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WHITE OAK CREEK EMBAYMENT

TIME-CRITICAL CERCLA REMOVAL ACTION

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WATER QUALITY MONITORING PLAN

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1 INTRODUCTION

1.1 Objectives and Functional Requirements:

The primary objective of the White Oak Creek Embayment (WOCE) Project is to achieve control of the contaminated sediments in WOCE and to prevent their downstream transport off-site and into the Clinch River and Watts Bar Reservoir.

Functional requirements of the interim corrective measure (ICM) proposed to achieve this objective are to:

(1) Contain contaminated sediments in the lower WOCE and prevent their transport into the Clinch River for a period of time consistent with the eventual remediation of up-gradient operable units.

(2) Minimize erosion and off-site transport of WOCE sediment by flow events in the White Oak Creek watershed and/or in the Clinch River.

(3) Minimize the surging of water into and out of the lower portion of the WOCE.

(4) Achieve year-round inundation of WOCE sediments to minimize risk due to direct exposure to contaminated sediment.

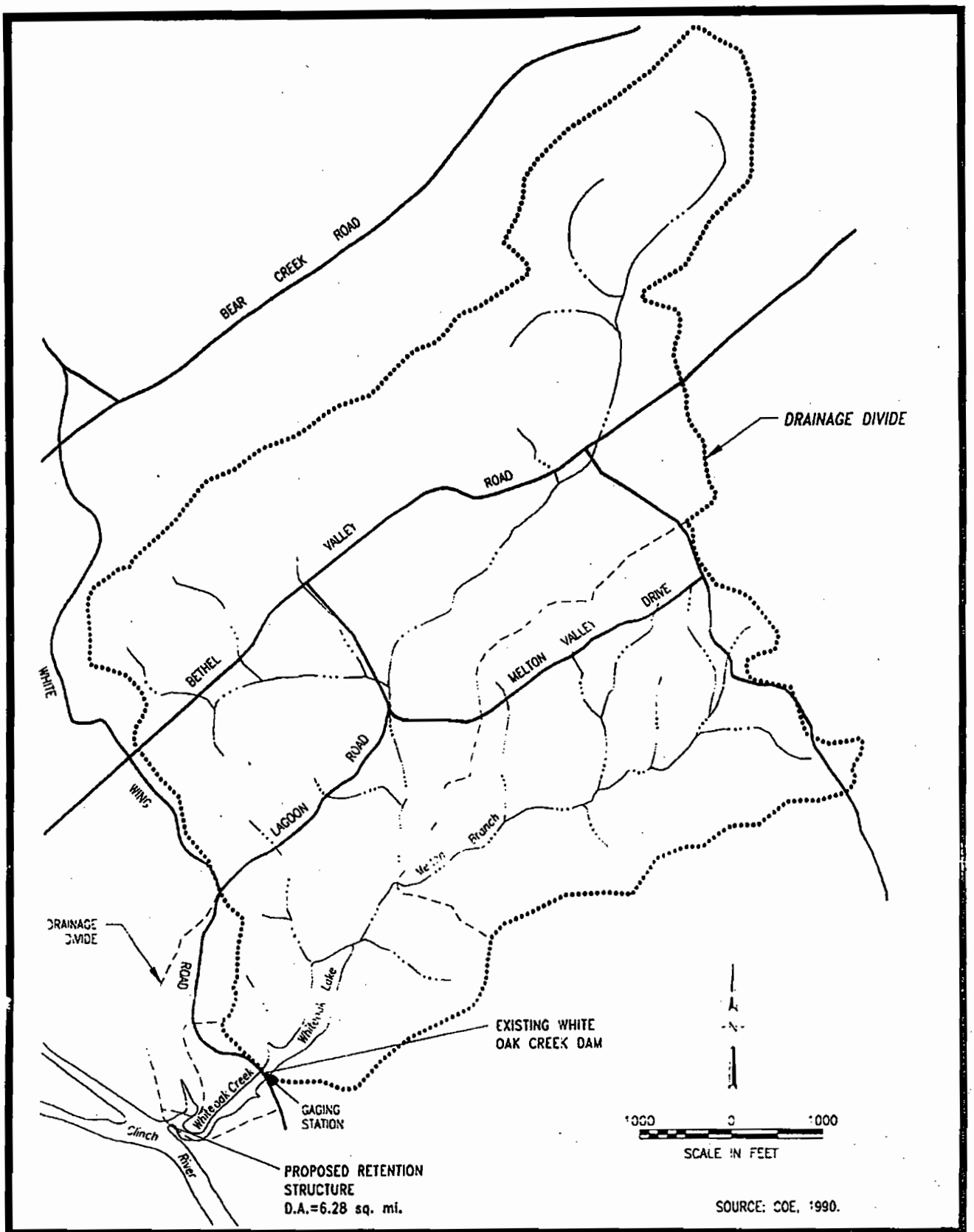
(5) Minimize movement of fishes into and out of the WOCE.

1.2 Background Information

White Oak Creek (WOC) is the primary surface water drainage for the Oak Ridge National Laboratory (ORNL) area (Fig. 1). WOC originates north of Bethel Valley Road on the southern slope of Chestnut Ridge ~1.6 miles northeast of ORNL. WOC flows west through the main ORNL area, then turns southwest and joins Melton Branch before flowing into White Oak Lake (WOL). WOL is a small impoundment that has served as a settling basin for low-level radioactive effluents from ORNL since 1943. The WOL dam, located 0.6 miles above the confluence of WOC and the Clinch River, is the last controlled ORNL discharge point.

The White Oak Creek Embayment (WOCE) extends 0.6 miles downstream of the WOL dam to the confluence of WOC and the Clinch River at Clinch River Mile (CRM) 20.8. The WOCE sediments are intermittently inundated; the depth of water in the embayment is determined by the regulated summer and winter water levels of Watts Bar Reservoir and hydropower-generation discharges from Melton Hill Dam, located on the Clinch River at CRM 23.1, ~2.3 river miles upstream from the mouth of WOC.

The summer-pool water level at the mouth of WOC is normally ~741 ft mean sea level (MSL). At summer pool the water depth at the upper end of the WOCE ranges from 1 to 3 ft, and the width of the WOCE ranges from ~225 ft at the upper end to ~40 ft at the lower end, where the embayment becomes a narrow, deep stream channel with a water depth of ~10 ft. The mouth of WOC widens to ~120 ft at the summer-pool water level, and the



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DRAINAGE BASIN OF WHITE OAK CREEK

WHITE OAK CREEK EMBAYMENT

FIGURE NO.

1

total surface area of the WOCE is ~8.5 acres. At winter pool (usually 738 ft MSL), the water level is decreased by ~3 ft, and the sediments in the upper, broader portion of the embayment are exposed. Sediments in the lower, deeper part of the WOCE remain inundated throughout the year.

Sediment cores obtained in Summer 1990 from the lower portion of WOCE revealed the presence of higher than expected levels of ^{137}Cs activity in near-surface (upper 2- to 4-in.) sediments. Cesium-137 is a radioactive isotope historically produced in research-reactor operations at ORNL. Mercury, chromium, lead, and ^{60}Co have also been observed in the WOCE sediment samples. Previous sediment samples obtained in 1979 and 1984 had indicated that the more highly contaminated sediment strata were located deeper in the sediment, ~1 to 2 ft below the sediment surface. These highly contaminated sediments are the result of historical releases from WOL in the mid-to-late 1950s.

The results of the Summer 1990 sediment sampling became available in late August and produced immediate concern because the WOCE sediments are uncontrolled; surface sediments, for example, can be eroded from the embayment and transported downstream into the Clinch River. An Occurrence Report was filed on September 7, and regulatory agencies were subsequently notified of the situation. On October 17, an agreement was reached among the Department of Energy (DOE), the Tennessee Department of Conservation (TDC), and the Environmental Protection Agency (EPA)-Region IV that a time-critical removal action would be conducted to control the contaminated WOCE sediment and to prevent its transport downstream into the Clinch River. This time-critical removal action is to be conducted in accordance with the National Contingency Plan (40 CFR Part 300) and Sections 104 and 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Accelerated site characterization, alternatives evaluation, and engineering design activities have proceeded in parallel since October 1990. A summary chronology of the WOCE activities to date is presented in Table 1. The projected schedule for construction of the sediment-retention structure is presented in Table 2.

1.3 Site Characterization Summary

Extensive sampling and analysis of the WOCE sediments have been conducted since October 1990. In particular, the sediment and underlying soil layers at the mouth of WOC, where the sediment-retention structure will be constructed, have been thoroughly characterized with the following results:

(1) The upper 2 to 3 ft of accumulated sediment in the stream channel are contaminated, and the contamination is due primarily to ^{137}Cs. The underlying soil layers (~3-12 ft of soil overlying bedrock) are not contaminated (Fig. 2).

