Sampling and Analysis Plan for the 105-N Basin Water

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ACRONYMS

ALARA = as low as reasonably achievable

BHI = Bechtel Hanford, Inc.

DQO = data quality objectives

EPA = U.S. Environmental Protection Agency

ERC = Environmental Restoration Contractor

ETF = Effluent Treatment Facility

FTF = final transfer filtration

GEA = gamma energy analysis

ICP = inductively coupled plasma

QA = quality assurance

QC = quality control

SAF = Sample Authorization Form

SAP = sampling and analysis plan

SDM = Sample and Data Management

VAC = volt AC

VOA = volatile organic analysis

1.0 INTRODUCTION

1.1 PURPOSE

This sampling and analysis plan (SAP) defines the strategy, and field and laboratory methods that will be used to characterize 105-N Basin water. The water will be shipped to the 200 Area Effluent Treatment Facility (ETF) for treatment and disposal as part of N Reactor deactivation. These analyses are necessary to ensure that the water will meet the acceptance criteria of the ETF, as established in the Memorandum of Understanding for storage and treatment of water from N- Basin (Appendix A), and the characterization requirements for 100-N Area water provided in a letter from ETF personnel (Appendix B).

1.2 PHYSICAL DESCRIPTION AND PROCESS KNOWLEDGE

The 105-N Basin was to receive, segregate, and store spent fuel during N Reactor operation (Figure 1-1). The 105-N Basin is a reinforced concrete structure 45.7 m (150 ft) long by 15.2 m (50 ft) wide and 7.3 m (24 ft) deep, which contains approximately 3.8 million L (1 million gal) of water. The 105-N Basin complex is segregated into the following areas:

- Discharge pit and fast cart tunnel
- Segregation pit
- Exam pit
- North and south basins
- North and south cask loadout pits.

The fast cart tunnel connects the discharge pit and the segregation pit. The segregation pit, exam pit, north and south basins, and the north and south cask loadout pits form six pools connected by openings in their common walls. The floor of the 105-N Basin is raised at these openings, creating 1.5- of 2.1-m (5- or 7-ft) thresholds that will act as dams when water is drawn down in individual pools, as shown in Figure 1-2 (BHI 1996a). Most of the basin is unlined; a welded stainless-steel liner is present in the fast cart tunnel and in parts of the discharge pit. Basin construction materials include concrete, both bare and painted; painted carbon-steel structural components; borated concrete cubicle panels; the welded stainless-steel fast cart tunnel liner; stainless-steel transport carts (fast carts); and aluminum cubicle components.

Hardware waste is being removed and packaged for disposal; sediment is being vacuumed from the basin floor and consolidated in the north cask loadout pit. Sediment will be removed from the north cask loadout pit at a later date. Waste and sediment have been addressed in separate data quality objective (DQO) process reports; however, these activities may be taking place concurrent with the processing and removal of the 105-N Basin water (BHI 1996b). Water in the basin will be circulated through a filtration system to remove particulate material larger than 5 microns. The system will filter and transfer all N-Basin water sent to the ETF for treatment.

1.3 DATA QUALITY OBJECTIVES SUMMARY

The objectives and goals for this sampling activity were defined in a U.S. Department of Energy, Richland Operations Office (RL) DQO workshop. The DQO was conducted in accordance with

the U.S. Environmental Protection Agency's (EPA) *Guidance for the Data Quality Objectives Process* (EPA 1994). Details of the DQO process are reported in the *Data Quality Objectives Summary Report for the 105-N Basin Water* (Oates et al. 1997). This SAP represents a resource-effective sampling and analytical strategy that was mutually agreed to by U.S. Department of Energy, Richland Operations Office, the ETF, and the Environmental Restoration Contractor (ERC) Project team. The DQO process resulted in the following objectives and criteria for sampling and analysis:

- Characterization of the water quality in the 105-N Basin for the identified parameters
- Verification that water quality does not change during basin dewatering by the following:
 - Monitoring the reliability of the filters during water drawdown
 - Monitoring for conformance with relevant transportation criteria
 - Identifying any changes to water chemistry due to flocculation, hydrolazing, or sealing of the 105-N Basin walls.

Figure 1-1. 100-N Reactor Area Site Plot.

Figure 1-2. N-Basin Plan.

