 Equipment checkout**

An instrument checkout procedure, with a form, shall be implemented to provide accountability for each instrument. The form shall also include a report on the condition of each instrument. Any item that requires maintenance or repair shall be returned immediately to the manufacturer or his designated representative for repair. Equipment checkout procedures are currently being prepared.

#### **3.4.5 Use of recorded data**

Recorded data in a logbook shall be examined for trends (*e.g.*, accuracy, precision) and excursions beyond control limits to determine instrument reliability.

#### **3.4.6 Maintenance measures**

Maintenance shall be performed when an instrument begins to degrade. Degradation is evidenced by an increase in delay of instrument reading, fluctuations in readings, shift in calibration data, decrease in sensitivity, or failure to meet one or more of the QC criteria.

Preventive maintenance shall be performed according to the procedures delineated in the manufacturer's instrument manuals.

Instrument downtime shall be minimized by keeping supplies of all expendable items, where expendable means an expected lifetime of less than 1 year. These items shall include electrodes, membranes, cables, and batteries.

## 4.0 AUDITS

The hydrochemistry facility provides a staging area for the Water Sampling Group and geochemical investigations in support of the UMTRA Project. This QAPP shall be the documented and approved QA program in place and implemented. Activities shall be performed in accordance with documented and approved SOPs.

Personnel conducting work in the facility shall be qualified and trained in accordance with requirements contained in the *UMTRA TAC Project Quality Assurance Program Plan* (DOE, 1992) and Section 3.1 of this QAPP.

Activities that use analytical measuring or test apparatus shall be performed with calibrated instruments. Calibration checks shall be conducted in accordance with Section 3.2.2 and/or the manufacturer's recommendation or industry standards.

Implementation of specified QA program, personnel training and qualification, and equipment calibration requirements shall be verified by surveys, monitoring, or audits by the QA department. Audits shall be conducted annually.

## 5.0 CORRECTIVE ACTION

The QA Department shall maintain a corrective action program that identifies the cause of any significant condition adverse to quality and provides the means for reversing indicated trends adverse to quality.

### 5.1 CORRECTIVE ACTION

All TAC personnel who are qualified to perform work in the core storage area or water sampling equipment storage area shall be responsible for identifying, documenting, and reporting to the facility manager the conditions adverse to quality, the cause of the condition, and the corrective action recommended.

Experiments performed in support of the UMTRA Project shall be monitored so that conditions adverse to quality are promptly identified. Technicians who are qualified to perform experiments shall be responsible for identifying, documenting, and reporting to the facility manager the conditions adverse to quality, the cause of the conditions, and the corrective action recommended.

If corrective action is deemed necessary, it shall proceed in accordance with requirements outlined above and in the *UMTRA TAC Project Quality Assurance Program Plan* (DOE, 1992).

### 5.2 CORRECTIVE ACTIONS RESULTING FROM AUDITS

If a facility audit identifies deficiencies requiring corrective action, the final audit report shall require that a written response outlining proposed corrective action be transmitted to the QA department.

The QA Manager or the lead auditor shall review the proposed corrective action to ensure that it will resolve the deficiency. The QA Manager or the lead auditor shall also determine whether the proposed corrective action is adequate to allow the audit to be closed out.

The QA Department shall verify implementation of corrective actions by conducting subsequent audits. If the identified deficiencies are serious, a followup audit may be conducted to verify implementation of corrective action(s) as well as to ensure quality advancement/enhancement.

## 6.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this QAPP.

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## 7.0 REFERENCES

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