(2) Cobalt-60 is also present in the contaminated embayment sediments, but at much lower levels (~1000x less) than ^{137}Cs.

(3) Chemical analyses of the contaminated sediment show low concentrations of organics and some contamination by metals (mercury, chromium, lead). However, TCLP (toxicity

Table 1. Chronology of events and activities associated with the development and conduct of the White Oak Creek Embayment Time-Critical CERCLA Removal Action.

•	WOCE SEDIMENT CORES OBTAINED	SUMMER 1990
•	DATA REVEALS CONTAMINATION, OCCURRENCE REPORT FILED	9/7/90
•	ACCELERATED ENVIRONMENTAL SITE CHARACTERIZATION EFFORT INITIATED, CONTINUING	MID SEPTEMBER —
•	RESTRICTION OF PUBLIC ACCESS TO WOCE AREA IMPROVED	LATE SEPTEMBER
•	EPA, TDC, AND DOE AGREE THAT INTERIM MEASURE SHOULD BE IMPLEMENTED AS A CERCLA REMOVAL ACTION	10/17/90
•	ALTERNATIVES ASSESSMENT BY US COE INITIATED	10/26/90
•	GEOTECH SITE INVESTIGATION CONDUCTED	11/12/90 - 11/21/90
•	NEPA DOCUMENTATION SUBMITTED TO DOE-HQ	LATE NOVEMBER
•	ALTERNATIVES ASSESSMENT COMPLETED; COFFER-DAM RECOMMENDATION AGREED TO BY DOE, TDC, & EPA	12/17/90
•	50% DESIGN REVIEW COMPLETED	1/15/91
•	90% DESIGN REVIEW COMPLETED	2/22/91
•	PRECONSTRUCTION SITE PREPARATION INITIATED	3/4/91
•	DRAWINGS & SPECIFICATIONS CERTIFIED FOR CONSTRUCTION	3/22/91
•	NEPA CX APPROVAL RECEIVED	4/30/91
•	INITIAL CONSTRUCTION BIDS RECEIVED	4/30/91
•	CONSTRUCTION BID TO BE AWARDED	~5/15/91
•	OPERATIONAL READINESS REVIEW COMPLETED, FINAL PRECONSTRUCTION BRIEFING OF DOE-HQ STAFF	~5/31/91
•	CONSTRUCTION TO BE INITIATED	~6/3/91

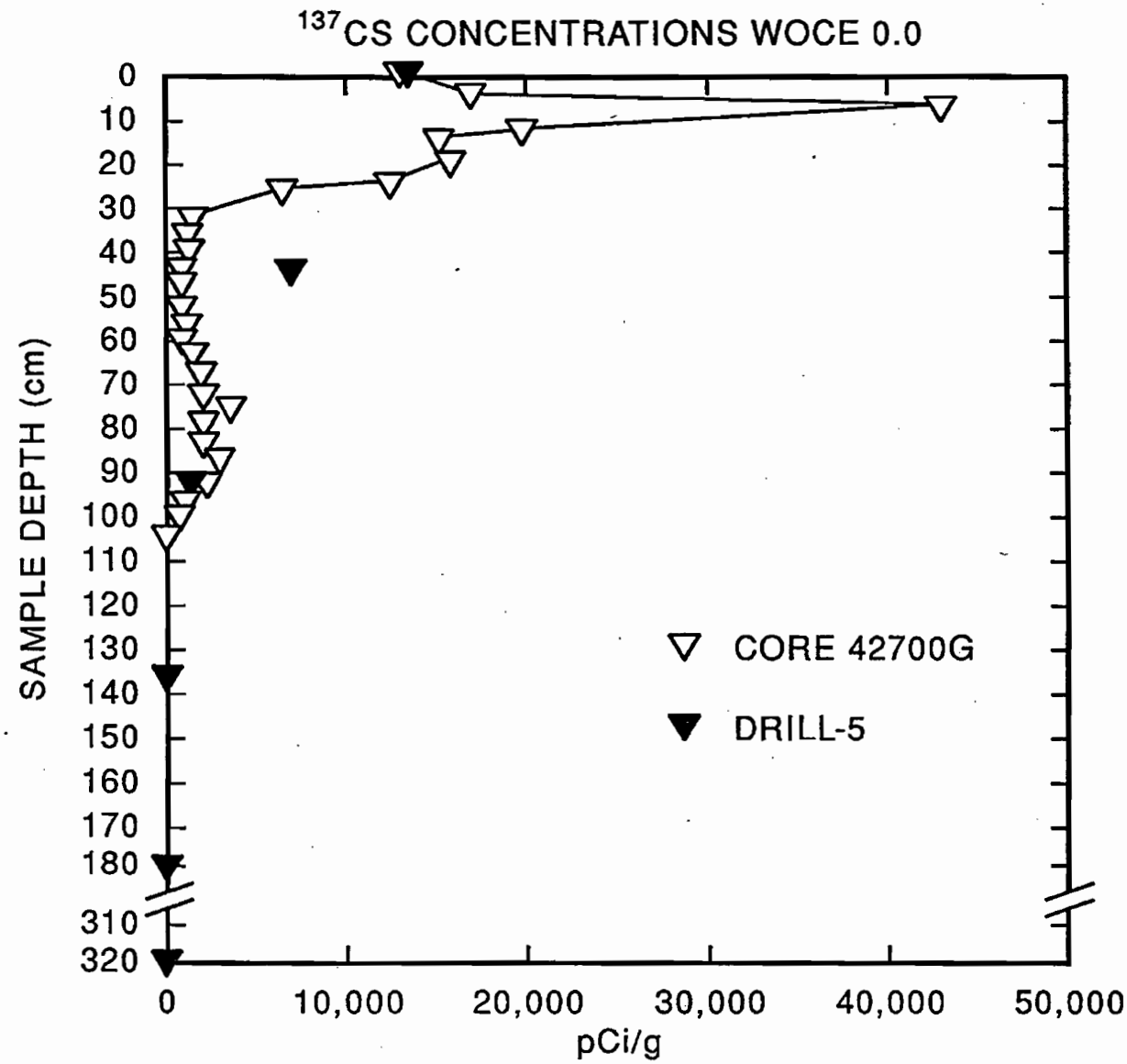
Table 2. Summarized target schedule for site preparation and construction activities associated with the White Oak Creek Embayment Project.

•	INITIAL SITE PREPARATION	3/4/91 - 5/27/91
•	SHEET PILE INSTALLATION	6/3/91 - 7/26/91
	- CELL CLOSURE LATE JULY	
•	JET GROUT TESTING	7/1/91 - 7/26/91
•	JET GROUTING	7/26/91 - 9/26/91
•	ROCK ANCHOR INSTALLATION	9/16/91 - 9/26/91
•	CONCRETE CAP INSTALLATION	9/26/91 - 10/11/91
•	GABION AND ROCK ARMOR PLACEMENT	10/11/91 - 12/30/91

FIG. 2

ORNL-DWG 91Z-10082

SEDIMENT AND SOIL PROFILE OF ^{137}CS DISTRIBUTION AT WOCE MOUTH



characteristics leaching procedure) results show that extractable/leachable metals are well below RCRA guidance levels (Table 3).

(4) The WOCE contamination problem is primarily a result of ^{137}Cs accumulated in the embayment sediments.

2 OBJECTIVES AND SCOPE OF THE WOCE ICM MONITORING PLAN

2.1 Objectives

The primary purpose of the WOCE Water Quality Monitoring Plan is to assess and document the water quality impacts of the activities associated with the construction of the WOCE ICM (i.e., the sediment-retention structure) at the mouth of WOC.

Specific objectives of the Monitoring Plan are to:

(1) Monitor the transport of contaminated sediment from the WOCE to the Clinch River during preconstruction, construction, and postconstruction phases of the WOCE CERCLA Removal Action activity.

(2) Provide a mechanism for the detection of the sediment disturbance or sediment transport events or other construction-related activities that may affect water quality.

(3) Provide a mechanism for emergency notification and emergency response actions in the case of a water-quality emergency.

2.2 Scope

The regulatory requirements for water quality are stated in the Rules of the Tennessee Department of Conservation (TDC), Division of Water Quality Control (Section 1200-4-3 and 1220-4-4). The Tennessee anti-degradation statement (Section 1200-4-3-.06) provides for the protection of existing water quality, and specifies that Section 304 (a) of the Clean Water Act and "other documents as specified by the commissioner" will be used to define the water quality criteria established by these rules. These criteria are enforced relative to the stream use classification (Rules of TDC, Section 1200-4-4), which rely upon the measurement of water quality parameters such as dissolved oxygen, pH, temperature and conductivity, as well as toxic substances and other pollutants. The TDC has not made the issuance of an NPDES or other water monitoring permit a requirement for this activity.