2.0 FIELD SAMPLE COLLECTION

This section outlines the strategy and procedures used to collect samples to characterize and verify the selected chemical and physical properties of water in the 105-N Basin. The selection of analytical parameters, laboratory arrangements, sample locations and frequencies, sampling equipment selection, and additional quality control (QC) measures is based on the DQO summary report (Oates et al. 1997) and the sampling objectives described in Section 1.3. Samples will be analyzed for chemical, radiological, and physical property parameters. A sufficient volume of water will be collected so an archive sample may be retained until analytical data have been returned and evaluated. Archival sample requirements are explained in Section 2.6.

2.1 SPECIAL CONSIDERATIONS AND CHOICES

Special considerations for sample collection and analysis were taken into account during the DQO because of the size of the 105-N Basin and the volume of water (i.e., 3.8 million L [1 million gal]). Water in the basin is anticipated to be vertically heterogeneous because of suspended particulate. Although activities associated with sediment removal will contribute to the homogenization of the water in the basin, a single sample taken from any location cannot be assumed to be representative of the entire water volume. Therefore, four random characterization samples will be collected from the accessible area and depth of the basin.

A few relatively small areas exist within the 105-N Basin that will not be accessible for characterization sampling. The discharge pit is the largest of these areas. This cover will maintain isolation of Zone III from Zone I during storage. Placement of the cover may occur before the

filtration system is operating with 5 micron filters. Physical obstructions also occur in other parts of the basin, such as the fast cart dump station in the south basin and in the west end of the basin where equipment is on top of cubicles. It is assumed the water in the inaccessible areas is similar to the bulk of the 105-N Basin water, and that the volume is small in comparison to the 3.8 million L (1 million gal) in the 105-N Basin.

The two sample collection events that will occur will include characterization and verification sampling. Characterization samples will be collected prior to dewatering the basin, and the samples will be analyzed for the parameters and constituents identified by the Memorandum of Understanding with ETF (Appendix A). Additional characterization samples may be collected

during basin cleanout operations that accompany draw down of the water. Verification samples will be collected during dewatering to verify that water quality does not adversely change during dewatering.

2.1.1 Characterization Sample Considerations

The basin has been divided into three-dimensional blocks to establish a sample location grid. Four characterization samples have been chosen at random from the grid. To ensure that the samples are independent of one another, grid dimensions correspond approximately to 233 L (60 gal), the volume of water required to flush the water sample collection tool four times plus the sample volume. A rectangular grid with dimensions 0.61 m by 0.61 m by 0.61 m (2 ft by 2 ft by 2 ft) corresponds to approximately 233 L (60 gal). The sample grid and characterization sample locations are shown in Figure 2-1. A similar figure showing these sample locations will be included in the sampling activity work package.

The water for characterization samples will be filtered with a tool that incorporates a 5 micron filter. The water sample will be collected at the sampling valve located downstream of the filter or at the outlet hose downstream of the filter (Figure 2-2).

Areas of the N-Basin may have sediment on the basin floor. The peristaltic pump inlet or the submersible pump inlet will be positioned so that sediment is not entrained.

2.1.2 Verification Sample Considerations

Verification samples will be collected during dewatering of the basin so they represent a probable worst-case scenario for the inventory that will arrive at ETF. These samples will be taken after the filters are replaced, if replacement is necessary, as new filters are less effective than filters that already have particulate buildup on them. The filtration system pumps (e.g., FTF-P-1) will be used to convey water to the filtration system.

The initial verification sample will be collected at the sample collection valve (FTF-V-26) downstream of the filters during the initial truckloads of water (Figure 2-3). Figure 2-3 represents the probable filtration system layout; the actual system may differ. The remaining four samples will be collected from that valve at approximately 760,000-L (200,000-gal) intervals as tanker

trucks are loaded with water. The last sample will be collected after the water has been lowered to a level below the gates and openings in the walls of the 105-N Basin, creating five isolated pools of water. The water will then be pumped from the individual pools into the south basin for removal. It is expected that the last sample will provide worst-case conditions for two reasons: (1) the concentration of particulate less than 5 microns, hence contaminants, will be most concentrated; and (2) any effects of the basin wall sealant will be the most prevalent.

2.2 SAMPLE COLLECTION METHODS/EQUIPMENT

Water sample collection for characterization will be accomplished using tool that incorporates a 5 micron filter to remove particulates larger than 5 microns. The sample will be collected at the sampling valve located downstream of the filters or at the outlet hose from the filter. A 110-volt AC (VAC) peristaltic pump and discharge hose or submersible pump and discharge hose will be connected to the filter during characterization sampling to allow sampling from the randomly selected location.