Site characterization investigations of the WOCE sediments, water, and biota have shown that WOCE contamination problem is primarily a result of ^{137}Cs accumulated in the embayment sediments (Section 1.3, above). Therefore, monitoring activities associated with the ICM construction will focus on:

(1) Determination of ^{137}Cs activity as a direct indicator of contaminated sediment disturbance and transport at the construction site.

Table 3. Comparison of TCLP values for WOCE sediments with regulatory guidlines for solid materials. Units for all values are $\mu g/g$ dry sediment.

Collection depth, date, id#	Ag	As	Ba	Cd	Cr	Hg	Ni	Pb	Se	Tl
TCLP Guidelines[a]:	100	100	2000	20	100	4	N/A[b]	100	20	N/A[b]
8-16 cm, 27Sep90, 42703L	0.21	0.04[e]	35	1.3	3.8	0.02[d]	2.7	16	0.11	26
0-0.5 ft, 16Nov90, D4-1L	0.23	0.04[e]	31	0.5	0.01[e]	0.02[d]	1.1	8.7	0.11	21
0-0.5 ft, 16Nov90, D5-1L	0.24	0.04[e]	43	0.58	0.31	0.02[d]	1.2	13	0.11	20
0-0.5 ft, 16Nov90, D6-1L	0.11	0.04[e]	32	0.17	0.01[e]	0.02[d]	0.62	4.5	0.11	39
0-24 cm, 12Dec90, 54201L	0.21	0.04[e]	28	0.34	0.01[e]	0.02[d]	1.1	7.2	0.11	24
0-10 cm, 01Apr91, 59300L	1.2	17	0.04[e]	0.11	0.07[e]	0.30	0.93	4.3	0.4	16
0-23 cm, 01Apr91, 59400L	1.3	26	0.04[e]	0.47	0.07[e]	0.03	1.6	11	0.4	16
0-12 cm, 01Apr91, 59500L	1.2	21	0.04[e]	0.16	0.07[e]	0.16	1.1	6.4	0.4	40
10-18 cm, 01Apr9i, 59600L	1.2	24	0.04[e]	0.46	0.07[e]	0.74	1.6	9.3	0.4	32
100-106 cm, 27Sep90, 42726L	0.015	0.05[e]	3	0.006	0.035	0.1[d]	—[c]	0.05[e]	0.085	—[c]
10-11 ft, 16Nov90, D5-6L	0.007	0.05[e]	2.4	0.05[e]	0.036	0.1[d]	—[c]	0.05[e]	0.05[e]	—[c]
1.5-2 ft, 16Nov90, D6-2L	0.005[e]	0.05[e]	2.2	0.05[e]	0.019	0.1[d]	—[c]	0.05[e]	0.05[e]	—[c]
104-108 cm, 12Dec90, 54227L	0.012	0.05[e]	1.6	0.06	0.032	0.1[d]	—[c]	0.05[e]	0.05[e]	—[c]
128-132 cm, 12Dec90, 54233L	0.011	0.05[e]	3.8	0.07	0.022	0.1[d]	—[c]	0.05[e]	0.05[e]	—[c]

[a] Values equal to guidance levels for solutions multiplied by 20 (convert to solids).
[b] TCLP reference values for these elements were not included in the Federal Register, March 29, 1990, pp 11798-11877.
[c] Value less than the detection limit, or missing.
[d] Mercury holding times violated for all samples collected prior to April 1. Value is less than the detection limit.
[e] Value less than the detection limit after correction for barium blank. Worldwide mean value for total barium in sediments approximately 460 $\mu g/g$ (Environmental Chemistry of the Elements, Bowen, 1979).

(2) Monitoring of ^{137}Cs levels at the K-25 water supply intake located at CRM 14.5, 5.3 river miles downstream from the mouth of WOC.

(3) Continuous nephelometric monitoring of turbidity and daily composite-sample determination of suspended sediment concentration as additional indicators of sediment disturbance and transport.

(4) Continuous monitoring of standard water quality variables (pH, specific conductance, water temperature, and dissolved oxygen concentration).

3 COORDINATION

The OSERP project coordinator will be the primary contact for all WOCE surface water monitoring activity communication. Project coordinators will be responsible for providing information regarding WOCE related activities to their respective groups.

3.1 Groups and Agencies Involved

The organizational groups and agencies involved in the White Oak Creek Embayment surface-water monitoring project and their respective roles are listed below:

- Off-Site Environmental Restoration Program

  The OSERP is responsible for monitoring plan design, preparation and review as well as implementation of surface water monitoring activities. All data management, functions will initially be coordinated by the OSERP. OSERP will also be responsible for carrying out and reporting on the activities described by this plan. OSERP will initiate monitoring, but routine operations may become the responsibility of the OESHP, or other environmental monitoring groups as soon as possible. This monitoring project must be in communication with emergency response networks, though establishment of such a network is beyond the scope of this plan. The OSERP coordinator is C. J. Ford, ORNL-ESD.

- Tennessee Department of Conservation

  The TDC will review the monitoring plan. TDC may have other review responsibilities for this monitoring activities, as described by the charter for this agency. The TDC coordinator for the project is to be identified.

- Tennessee Emergency Management Agency

  The Tennessee Emergency Management Agency (TEMA) will be notified of this monitoring activity, and will be included in any emergency response network established for this project. Establishment of this network is beyond the scope of this plan, though this monitoring project must be in communication with emergency response networks. The TEMA coordinator for this project is to be identified.

- ORNL Water Resources Emergency Response Group

Existing ORNL Water Resources Emergency Response Group will provide emergency response support as necessary for these monitoring activities. The ORNL Water Resources Emergency Response group coordinator for this project is to be identified.

- ORNL Office of Environmental Safety and Health Protection

  The ORNL Office of Environmental Safety and Healthe Protection (OESHP) will provide support to plan design, preparation and review as well as implementation of the WOCE surface water monitoring activities defined by this plan and any supporting documents. Though OSERP will initiate monitoring, routine operations may become the responsibility of the OESHP as soon as possible. The OESHP coordinator is to be identified.

- ORNL Health and Safety Research Division

  The ORNL Health and Safety Research Division (HSRD) will provide support to monitoring activities defined by this plan. The ORNL HSRD coordinator is to be identified.

- ORNL Analytical Chemistry Division

  ORNL Analytical Chemistry Division (ACD) will provide analytical support services to monitoring activities defined by this plan. The ORNL ACD coordinator is to be identified.

- K-25 Site Health, Safety and Environmental Affairs Division

  The Health, Safety and Environmental Affairs Division (HSEAD) will support monitoring activities involving existing K-25 site monitoring locations, specifically the K-1513 water intake structure. The K-25 HSEAD coordinator is to be identified.

4 SAMPLE AND DATA COLLECTION

This section includes general information regarding sample and data collection for the WOC Monitoring project. Parameters to be monitored are listed in Table 4. The sampling and data collection procedures defined in this plan will be supplemented as needed by activity-specific monitoring plans. Supplemental plans, prepared by the OSERP will be provided to the groups and agencies identified in section 3.1. The need for such supplemental sampling plans will be determined relative to the construction activity occurring at the site as well as any response to unpredicted events.

4.1 Monitoring Station at White Oak Creek Mouth

The monitoring station consists of two PVC pipes at the WOC mouth, which function as platforms, and a monitoring building located on shore, approximately 50 yards west of the monitoring pipes. One pipe serves as both a stilling well and a composite-sample collection point. The composite sampler, located on shore, is connected by a sample line to this first pipe. The other PVC pipe functions as a platform for *in situ* monitoring equipment. The data logging equipment, connected to monitoring instrumentation submersed at these platforms, is housed in the monitoring building. The physical integrity of data on storage devices (such as E-Z data ROM modules) between deployment and retrieval will be ensured by use of custody seals.

Table 4. Water quality parameters to be monitored at the mouth of White Oak Creek Embayment. This table presents the maximum water quality monitoring requirements under this plan. Actual frequency of data collection dependent upon construction activity (section VI).

Parameter	Collection type	Analytical Level[a]	Calibration Category[b]
Flow (ft^3)	Continuous	II	B
Stage Height (feet)	Continuous	II	C
Turbidity (NTU)	Continuous	II	C
Temperature (°C)	Continuous	II	C
pH	Continuous	II	C
D. O. (mg/L)	Continuous	II	C
Conductivity (μmho/cm)	Continuous	II	C

[a] Analysis levels from ESP-700, Section IV (Kimbrough et al., 1990).
[b] Calibration category from CRRFI, Section 10.4.1 (ES/ER-1/D1, 1990).

4.2 Parameters

Instrument output of all field data parameters monitored at the WOC mouth will be recorded by digital data logger. Water flow (ft^3, Table 4) at the White Oak Dam monitoring station will be recorded in conjunction with this project. River stage height (feet, Table 4) is monitored using a pressure transducer, installed in the PVC stilling well and connected to the on-shore data logger. Turbidity (NTU, Table 4) is monitored using a flow-through nephelometric monitoring device installed at the site. Temperature (°C), pH, dissolved oxygen (mg/L) and specific conductance (μmho/cm) are monitored using a multiparameter water quality data acquisition system (Hydrolab, Table 4), installed at the site. Frequency of data collection is dependent upon the conditions specified in section 6.

Composite water samples will be collected using an automatic sampler (Martin Marietta Energy Systems Environmental Surveillance Procedure (ESP) 301-3, edited by Kimbrough et al., ESH/Sub/87-21706/1/Revision 1, 1990) and a bottle sampler (ESP 301-4). All sampling devices used by this project will be compatible with the analytes being collected. Additionally, the quantity collected per sampling period must be sufficient to meet the volumetric specifications of Table 5. Parameters to be quantified daily are listed in Table 5. Samples to be analyzed for total suspended solids and gamma emitting radionuclide spectrometry will be collected by composite sampler.

4.2.1 Data and sample retrieval

All sampling and data storage/retrieval devices used by this project will be compatible with the analytes being collected. Prior to sample collection, all containers will be either precleaned by lab personnel (ESP 900) or purchased precleaned from a specialty vendor. The collection frequency of QC samples, composite samples and grab samples will depend upon conditions specified in section 6. Specific analytical procedures are referenced in section 4.3.

All information gathered during sample and data retrieval will be recorded following the procedures outlined in section 5.4.6, paying particular attention to the minimum required daily entries. Routine retrieval of data and samples collected by this sampling program will begin at the White Oak Dam monitoring station;

(1) Record gross water flow from the WOD transmission; volume will be determined by difference from the previous reading.

Proceed to the monitoring building located at the mouth of WOC.

(2) Review the strip chart record of turbidity (NTU) from the previous sample collection period for anomalous readings and note general trends in the field notebook (section 5.4.6). The strip chart is collected, following manufacturer's instructions, custodized (section 5.4.4) and initialized for the next collection period. If no anomalies are detected, continue with step 3. If an anomaly is detected, a beta-gamma survey of the water sample will be conducted immediately (step 4).

(3) Tamper-evident custody seals on data storage modules are examined, their condition is noted (section 5.4.4), and the seals are removed. The used storage module is collected, following manufacturer's instructions, custodized and a clean module initialzed with a new tamper-evident

Table 5. Daily to weekly composite and grab samples to be collected at the mouth of White Oak Creek Embayment. All composite samples will be collected on a time proportional basis. The analytical level for all of these parameters has been set to III (ESP-700, Kimbrough et al., 1990). Actual frequency of sample collection and analysis is dependent upon category of construction activity (Scheduling and Implementation, Section VI).

Parameter	Collection type[a]	Sample volume required[b]	Analytical Procedure[c]
Total Suspended Solids	24h-composite, (daily)	1 Liter	SOP-16
Gamma Spectrometry	24h-composite (daily)	3 Liters	SOP-19.2

[a] Tentative collection frequency in parenthesis.
[b] Volume estimates derived from ESP-700 or laboratory procedures.
[c] SOP references, included as an appendicies, found in Surface Water Processing Laboratory Standard Operating Procedures Manual (Ford et al, 1991).

seal, for the next collection period. This procedure is repeated for each data storage unit used. Data storage modules record output from the pressure transducer, nephelometer and Hydrolab water quality monitoring unit.

Proceed to composite water sampler, located on the river bank between the monitoring building and the monitoring station.

(4) The outside of the composite water sampler is surveyed using a beta-gamma monitor, and activity readings recorded in the field notebook. If at any time during the beta-gamma survey readings are found to be within the range of critical values, procedures delineating the identification of unpredicted events, will be followed (Fig. 3). Tamper-evident custody seals on the composite water sampler are examined, their condition noted and the seals removed. The sampler is opened and surveyed as above and the results recorded. The composite sample is removed, field surveyed and the results compared with critical values. The appearance of the sample is noted, the sample is custodized and a clean container (ESP 900) is installed for the next sampling period.

(5) Surface water grab samples (ESP 301-4) will be collected from the same location as the composite sample intake at the mouth of WOC. Samples will be collected from a boat positioned at the WOC mouth. These samples will be custodized and radiologically surveyed in the field. The sampler will also be surveyed after sample collection. Survey data will be compared with critical values. This sampling will be conducted (1) weekly to provide a check on the automated composite water samples, or (2) more frequently depending on the construction phase in progress.

All samples and data will be returned to the laboratory for processing, following the procedures in section 4.3.

4.2.2 Equipment maintenance and calibration

Maintenance and calibration of Hydrolab equipment will be conducted at least once per week, following manufacturer's recommendations. Routine calibration and maintenance will be conducted by replacing the sonde unit installed at the mouth with a calibrated unit, and returning the used unit to the lab. If particular parameters are thought to be out of calibration, equipment may be exchanged more frequently. The calibration procedures outlined in manufacturer's manuals will be followed. Other monitoring equipment installed at the site will be maintained as outlined in section 5.4.5.

4.3 Analytical Design

Processing of all samples prior to distribution will occur in the ESD SWPL unless otherwise noted. All samples will be custodized and sample custody transfers to analytical labs will follow the protocol outlined in section 5.4.4. Upon completion of analyses, all data will be sent to the OSERP data base manager, with a copy going to the OSERP project coordinator.

Water samples to be analyzed for total suspended solids (Standard Operating Procedure (SOP) 16, Appendix A) and gamma-emitting radionuclide spectrometry (SOP 19.2, Appendix B) will be subsampled from composited samples (Table 5). Routine gamma spectrometry samples will be submitted to the ORNL-ACD. Non-routine samples (associated with unpredicted events, or as

specified by section 4.4.1) will be submitted to the ORNL-ESD gamma spectrometry laboratory for immediate analysis and data turn-around. Total suspended solid samples will be processed and data reported daily.

4.4 Monitoring Data and Sample Collection Plan

4.4.1 Unpredicted event criteria

Supplemental monitoring plans will be issued to address the monitoring to be associated with specific construction phases. These supplemental monitoring plans will include:

- Definition of unpredicted events specific to particular construction activities, including a list of critical parameters
- Parameter specific values for decisions defining an event.
- Criteria for appropriate response.
- Response Criteria
- Instructions regarding collection of non-routine samples for unpredicted events.

4.4.2 Frequency of data collection

Monitoring data from instruments installed at the WOC monitoring site will be retrieved by 0900 each weekday for the preceding 24-hour time period. Data will be allowed to accumulate from Friday to Monday. Flow volume for the time period will be recorded in the monitoring data logbook, from the transmission located at the WOD monitoring station.

Routine data and sample collection procedures described in section 2.1 will be followed. Any change in turbidity during the prevoius time period shall be noted in the logbook. Strip chart recorder output for the previous monitoring period shall be custodized and the chart reset for the next sampling period.

Water quality monitoring (Table 4) and stage height data for the WOC mouth will be recorded every 15 minutes, using a digital data acquisition system. Data memory cartridges used for water quality, turbidity and stage height parameters, will be removed, custodized, and replaced with clean cartridges, following procedures given in section 4.

The Health, Safety, and Environmental Affairs Division at the K-25 Plant will support monitoring activities by increasing the frequency of sampling at the K-1513 water intake structure and, if needed, sampling of finish water from the K-25 water treatment plant. The normal monitoring frequency at the K-1513 water intake is quarterly sampling. During the construction period, monitoring will be increased to a sampling frequency (1) appropriate to the construction phase in progress, and/or (2) direct response to a contaminant transport event. In accordance with the nature of the sediment contamination in the White Oak Creek Embayment, the parameters to be monitored are ^{137}Cs activity and the concentration of total suspended solids.

During the construction period (June-December 1991), the baseline monitoring will be collection of a 24-hour composite sample twice weekly (Tuesday and Thursday) at the K-1513 water intake. During phases of construction having higher potential for sediment disturbance or is warranted by unpredicted events, sampling frequency will be increased to the collection of a 24-hour composite sample daily. In the case of an emergency, samples of finished water will be collected daily at the K-25 water treatment plant to determine the extent of contamination of treated water.