During dewatering of the basin, water samples will be collected at the filtration system sampling valve (FTF-V-26), which is located downstream of the filters. The filtration system pump(s) will supply water to the system. An activity work package will address the characterization and verification sampling.

2.2.1 Peristaltic Pump

A peristaltic pump and associated discharge hose will be used to pump water from the sampling locations to the filter inlet for characterization samples, as summarized in the following:

- A 110 VAC peristaltic pump will be used to supply basin water to the filter. The 110 VAC peristaltic pump discharge rate will be compatible with the filter.
- At least 186 L (48 gal), which corresponds to four times the internal volume of the largest 5 micron filter unit , will be pumped through the water sample collection tool , filtered, and returned to the basin to purge the sampling tool before each sample is collected.
- After purging the sampling tool, the sample of water will be collected at the sampling valve or at the hose connected to the filter outlet.

These steps will be repeated for each characterization sample location.

2.2.2 Sample Collection Contingencies

Because unknown conditions in the field may occur, the sampler is ultimately responsible to select the most practical and appropriate sampling method for water that will provide a representative sample. In lieu of using the 110 VAC peristaltic pump and as authorized by the project engineer, a 110 VAC submersible pump may be used to obtain a sample of the 105-N Basin water for characterization. This is not the preferred alternative because a method for reducing the flow rate from the a 110VAC submersible pump would be required and possibly a flow rate indicator would be needed, and the pump, hoses, and filter are larger than the 110 VAC

peristaltic pump, hoses, and filter. The 110 VAC submersible pump, hoses, and filter may also be more difficult to position in the characterization sample locations than the inlet hose to the peristaltic pump.

A submersible pump and associated discharge hose will be used to pump water from the sampling locations to the filter inlet for characterization samples, as summarized in the following:

- A 110 VAC submersible pump will be used to supply basin water to the filter instead of the peristaltic pump. The 110 VAC submersible pump discharge rate will be throttled to be compatible with the filter.
- At least 186 L (48 gal), which corresponds to four times the internal volume of the tool and filter, will be pumped through the tool, filtered, and returned to the basin to purge the sampling tool before each sample is collected.
- After purging the sampling tool, the sample of water will be collected at the sampling valve, which is located downstream of the filter.

2.3 SAMPLING LOCATIONS/FREQUENCIES

Water samples for characterization will be collected from four locations (shown in Figure 2-1 and described in Section 2.2.1) and will be analyzed as described in Section 3.0. The locations and numbers of samples to be collected are summarized in Table 2-1.

2.4 FIELD DOCUMENTATION OF SAMPLING

This section describes the procedures to be followed for sample identification, chain-of-custody, and field logbook documentation.

2.4.1 Sample Identification

The Sample Data Tracking database will be used to track the sample and laboratory data obtained during these characterization activities. Before initiating field sampling activities, a block of unique sample numbers will be issued to the sampling organization for this project in accordance with BHI-EE-01, *Environmental Investigation Procedures*, EIP 2.0, "Sample Event Coordination." Each sample will be identified and labeled with a unique sample number. The sample location and corresponding unique sample number will be documented in the field sampling logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- Unique sample numbers
- Sample authorization form (SAF) number
- Sample collection date/time
- Name/initials of sampler
- Analysis required

- Preservation method (if applicable).

2.4.2 Chain-of-Custody

All samples will be controlled from the point of origin to the analytical laboratory in accordance with BHI-EE-01, EIP 3.0, "Chain of Custody." A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples. Chain-of-custody procedures will be followed throughout the sample collection, transfer, analysis, and disposal to ensure that the integrity of the sample is maintained.

A custody seal (evidence tape) will be affixed to the lid of each sample jar. The custody seal will be initialed and dated by the sampler at the time the container is sealed.

2.4.3 Field Logbooks

All information pertinent to field sampling and analysis will be recorded in bound logbooks in accordance with BHI-EE-01, EIP 1.5, "Field Logbooks." The sampling team must record all relevant sampling information including, but not limited to, the information listed in Appendix A of EIP 1.5. Logbook entries will be dated and signed by the individual who makes the entry.

The sampler will collect the depth of water and location data for each characterization water sample location before sampling and recording in the field logbook.