4.4.3 QA/QC data for field instruments

Quality assurance for water quality data is achieved by maintaining calibration records for particular Hydrolab instruments. Procedures referenced in section 4.2.2 will be followed. Original Hydrolab calibration forms are filed with the permanent records for a particular week.

5 REQUIREMENTS

This section supports monitoring implementation. The frequency of data and sample collection by the monitoring program, will be determined by the category of construction activity occurring at the site. This section discusses the monitoring requirements for the station located at the mouth of WOCE.

5.1 Analytical Requirements

The monitoring plan focuses on both the transport of contaminated sediments out of WOCE, and on estimates of other parameters related to changes in water quality before, during and after construction activities. This plan calls for monitoring of stage height, surface water quality parameters, turbidity, suspended sediment concentrations, and ^{137}Cs activity, as an indicator of disturbance and transport of contaminated WOCE sediments.

Surface water samples will be collected for the parameters listed in Tables 4 and 5, at the frequency specified in section 4.4.2. Analysis levels to which measurement tasks have been assigned (ESP-700, Section IV, Kimbrough et al., 1990; USEPA, 1988) are included in these tables. Details of sample collection and analytical design are found in section 4.

5.2 Data Quality Objectives

This section establishes the data quality objectives (DQOs) for this project. DQOs are statements which specify the type and quality of data needed to support the activities and decisions governed by this monitoring plan. These must support the monitoring plan objectives, outlined in section 2.1, and will determine the level of analytical effort necessary to meet those objectives. Internal control and review ensuring that the data are scientifically sound and legally defensible is outlined in section 5.5.

The Quality Assurance (QA) objectives for data are that (1) Scientific data generated will withstand scientific scrutiny; (2) Data will be gathered using appropriate procedures for field acquisition, chain-of-custody, laboratory analyses, and data reporting; and (3) Data will be of known precision and accuracy, consistent with the intended use of the data and the limitations of the sampling and analysis procedures used. The quality assurance objectives for quality control (QC) data are intended to (1)

screen out data of unacceptable precision or accuracy and (2) provide data that will meet the data quality goals for this project.

The first data QA objective is met by strict adherence to sampling and analytical requirements and data validation and reporting requirements. Data QA objective number two is met by use of documentation that the specified standard procedures were followed. The third data QA objective is accomplished through the assignment of measurement tasks to the appropriate analytical level (Data Quality Objectives for Remedial Response Activities, USEPA 1987).

The procedures to be used for assessing the quality of field and analytical laboratory data are outlined in section 5.3. Detailed discussion of these procedures is found in the Clinch River RCRA Facilities Investigation Work Plan (Sections 10 and 11, ES/ER-1/D1, 1990). QA requirements specific to White Oak Creek embayment monitoring activities are described in QA/QC (section 5.4). Analytical laboratories selected for this project must meet criteria for laboratory certification and adherence to regulator QA requirements.

Typical quantitation limits applicable to this project are presented or referenced in the CRRFI Plan (ES/ER-1/D1, 1990). The time allowed from sample delivery to until data return from analytical labs (turn-around time) must be short in order to accomodate the project data needs. Turn-around times will be parameter specific, and will depend upon the scheduled level of activity occurring at the site. Use of the holding time values to define the minimum data turn-around for crucial parameters is not acceptable. These requirements will be included in all contractual agreements between OSERP and contract laboratories.

5.3 Decision Rules

Decision rules are divided into three categories, unpredicted events, quality assurance issues and variance system. These provide the rationale for using monitoring data to achieve the objectives of this project. These rules also formalize decisions related to project coordination among agencies involved in the project (section 3).

Due to the nature of this project, decisions regarding construction impacts on water quality and possible halting of construction must be made within a short time frame. All data will be made available to the project coordinator as soon as they are processed. Raw data will also be transmitted to data management as soon as they are available for processing according to the schedule. Prior to release, data must be validated, using protocol developed for the Clinch River Remedial Investigation. In cases where unverified/unvalidated data indicate that water quality has been impacted by construction activities, the project coordinator may request accelerated processing of the data in question.

5.3.1 Unpredicted events

The term "unpredicted event" refers to unexpected change in water quality parameters associated with construction. Possible decisions made based upon such occurences range from no action to a halt in construction until the event's cause can be determined. Rationale to anticipate all possible conditions encountered during a monitoring program cannot be prepared. However, scenarios for changes in monitoring parameters may be outlined (Fig. 3).

A combination of sediment resuspension parameters, corresponding to construction activities, will be used to monitor for unpredicted significant events. These include changes in turbidity, total suspended solids, and gamma spectrometry. Turbidity changes provide a real-time indicator that an unpredicted event either is in progress, or has recently occurred (section 4.4.1). The concentration of total suspended solids from composite samples permits direct quantitation of the mass of material

resuspended at the construction site. Gamma spectrometry, a direct indicator of the disturbance of contaminated sediment, is the final parameter used for identifying an unpredicted event.

Initial indications of the occurrence of an unpredicted event include, but are not limited to unexpected change in the behavior of construction equipment (eg. sheet pile, H-pile, grout jet rod or rock anchor drill), the observation of a turbidity plume by construction personnel, observation of a recorded turbidity increase by monitoring personnel, and observation of increased levels of radioactivity upon field survey of retrieved water samples (section 4). Following the guidelines found in section 4, as soon as such an event is detected, the site ES&H coordinator will be notified and sediment disturbing construction activities halted until the source of contaminant release is identified (Fig. 3).

5.3.2 Statistical evaluation

A statistical evaluation of all analytical results will be performed applying precision and accuracy criteria from Statistical Assessment of Data Quality (Section 10.10, ES/ER-1/D1, 1990). Upon completion of a sample analysis set, the QC data will be reviewed for precision and accuracy determinations and evaluated to validate the data set (Section 10.10.1, Section 10.10.2, ES/ER-1/D1, 1990). The definitions for precision, accuracy, completeness, comparability and sensitivity given in the Handbook for Analytical Quality Control in Water and Wastewater Laboratories (USEPA 1979) will be followed during this project.

5.3.3 Variance system

Unplanned variances from procedures specified in this, or referenced plans will be documented following in the Clinch River RCRA Facilities Investigation Plan (Variance System, Section 10.2.8, Deviations From Established Procedures, Section 10.11, ES/ER-1/D1, 1990). Such deviations may be necessary given that procedures properly addressing the entire range of conditions encountered during a monitoring program cannot be prepared. Responsibilities of personnel in terms of variance reporting are clearly spelled out in Responsibilities of Project Participants (Section 10.11.1, ES/ER-1/D1, 1990).

Any unplanned deviation or nonconformance, will be evaluated with respect to possible effects on reportable data. All unplanned deviations from standard operating procedures, equipment calibrations or any other QA aspect of this plan will be evaluated and documented. Significant deviations identified by the statistical assessment of quality data (Section 5.3.2) will also be used in reporting any nonconformancies (Section 10.11.2, ES/ER-1/D1, 1990). Requirements for issuance and implementation of variance from standard procedures are found in Variance Procedures (Section 10.11.3, ES/ER-1/D1, 1990).

5.4 Quality Assurance/Quality Control

This section defines or references the Quality Assurance / Quality Control (QA/QC) procedures to be used during the monitoring activity supported by this plan. Where applicable, reference will be made to the QA/QC section of the CRRFI Plan (Section 10, ES/ER-1/D1, 1990). Monitoring activity QA will address the data quality objectives outlined in section 4.2, specifically in terms of precision, accuracy, representativeness, and completeness. These data quality parameters are defined for field activities in Section 10.2.2.1, and lab activities in Section 10.2.2.2 of the CRRFI Plan (ES/ER-1/D1, 1990).

5.4.1 Container cleaning

Cross contamination of samples will be prevented by precleaning sampling containers prior to collection, following ESP-900 (Kimbrough et al. 1990). Precleaning activities will be recorded in appropriate logbooks. The guidelines for decontamination of sample containers and sampling devices given in ESP-900 (Kimbrough et al. 1990) will be followed. Specific decontamination procedures are addressed in Section 12.9 of the Health and Safety Plan (ES/ER-1/D1, 1990).

5.4.2 Shipping

Handling, shipping and storage of samples and data resulting from field activities will adhere to custody and safety procedures outlined in the CRRFI Plan (ES/ER-1/D1, 1990). These procedures ensure that sample integrity for analytical purposes is maintained. Shipping and handling procedures for WOCM samples are found in OSERP memoranda (water, C. J. Ford, November 12, 1990; sediment, C. J. Ford, December 12, 1990, January 14, 1991)

5.4.3 Sample identification

The identification of samples will be established and maintained as specified for sample coding and chain-of-custody procedures (section 5.4.4; Section 9, Section 10.3, ES/ER-1/D1, 1990).