2.5 FIELD QUALITY CONTROL SAMPLES

The QC requirements for the field sample collection process are defined as follows:

- For any water samples shipped to the laboratory for volatile organic analysis (VOA), one VOA trip blank consisting of American Society for Testing and Materials Type II water should accompany the sample shipment to the laboratory. The trip blank will be used to detect organic cross-contamination resulting from the handling of samples and their transportation to the laboratory.
- One field duplicate sample will be collected. Field duplicates are two samples produced from the same material, collected in the same location, and at the same approximate time. Field duplicates provide information concerning the homogeneity of the matrix, as well as an evaluation of the precision of the sampling and analysis process.

2.6 ARCHIVE SAMPLES

The Quanterra Environmental Services laboratory will retain unused sample material from each water sample in the event that additional analysis is required. This retained material will be a subset of the homogenized water sent to the laboratory. Any analyses of retained material will be included in contractual agreements arranged by ERC Sample and Data Management (SDM) with the offsite commercial laboratory. These services will be performed in accordance with contractual agreements and the project SAF.

2.7 DECONTAMINATION

Sampling-related equipment that comes in direct contact with the samples should be chemically decontaminated in accordance with WHC-CM-7-7, *Environmental Investigations Instruction*, EII 5.5, "Sampling Equipment Decontamination" before use. The pumps and associated hoses used for characterization and verification sampling are excluded from this chemical cleaning because the equipment is impractical to clean to this protocol. Instead, a volume of basin water equal to at least four times the volume in the tool and filter (approximately 186 L [48 gal]) will be pumped through the tool and filter before use in each characterization sampling location. All equipment will be handled in a manner that will minimize cross-contamination between sample locations.

After sample collection, the equipment will be field cleaned to the extent practical by rinsing and wiping. The 110 VAC submersible pump will be stored in the N-Basin until needed for dewatering, if this pump is used. Any equipment removed from the N-Basin will be field cleaned to the extent practical by rinsing and wiping. The equipment will then be surveyed to be free of radiological contamination, or it will be wrapped in plastic and controlled in accordance with radiological control requirements in BHI-SH-04, *Radiological Control Work Instructions*.

2.8 SAMPLE PACKAGING AND SHIPMENT

Water samples will be collected in accordance with container sizes and types specified in the SAF. All samples will be shipped to the laboratory in accordance with U.S. Department of Transportation requirements in 49 *Code of Federal Regulations* 171-173. The outside of each sample bottle will be surveyed by the radiological control technician to be free of smearable surface contamination in accordance with BHI-SH-04, Procedure 3.1, "Conduct of Radiological Surveys." In addition, the radiological control technician will measure the radiological activity on the outside of each sample container (through the container) and will mark the container with the highest contact radiological reading in either disintegrations per minute or mrem/hr, as applicable. Each sample container will be labeled with the word "radioactive" in accordance with Department of Transportation requirements.

2.9 MANAGEMENT OF INVESTIGATION DERIVED WASTE

All investigation-derived waste generated during field sampling will be handled in accordance with Bechtel Hanford, Inc. (BHI) waste-management requirements specified in BHI-EE-02, *Environmental Regulations* and in BHI-FS-01, *Field Support Administration*, Procedure 4.14, "Control of CERCLA and Other Past Practice Investigation Derived Waste." The work package for the sampling will refer to the 105-N site-specific waste management instruction. The waste will be managed for disposal to the Environmental Restoration Disposal Facility, in accordance with the *Engineering Evaluation/Cost Analysis for 100-N Area Waste* (Mihalik 1996). Efforts will be made to minimize not only the volume of water/waste derived from sampling and decontamination procedures, but also the volume of personal protective equipment waste. Field screening and waste management procedures will be used to assist in segregating radiological waste from clean waste. Sampling equipment that cannot be successfully decontaminated and

cannot be used again will be managed as waste.

Used samples will be disposed of by the analytical laboratory in accordance with

laboratory-specific disposal requirements. Unused sample material that is no longer needed for archival (as directed by the ERC-SDM and the project manager) will be disposed by the laboratory or may be returned to the ERC for disposal. Any samples returned to the ERC for disposal must be unused and not altered from the original chemical, radiological, and physical form. These samples will be returned to the associated waste accumulation area where the sample was collected.

Figure 2-1. Characterization Sample Locations and Sampling Grid.

Figure 2-2. Water Sample Collection Tool for Sampling.