5.4.4 Sample custody procedures

Strict chain-of-custody, requiring documentation of sample custody from collection until disposal, will be followed for all data, devices and samples collected for this monitoring project. Chain-of-custody definitions and procedures will follow those of Sample Custody Procedures (Section 10.3, ES/ER-1/D1, 1990) and MMES ESP-500 (Kimbrough et al. 1990). Additional details of document control are included in the CRRFI Data Management Plan (Section 11, ES/ER-1/D1, 1990).

Custody will be initiated at the time of collection. Field data (hardcopy and devices) and samples will be identified by labels with the following information: unique sample identification code, date and time of collection, sampling location, preservation, requested analysis, and any additional comments that are applicable (Section 10.2.4, ES/ER-1/D1, 1990). Field chain-of-custody forms containing the sample lable information will be completed for each set custodized materials retrieved. Field custody procedures will follow the steps outlined in the CRRFI Plan (10.3.1, ES/ER-1/D1, 1990).

Upon receipt at the laboratory, identification for each sample will be compared to the information contained on the chain-of-custody forms. After sample receipt, an initial inspection of transport containers, seals and samples is made. This inspection includes: (1) Seals or tapes on the sample transport cooler are intact; (2) The sample containers in the cooler are intact; (3) The identification on sample containers corresponds with the description on accompanying forms; and (4) The number of sample containers received is equal to the number of samples listed on the chain-of-custody forms. Results of this inspection are noted by exception only. If any of these conditions is not met, the project coordinator will be advised, so that a decision as to the fate of each affected item can be made. If deemed necessary, a Nonconformance Report will be initiated following procedures found in Deviations from Established Procedures (Section 10.11, ES/ER-1/D1, 1990).

Once samples are in the possession of the laboratory, proper internal laboratory chain-of-custody, sample handling and packaging procedures must be folllowed (Laboratory Receipt and Handling of Samples, Section 10.3.3, Table 10.4, ES/ER-1/D1, 1990). Unused sample portions will be archived. Non-archivable residues from analytical procedures will be disposed of by contractor laboratories in accordance with laboratory waste management procedures, ESP-1000 (Kimbrough et al. 1990), or other EPA approved procedures.

5.4.5 Calibration procedures and frequency

All measuring and test equipment to be used in the monitoring project will be included in the existing preventive maintenance and calibration program (Surface Water Processing Laboratory Operations Manual, Ford et al, 1991; Instrument Calibration Procedures and Frequency, Section 10.4.1 and Preventive Maintenance Procedures Section 10.9, ES/ER-1/D1, 1990). Preventative maintenance for ESD laboratory equipment will follow the procedures established in QA-ES-12-100 (Roberson and Logsdon 1989). Calibration data will be recorded in the instrument log book or on the appropriate standard form. Records will be prepared and maintained for each instrument to indicate that established calibration and programmed maintenance procedures have been followed. The sampling team leader or laboratory supervisor will ensure that these records are kept current.

Scheduled periodic calibration of equipment does not relieve field or laboratory personnel of the responsibility of employing properly functioning equipment, since any equipment malfunction has the potential to impact data quality . All malfunctioning equipment will be removed from service and evaluated regarding the impact of this malfunction on data quality. The team leader will evaluate and

document (instrument log book) both the validity of data collected between the last calibration and the malfunction and the validity of the previous calibration.

5.4.6 Recording of field data

All field measurements will be recorded in the field notebooks or on specially designed data forms. All data will be directly entered in the field, signed, and dated. Daily entries in the logbooks or on the data forms will be made in water-resistant ink and will include as a minimum 1) The names and affiliations of sampling personnel, 2) A description of the current monitoring activities, 3) Documentation of weather conditions during the previous 48 hours, as well as current conditions, 4) Equipment and instrument notes, and 5) Monitoring instrument measurements. The frequency and detail of entries will be determined by the category of construction being conducted at the site. If entry changes are made, one line will be drawn through the change and the explanation will be signed

and dated in the notebook or on the data form. Changes made to original notes should not obliterate the original information. All field data records will be organized into standard format when possible. Team leaders are responsible for review of daily entries in the field log books.

5.4.7 QC samples for field and laboratory analyses

Quality control checks and frequency for field and laboratory activities will follow the criteria discussed in the CRRFI Plan (Internal Quality Control Checks and Frequency, Section 10.7, ES/ER-1/D1, 1990). Requirements for field quality control samples, including collection of blank, duplicate and rinsate samples will be followed where applicable. No duplicates will be collected for composite samples, though blank and rinsate sampling conditions will be applicable. Specific frequency for collection and analysis is dependent upon the construction activity occurring at the site (section 6).

Laboratories identified in Section 3.1 above will be contracted to provide analytical support to this project. Each contractor laboratory which analyzes samples will provide quantification limits for each constituent analyzed. In addition to evaluating each set of data for accuracy and precision, laboratory QC samples will be used to check sample preparation and analysis, to monitor laboratory performance, and to assess the completeness of the data (Data Quality Parameters Section 10.2.2, ES/ER-1/D1, 1990). QC samples will include blanks, duplicates, spikes, and laboratory standards, as well as laboratory duplicates of all field samples for precision determinations.

5.4.8 Performance and systems audits and frequency

Planned and scheduled audits will be performed to verify compliance with all aspects of the QA program and to determine the program's effectiveness. These audits will be conducted in accordance with written procedures and checklists and will be performed by personnel who do not have direct responsibility for performing the activities being audited. Audit results will be documented and reported to and reviewed by responsible management. Follow-up action will be taken by the responsible line organization when necessary, and the corrective actions will be monitored by the ORNL Manager of Quality Audits. Audit and surveillance activities for the Off-Site Environmental Restoration Program are detailed in the Clinch River RCRA Facilities Investigation Plan (Performance and Systems Audits and Frequency, Section 10.8, ES/ER-1/D1, 1990).

5.4.9 Quality assurance reports to management

Routine QA reports for this project, found in sections 6.6.2 and 6.6.4, will be available to OSERP management. Management will be aware of project activities including development, review, and operation of the project. Additional QA reports may be submitted as specified in Quality Assurance Reports to Management (Section 10.12, ES/ER-1/D1, 1990). QA reports will be made available via reporting to all parties interacting on this project (Section 3).

5.5 Records Management for Data and Samples

This monitoring project will generate data from field measurements, laboratory analyses, QC samples, and calibration records. Important records regarding the collection, analysis, and disposition of the samples and data will also be generated. The procedures described in the CRRFI Data Management Plan (Section 11, ES/ER-1/D1, 1990) will be followed.

The data management objectives of this plan, to provide organization, protection, retrievability, and accountability of the data and documents generated during monitoring, will ensure that a complete and accurate history of data collection and analyses be included in the records management system (EPA 1988). These procedures are necessary to ensure that data and records documentation is sufficient to support any future legal or administrative actions. The data management procedures will assure that data are made available for uses such as statistical analysis and modeling without the introduction of additional uncertainty from data entry and management activities (Section 11, ES/ER-1/D1, 1990).

As noted under Decision rules (section 5.3) the nature of this project necessitates that, contrary to the specifications of the CRRFI Data Management Plan, all data will be made available to the project coordinator as soon as they are processed for emergency notification purposes, prior to validation procedures. Prior to release, data must be validated, using protocol developed for the Clinch River RI. In cases where unverified/unvalidated data indicate that water quality has been impacted by construction activities, the project coordinator may request accelerated processing of the data in question.

5.5.1 Data management

Data management for this project will utilize the CRRFI Numeric Data Base (NDB) for management and storage of field, analytical, and QA/QC data as described in Voorhees et al. (1988, 1989). Numeric data will be manipulated and stored primarily on an ORNL mainframe computers, with data being made available for personal computer use to persons with a demonstrable need for the data. The CRRFI Record Controls Data Base (RCDB) will be used for management of record material. The RCDB serves as a computerized index for retrieval of information generated by the program (e.g., correspondence, project plans, field notebooks, chain-of-custody records, hard-copy data reports, etc.) from serially numbered archived files. All records will be permanently retained. Data management activities will support the preparation of all documents required for the Administrative Record.

The principal steps for processing and control of information to be included in the NDB, the RCDB, and ultimately the Administrative Record are described in the CRRFI Data Management Plan (Sections 11.3, 11.4, 11.5 and 11.6, ES/ER-1/D1, 1990).