Figure 2-3. Filtration System Water Flow Path During Dewatering.

Table 2-1. Sampling Locations and Frequencies Summary.		
Sample Type	Number of Water Samples*	Sampling Strategy
Characterization	Four	Water samples will be collected downstream of the 5 micron 3M filter. A peristaltic pump and hose will transport the water to the filter. The pump intake will be located at four random depth and areal locations within the 105- N Basin. Samples will be collected downstream of the 5 micron filter, before dewatering of the 105-N Basin water begins. Sampling design will use a grid system. The sample grid and specific sample points are identified in Section 2.2.1 of this sampling and analysis plan and in the sampling activity work package.

Verification	Five	The water will be collected from the sampling valve downstream of the filtration system filters. One sample will be collected shortly after water shipments are initiated. Four samples will be taken at approximately 760,000- L (200,000 gal) intervals. The last sample will be taken after the water level is below any gates or openings in the walls between the pools of the 105-N Basin.
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*Does not include associated duplicate samples, equipment blanks, or VOA trip blanks that must be taken concurrently with the characterization and verification samples.

3.0 SAMPLE ANALYSIS

3.1 ANALYTICAL STRATEGY

The analyses that will be performed on the water samples and their corresponding analytical detection limits are provided in Table 3-1. This list of analytes, methods, and techniques were developed as part of the DQO process and reported in the DQO summary report (Oates et al. 1997). Some parameters are not analyzed in the verification samples. These analytes are not likely to change from the characterization samples due to basin cleanout operations and need not be included as part of verification.

3.2 WATER SAMPLE LABORATORY ANALYTICAL INSTRUCTIONS

Water samples will more than likely be less than 10 mR/hr on contact; therefore, the analysis can be performed by an offsite-contracted commercial laboratory. If samples exceed 10 mR/hr, sample analysis will be arranged on a case-by-case basis by the ERC-SDM.

The samples will be collected as specified in the SAF for the designated laboratory. The samples will be analyzed for the parameters listed in Table 3-1.

Table 3-1. Analytical Parameters for Water Analysis. ^e (Page 1 of 3)					
Analytical Category	Analytical Parameter	Analytical Method	Detection Limit/Watera	Cg	Vg
Radionuclides	Gross alpha	Gas proportional counting	3 pCi/L	x	x

	Gross beta	Gas proportional counting	4 pCi/g	x	x
	Americium-241c	Gamma Energy Analysis (GEA)b	50 pCi/L	x	x
	Cobalt-60		50 pCi/L	x	x
	Antimony-125		50 pCi/L	x	x
	Cesium-134		50 pCi/L	x	x
	Cesium-137		50 pCi/L	x	x
	Europium-152		50 pCi/L	x	x
	Europium-154		50 pCi/L	x	x
	Europium-155		50 pCi/L	x	x
	Radium-226	Chemical separation/alpha scintillation counting	2 pCi/L	x	
	Tritium	Distillation/liquid scintillation counting	400 pCi/L	x	
	Carbon-14	Chemical separation/liquid scintillation counting	300 pCi/L	x	
	Nickel-63	Chemical separation/liquid scintillation counting	30 pCi/L	x	
	Strontium-90	Chemical separation/beta proportional counting	2 pCi/L	x	
	Technetium-99	Chemical separation/liquid scintillation counting	30 pCi/L	x	

	Iodine-129	Chemical separation/low energy photon spectroscopy	10 pCi/L	x	
	Total Uranium	Kinetic phosphorescence analysis	0.1 µg/L	x	
	Neptunium-237	Chemical separation/alpha energy analysis	2 pCi/L	x	
	Plutonium-238	Chemical separation/alpha energy analysis	2 pCi/l	x	
	Plutonium-239 /240	Chemical separation/alpha energy analysis	2 pCi/l		
	Americium-241	Chemical separation/alpha energy analysis	2 pCi/L	x	
	Curium-244	Chemical separation/alpha energy analysis	2 pCi/L		
Chemical Analysis	Metals:d	ICP SW-846 / 6010A	1.0 ppm	x	
	Aluminum		1.0 ppm		
	Antimony		1.0 ppm		
	Arsenic		1.0 ppm		
	Barium		1.0 ppm		
	Beryllium		0.5 ppm		
	Cadmium		1.0 ppm		
	Chromium		1.0 ppm		
	Iron		1.0 ppm		
	Lead		1.0 ppm		
	Manganese				

	Nickel		1.0 ppm		
	Selenium		0.5 ppm		
	Silica		1.0 ppm		
	Silver		1.0 ppm		
	Sodium		1.0 ppm		
	Thallium		1.0 ppm		
	Vanadium		0.5 ppm		
	Zinc		0.5 ppm		
	Mercury	Cold vapor atomic absorption SW-846 / 7471	0.1 ppm	x	
	Anions: Chloride Bromide Fluoride Nitrate Nitrite Phosphate Sulfate	Ion chromatograph y EPA 300.0	0.5 ppm	x	
	Ammonia	Distillation/col orimetric EPA 350.2/3	0.1 ppm	x	
	Total Kjeldahl Nitrogen	Distillation/col orimetric EPA 351.2	0.05 ppm	x	
	Sulfide	Distillation/titr ation SW-846/9030	0.2 ppm	x	

	Cyanide	Distillation/colorimetric EPA 9010	0.02 ppm	x	
Organic Analyses	Volatile Organicsf	GC/MS SW-846/8260A	1-50 ppb	x	
	Semivolatile Organicsf	GC/MS SW-846/8270A	1-50 ppb	x	
	2-Butoxyethanol	GC SW-846/8015	1,000 ppb	x	
	Polychlorinated Biphenyls	GC SW-846/8080 A	1ppb	x	
	Total Organic Carbon	Combustion, coulometric SW-846 9060	10 ppm	x	x
Properties	pH	Ion specific electrode SW-846/9045	N/A	x	
	Total Dissolved Solids	Filtration/evaporation /gravimetric EPA 160.1	50 ppm	x	
	Total Suspended Solids	Filtration/gravimetric EPA 160.2	10 ppm	x	x
	Conductivity	Electrode EPA 120.1	5 µmho/cm	x	

aDetection limits are highly matrix-dependent and will be negotiated with the laboratory. Detection limits for radionuclides are those needed to monitor radiological release for waste as found in Stickney (1988), Table J-1b. Detection limits for chemicals are those needed to support waste criteria evaluation. Laboratory actual working detection limits will be established to ensure that these limits will be met with sufficient confidence to support waste decisions.

bIsotopes with half lives less than 1.5 years and naturally occurring isotopes, such as K-40, will not be specifically targeted by GEA. The laboratory will report other gamma emitters that are detected by the method.

cGEA for Am-241 will be requested, but may show significant interferences from other gamma emitters.

dICP metals analysis for water will include additional reporting of routine analyte list components such as calcium, cobalt, copper, potassium, and magnesium (see Appendix F of BHI 1997).

eVolume and cost estimates will be finalized after discussions with laboratory personnel. Volumes for the archive will be assessed separately and are separate for those analyses.

fSpecific volatile and semivolatile organic analytes required by ETF are defined in Appendix C.

gC = characterization samples, V = verification samples.

GC = gas chromatography

ICP = inductively coupled plasma

MS = mass spectrograph

N/A = not applicable

ppb = parts per billion

ppm = parts per million.

4.0 QUALITY ASSURANCE PROJECT PLAN

The quality assurance (QA) objectives established for this sampling and analysis activity are listed below. Generally, the total error in the results derived from the data will be controlled to achieve an acceptable level of confidence in the decisions that are made as a result of reviewing the data. The methods and procedures used to implement and accomplish the QA objectives are described throughout this SAP.

- Implement standard operating procedures for field sampling, sample custody, equipment operation and calibration, sample analysis, data reduction, and data reporting that will ensure the consistency and thoroughness in the data that is generated.

- Assess the quality of data generated to ensure that all data are scientifically valid, of known and documented quality, defensible, and useful to the project. This criteria is established using the EPA's seven-step DQO process (EPA 1994).
- Achieve an acceptable level of confidence in the decisions that are made from data by monitoring the degree of total error in the data using QC checks. Data that fails QC checks, or do not fall within the acceptance criteria established, will be rejected from further use or qualified for limited use.
- Ensure that the QA procedures outlined in this SAP are properly implemented by conducting compliance inspections and audits. In addition, verify that corrective actions are executed for any noncompliance identified.

4.1 PROJECT ORGANIZATION AND RESPONSIBILITY

4.1.1 Technical Lead Responsibility

The N-Basin Cleanout Project Engineer must direct and approve all technical aspects of this characterization. Additional responsibilities are to coordinate efforts of support organizations, and to evaluate and select external contractor and subcontractors, as needed, to complete the required task activities.