5.5.2 Field data management

Field records will be recorded in permanent ink, legible, and sufficiently complete to permit reconstruction of data-gathering activities by a qualified individual (other than the originator) when data are reduced. Field notebook entries should be factual, detailed, and objective. The field records will be the basis for later written reports and all entries must be free of terminology which might prove inappropriate. The method of data reduction will be identified and recorded. Field-generated data sheets will be collected and reviewed daily for accuracy and completeness by the Sampling Team Leaders. Non-electronic field data will be manually entered into specified mainframe computer systems by K-25 ORGDP Data Entry, to facilitate retrieval by OSERP personnel. Quality will be checked by double entry and verification of entered data. The monitoring project coordinator will forward field notebooks and all data to data management for inclusion in the appropriate data base.

5.5.3 Data summarization, validation, and reporting

Data validation is a systematic process for reviewing a body of data against a set of criteria (section 5.3.2) to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification and review (USEPA 1989). Data reduction, verification, and reporting will be in accordance with the ongoing ORNL Remedial Action Program Data Base Management activities (Voorhees et al., 1988). A detailed discussion of data summarizaiton, validation and reporting is found in the CRRFI QA and Data Management Plans (Section 10.6 and 11, ES/ER-1/D1, 1990).

5.5.4 Field data reduction and evaluation

Processing of field data will follow standard procedures, as outlined in Field Data Reduction and Evaluation (Section 10.6.1, ES/ER-1/D1, 1990). Written reports incorporating reduced and summarized data will include the raw data in appendices. Specific calculations used for data reduction will also be included.

5.5.5 Analytical laboratory data reduction, evaluation and reporting

Processing of laboratory data will follow standard procedures, as outlined in Analytical Laboratory Data Reduction and Evaluation and Reporting and Data Reporting of Analytical Results (Section 10.6.2 and 10.6.3 respectively, ES/ER-1/D1, 1990). Data reduction and evaluation procedures for analytical laboratories are described in laboratory specific documents. Written reports incorporating reduced and summarized data will include the raw data in appendices. Specific calculations used for data reduction will also be included.

The format and content of data reports will adhere to project needs. All data reports will include the following: (1) Data verification & validation will be checked in accordance with data validation requirements and approved by the appropriate sampling team leader or laboratory manager; (2) Data will be presented in a tabular format whenever possible; and (3) Each page of data will be identified with the project number, project name, and date of issue.

Laboratory supervisors are responsible for the preparation of each technical report including the process of data validation. No hardcopy report format is specified by this plan. Procedures and guidelines for electronically transfered data must adhere to the criteria established by OSERP data management for the Clinch River RI.

6 IMPLEMENTATION

The construction schedule (Table 2) will determine the category of monitoring conducted. The most intensive monitoring will be conducted during active construction phases, and particularly those phases which have a high potential for sediment disturbance. Activities including most site preparation, stripping and excavating, and wing wall construction have a minimum potential for disturbance of contaminated sediment. Monitoring will focus on collection of background information, to be compared with later results collected during sediment penetration activities. Subsequent monitoring efforts, in conjunction with sediment disturbance, will include intense monitoring during the first day of a particular activity to check for real-time sediment disturbance and

movement downstream. During periods of no construction, monitoring activities will be less intensive.

The sampling and data collection procedures defined in this plan will be supplemented as nnede by activity-specific monitoring plans. Supplemental plans, prepared by the OSERP, will be provided to the groups and agencies identified in section 3.1. The need for supplemental sampling plans will be determined relative to the construction activity occurring at the site as well as any response to unpredicted events.

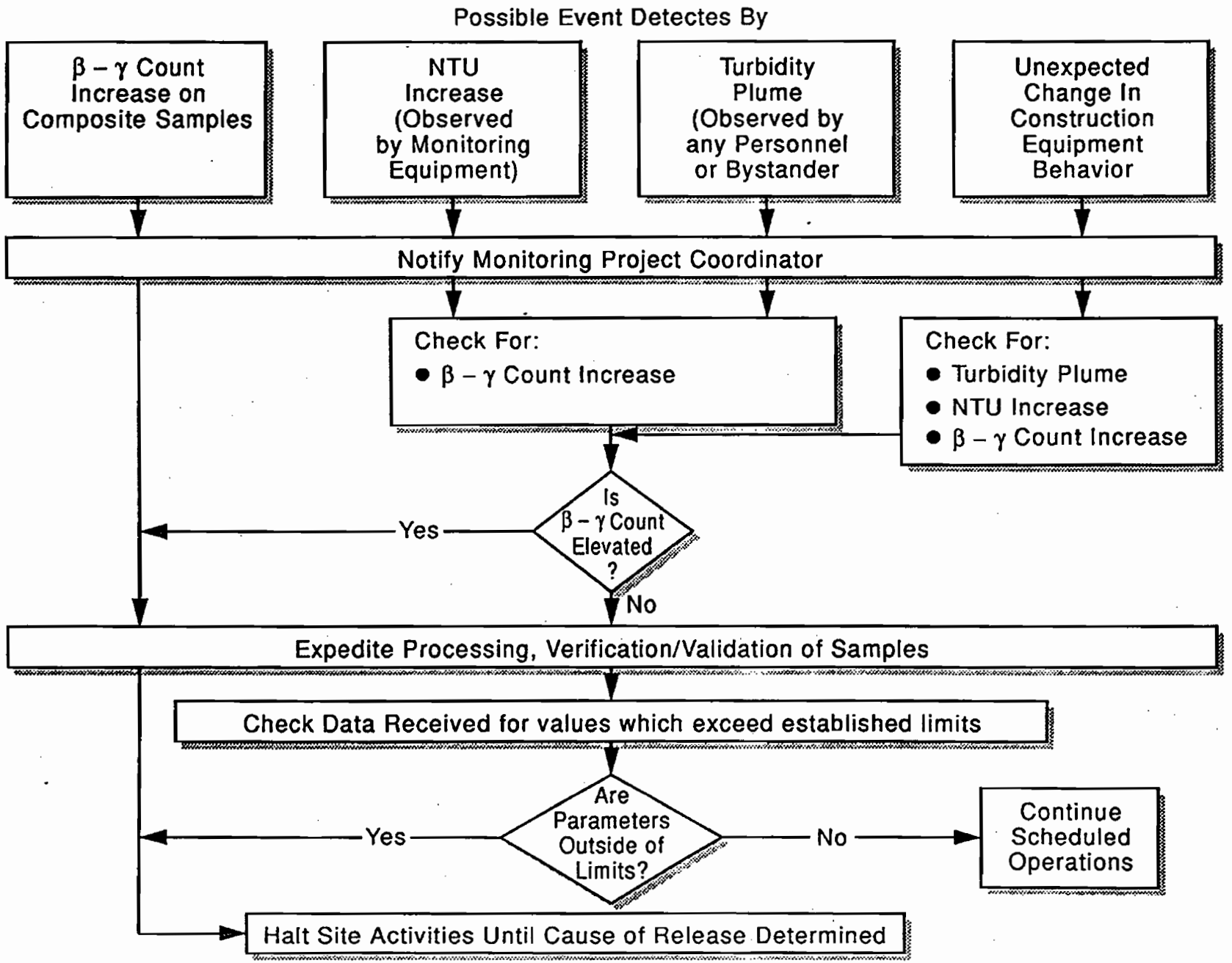
Snagging out and moving stumps will be only site preparation activity of high potential for disturbance of contaminated sediments. Sheet pile driving will be the first construction activity to involve direct sediment contact and therefore a potential for sediment disturbance. All subsequent construction activities, with the exception of rock armoring of the shoreline, will occur on the upstream side of the wall. Close-interval water sampling from boats at the embayment mouth, as well as standard composite sample collection by the monitoring station, will be conducted during the first day of each construction activity.

Rock armoring of the shore, the activity with the greatest potential for sediment disturbance, will necessitate the relocation of the monitoring station to a downstream site to be determined. As a consequence, this activity will be monitored closely.

The Decision Rules (section 5.3) will be used to implement sampling and analysis, following the framework of Sample and Data Collection and Analytical Design (section 4). Scheduling and implementation will be updated as needed, to remain current with the construction activity and the actual monitoring practices being implemented.

FIG. 3

ORNL-DWG 91Z-10083



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APPENDICES

A. SOP-16. Determination of Total Suspended Particles in Surface Water Samples.

B. SOP-19.2. Processing of Surface Water Samples for Gamma Spectrometry

C. Sample ID Codes for Water Sampling

Title: DETERMINATION OF TOTAL SUSPENDED PARTICLES IN SURFACE WATER SAMPLES

Purpose

To determine total suspended particle concentrations in surface water samples collected from river reservoir environments.