4.1.2 Support Responsibilities

The BHI Field Support and ERC Field Sampling organization will be responsible for sample collection and shipping support. The ERC-SDM organization must arrange for laboratory analytical services. Health and safety documentation and field monitoring will be provided by the ERC's Health and Safety and Radiological Support organizations. These organizations must perform all services in accordance with the requirements in this SAP.

The ERC-SDM organization will arrange for offsite commercial laboratory analysis. The services will be performed in accordance with contractual agreements and the project SAF. Procurement of all material, equipment, and contracted analytical services will be in compliance with the standard BHI procurement procedures and requirements outlined in BHI-PR-01, *ERC Procurement Procedures*.

4.2 SAMPLING PROCEDURES

All sampling and sample packaging and shipment will be performed in accordance with procedures identified in BHI-EE-01. Procedures for sampling activities not covered in this manual will be prepared by the project personnel and will be attached to the work control package. Procedures will be carefully followed during the field-sampling activities to ensure that the samples collected are representative of the water that is being characterized.

4.3 SAMPLE CUSTODY

4.3.1 Field Custody

To ensure the defensibility of the analytical results, sample chain-of-custody will be maintained at all times, from the time the sample is collected to the time the sample is disposed. All samples obtained during the course of this project will be controlled from the point of origin to the analytical laboratory, as required in BHI-EE-01, EIP 3.0, "Chain of Custody."

4.3.2 Laboratory Custody Procedure

Sample custody during laboratory analysis will be addressed in the applicable laboratory standard operating procedures. Laboratory-custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

4.3.3 Final Evidence Custody Procedure

All relevant documents, records, reports, logs, field notebooks, pictures, subcontract reports, and analytical reports will be submitted, secured, and stored in accordance with the Document and Information Services section of BHI-MA-02, *ERC Project Procedures*.

4.4 EQUIPMENT OPERATION AND CALIBRATION

All sampling, field-screening, and analytical equipment used to support this project will be calibrated to operate within the specifications provided by the manufacturer. Calibrations will be performed as stipulated by the manufacturer's calibration procedure, the project-specific calibration procedure, or as specified by the analytical method. Continuing calibration of all field instruments will be conducted periodically throughout the work day if required by the manufacturer's specifications or standard operating procedure. For radiological screening instruments, source/response checks will be performed.

4.5 ANALYTICAL PROCEDURES

Analytical methods to be used by the commercial analytical laboratory will be specified by the contractor procurement document. The ERC-SDM will issue a SAF to identify analytical methods, volume requirements, holding times, and bottle requirements for the commercial laboratory analysis. Site-specific analytical methods are identified in Section 3.0.

4.6 OBJECTIVES FOR ANALYTICAL MEASUREMENTS

The rationale for establishing DQOs and data needs for the sampling task are discussed in the DQO summary report (Oates et al. 1997).

Parameters have been established for each of the five data assessment areas of precision, accuracy, representativeness, comparability, and completeness, and they are identified in the following sections for the 105-N Basin characterization samples. These objectives are expressed as qualitative statements concerning the type of data needed to support a decision, based on a specific level of uncertainty. The precision, accuracy, representativeness, comparability, and

completeness parameters for offsite laboratory sample analysis will comply with laboratory contractual requirements.

4.6.1 Precision

Precision is the measure of mutual agreement among replicate (or between duplicates) of collocated sample measurements of the same analyte. The closer the number values of the measurements are to each other, the more precise the measurement. Precision for a single analyte will be expressed as a percentage of the difference between results of replicate samples or matrix spike duplicates. For all laboratory analyses, precision is $\pm 20\%$. Deviations will be documented in the data report.

4.6.2 Accuracy

Accuracy is a measure of bias in a measurement system. The closer the value of the measurement matches with the true value, the more accurate the measurement. This will be expressed as the percent recovery of a known spike analyte or a standard reference sample. For all laboratory analyses, accuracy is ± 2 sigma warning level, ± 3 sigma control level for laboratory control samples, and $\pm 25\%$ ($\pm 50\%$ for organic analysis) recovery for spiked samples. Deviations will be documented in the data report.

4.6.3 Representativeness

Representativeness will be achieved by using BHI-approved sampling and analytical methods.

4.6.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set given similar precision, accuracy, detection limit, analytical method, and sample matrix. Because the analytical data do not need to be compared with other laboratory or field-screening techniques, comparability for this project will not be quantified.

4.6.5 Completeness

Completeness measures the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

$$\% C = 100 \times V/n$$

where: V = number of valid data points acquired

n = total number of data points.

At a minimum, the analytical data for this project should be 90% complete.

4.7 INTERNAL QUALITY CONTROL

Several QC samples are introduced into the collection system to monitor the adequacy of the sampling system, and the integrity of samples during their transfer from the field collection point through the laboratory analysis. The QC requirements for the field sample collection process and the laboratory analysis are defined below.

4.7.1 Field Quality Control Requirements

The QC requirements for the sampling process are as follows:

- For any water samples shipped to the laboratory for VOAs, one VOA trip blank consisting of American Society for Testing and Materials Type II water should accompany the sample shipment to the laboratory. The trip blank will be used to detect any organic cross-contamination resulting from the handling of samples and their transportation to the laboratory.
- One field duplicate sample, or a minimum of one per every 20 samples, of the same matrix will be collected. Field duplicates are two samples produced from the same material and collected in the same location. Locations and requirements for field duplicate samples are specified in Section 2.5. Field duplicates provide information concerning the homogeneity of the matrix, as well as an evaluation of the precision of the sampling and analysis process. Precision should be compared to variance estimates used in Section 5.6 of the DQO summary report (Oates et al. 1997).

4.7.2 Laboratory Quality Control Requirements

The QC requirements for the analytical laboratory are as follows:

- One method blank for every 20 samples, analytical batch, or sample delivery group (whichever is most frequent) will be used to monitor contamination resulting from the sample preparation process for each analytical method.
- One laboratory control sample or blank spike will be performed for every batch of samples for each analytical method criteria to monitor the effectiveness of the sample preparation process. The results from the analysis are used to assess laboratory performance.
- A matrix spike sample, as applicable to the method, will be prepared and analyzed for every 20 samples of the same matrix or sample preparation batch, whichever is most frequent. The matrix spike results measure the accuracy of the analytes of interest that are measured in the sample matrix.
- Laboratory duplicates or matrix spike duplicates, as applicable to the method, will be used to assess precision and will be analyzed at the same frequency as the matrix spikes.
- Detection limits for metals and total organic carbons in water should be typical of EPA SW-846 methods, as the treatment facility does not have a permit limit or waste acceptance criteria limit.

4.8 DATA REPORTING AND MANAGEMENT

4.8.1 Reporting

Laboratory personnel must prepare a report summarizing the analysis results. Confirmation sample data will be reported in summary data packages. Summary data packages will include, at a minimum, sample identity, sampling and analysis dates, reduced data, and applicable QC results. Verification sample data will be provided in a summary report. This summary report will include sample identity, sampling and analysis dates, and reduced data. Both summary data packages and summary reports will include a case narrative that is written by the laboratory, which will discuss any laboratory performance issues or QC problems.

4.8.2 Data Validation

Level C data validation has been selected per procedures WHC 1993a and 1993b for characterization samples only. This allows the review of all QC data, transcription error verification, and holding-time review. This level is the middle validation level and does not require review of raw data and recalculation of data. Should problems arise from the Level C review, the project reserves the right of recalculation and review of raw data.

A limited set of deliverables will be received for the verification samples. The limited set does not allow validation per existing validation procedures. Should statistical or other limits be established from characterization results, these will be used to evaluate verification results.

4.8.3 Data Management

Data generated as a result of laboratory analysis will be managed and stored by the ERC-SDM organization, as outlined in BHI-EE-01, Section 2.0, "Sample Management."

All validated reports and supporting analytical data packages will be subject to final technical review by qualified reviewers before their submittal to regulatory agencies or inclusion in reports or technical memoranda, at the direction of the BHI Project task lead. Electronic data access, when appropriate, will be through computerized databases (such as the Hanford Environmental Information System). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990).

4.9 PERFORMANCE AND SYSTEM AUDITS

The BHI QA department may conduct random surveillance, audits, and assessments to verify compliance with the requirements outlined in this SAP, the project work packages, the BHI Quality Management Plan, and the BHI procedures and regulatory requirements. Collectively, the surveillance and assessments will address quality-affecting activities that include, but are not limited to, measurement system accuracy, field activities, data collection, processing, validation, management, and QA programs.