Equipment

Forceps
Graduated cylinders (250 mL, 500 mL)
Whatman 4.25 cm diameter glass microfibre filters (either 934-AH or GF/F, as required)
Mettler AE 163 analytical balance
Gelman filter funnels and manifolds
Aluminum weighing pans
Drying oven
Dessicator
Total Suspended Particle data log book
Ball point ink pen
Muffle furnace

Scope and Application

This determination of total suspended particle (TSP) concentrations in surface water samples is done through gravimetric means. This differs from the determination of total suspended solids, determined through evaporation of sample volume. It allows for rapid determination of suspended particle concentrations in stream, river and reservoir environments. Resulting data are quantitative in nature and are appropriate for use in preliminary surveys as well as confirmatory sampling.

Comments

Numeric identification for aluminum weighing dishes is etched into the pan with a ball point pen.

The same analytical balance should be used for tare and dry weight determinations.

Filters should always be handled using forceps.

Filters are placed on the magnetic filter holders so that they completely cover the support frits. The filter funnels will be clamped firmly onto the filter supports and sample poured into the funnel

Sample containers must be thoroughly mixed to ensure that TSP concentration is uniform throughout the sample.

Turbid samples may require less than 0.5 L of sample volume per filter. Low TSP samples may require as much as two liters of sample per filter. To prevent inordinately long filtering times (and delays with the filtering apparati), the well mixed samples should be measured out in 200 to 500 mL quantities using 500 mL graduated cylinders. Additional aliquots should only be added when it is apparent that the previous aliquot will pass through the filter completely.

Calibration and maintenance

Calibration of analytical balances is performed biannually by certified technicans from the ORNL Instruments and Controls (I&C) division. Maintenance is performed by qualified personnel from the ORNL I&C division. Programmed maintenance for all balances is performed annually. Calibration of all ovens (drying and muffle) is performed annually by certified technicans from I&C Division. Programmed maintenance is performed annually by qualified I&C division personnel.

Procedure

1. Glass microfibre filters (either Whatman 934-AH or GF/F) are placed in sequentially numbered aluminum weighing pans (use forceps). Identification and filter type for filter-pan sets is recorded in the TSP sample log book (see Exhibit SOP-16.1). Each filter-pan is dried for 2 to 4 hours at 100°C. Pans and filters are allowed to cool in a desiccator.

2. Filters plus pans are tared using an analytical balance (Mettler AE 163), and their weights recorded in the TSP sample log book. Tared filter-pan sets are stored in a dessicator until use.

3. Place tared filters on the filter frits and attach funnels. Mix the sample thoroughly before pouring. Measure out appropriate quantities of sample and filter duplicate sample aliquots (volume required depends upon sample turbidity) onto tared filters.

4. Several aliquots may be necessary to satisfy the volume requirement for a particular filter duplicate. Aliquots should be measured out in 200 to 500 ml quantities. Additional

aliquots should be added only when it is apparent that the previous aliquot will successfully pass through the filter. Aliquot volumes for a particular sample will be summarized to obtain a total volume filtered. Record total volume filtered in the TSP sample log book.

5. After completion of sample filtering, filters are removed from the frits, and placed with residue side up in the aluminum weighing pans. Samples are dried over night at 100°C.

6. Filtrate is disposed of properly, and filter rigs are rinsed thoroughly with distilled water.

7. Samples are removed from the drying oven to a dessicator to cool. Final dry weight for each sample is measured on the Mettler analytical balance, and recorded in black ink in the TSP sample log book. After initial weighing, the filters are stored in a securable desiccator. If sample is also being processed for particle-associated gamma-spectrometry (SOP-19.2), TSP values should also be recorded on the appropriate record form.

8. As necessary, replicate filters may be combusted at 500 °C in a muffle furnace, cooled, weighed and recorded to determine ash free dry weight.

9. The replicate filters plus pans will be packaged in aluminum foil and stored in a securable deep freezer.

Contamination Control

All instruments or devices which come in direct contact with the sample, including Filter frits and funnels and graduated cylinders will be rinsed thoroughly with distilled water between samples (see step 6, above). After sample processing is completed, all of these instruments shall be washed with laboratory grade detergent and a scrub brush, double rinsed (first in tap water, then in distilled water), and allowed to air dry.

Normally, filtrate will be disposed of as sanitary waste water. If contamination above levels of concern is suspected, filtrate will be disposed of appropriately, depending upon the predominant contaminant present.

QA/QC

The procedures described above serve as quality assurance for the determination of total suspended particles. Quality control samples for TSP determinations consist of duplicate samples for determination of sample homogeniety and analytical technique.

Title: PROCESSING OF WATER SAMPLES FOR PARTICLE-ASSOCIATED GAMMA-SPECTROMETRY USING A CARTRIDGE FILTER ATTACHED TO A PERISTALTIC PUMP

Purpose

This procedure describes the methods for processing of water samples collected from streams, rivers or reservoirs for particle-associated gamma-emitting radionuclide determination. The procedure uses a peristaltic pump and cartridge filter system. It is applicable for rapid, clean determination of particle-associated gamma-emitting radionuclide concentrations.

Equipment

Masterflex peristaltic pump
Sample tubing, silicone or tygon as appropriate
Particle-associated Gamma-spectrometry sample record form
Filter cartridge appropraite to application (0.45 μm diameter, 1000cm^2 surface area)
Graduated cylinder or other volumetric vessel
Carboy containing field sample (15 L)
Secondary containment tray (photo tray)
Holder for filter cartridge
Plastic tape
Small freezer bags
Chain-of-custody forms
Ink pens

Scope and Application

The use of cartridge filter-peristaltic pump apparati for sample processing is practical for determination of gamma-emitting radionuclides in surface waters. The sample containment effected by this particular technique has the following advantages: 1) exposure of processing personnel to potentially contaminated material is minimized, 2) the cartridge can be placed directly onto a gamma detector, and 3) sample geometry is the same for all samples processed using this method. The resulting data are quantitative in nature and are appropriate for use in preliminary surveys as well as confirmatory sampling.

Comments

Between samples, used tubing should be either discarded or cleaned prior to reuse, following ESP-900 (ESH/Sub/87-21706/1 revision 1, 1990).

Procedure may be modified and combined with SOP-19.1 for determination of dissolved gamma-emitting radionuclides.

All pertinent sample identification, collection, background, filtration, custody and gamma spectrometry information shall be recorded on the Particle-associated Gamma-spectrometry sample record form.

A photo tray will be used as secondary containment for the filter cartridge to prevent loss of sample material.

Procedure

1. Record all sample collection, turbidity and pump identification information on the sample record form (Exhibit SOP-19.2.1).

2. Install tygon tubing on the peristaltic pump head, ensuring that they are in proper working condition.

3. Install the in-line filter cartridge, with sample in-flow and out-flow following the direction indicated on the cartridge. Tubing is connected to the outfall end of the cartridge to facilitate collection of filtrate in a graduated cylinder or other volumetric vessel. Place the filter cardridge in the holder, in the photo tray, making certain that all tubing connections are located within the tray.

4. Place the intake end of the tygon tubing into the sample container, to a depth of approximately one-half the distance between the top of the fluid level and the container bottom.

5. Thoroughly mix the sample in its container to ensure even sample distribution. If settled particles are observed on the bottom of the sample container, this action may be repeated throughout the filtration process.

6. Record the time on the sample record form. Begin processing by turning on the peristaltic pump and forcing sample into the filter. Volume filtered will be determined by collection of effluent in a graduated cylinder or vessel. If a graduated cylinder is used, volume should be recorded on the sample record form each time the cylinder is filled. Filtrate should be retained in a cubitainer or other vessel until final determination is made as to future processing.

7. Sample will continue to be pumped through the cartridge filter until either a predetermined volume has been pumped through the filter, or the rate of sample flow through the filter slows significantly. The latter determination relys upon the discretion of the lab technican.

8. When sample collection is complete (see step 7) remove the sample intake end of the tubing from the sample container, allowing the residual water in the tube to be pumped into the

filter cartridge. The peristaltic pump is turned off and completion time is recorded on the sample record form.

9. The filter cartridge is tilted in-flow end up to prevent sample water and particulate matter from flowing back out of the cartridge. The in-flow end tubing is removed from the filter cartridge and residual filtered sample is allowed to drain from the cartridge into the graduated sample collection vessel.

10. When all of the apparent sample has drained from the cartridge, the in-flow end of the cartridge is covered with plastic tape, the cartridge is tilted out-flow end up, the out-flow tubing is removed, and the out-flow end is covered with plastic tape. The final volume filtered is recorded and summed as necessary on the sample record form.

11. The cartridge filter containing the sample is placed in a freezer bag, the chain-of-of-custody tag is attached and the lab chain-of-custody form is completed.

12. The custodized sample is submitted to the appropriate laboratory for analysis. Sample effluent is either processed following SOP-19.1, or is disposed of properly. Tubing is either disposed of properly, or cleaned following ESP-900.

Contamination Control

Sample processing equipment will either be new, or will be cleaned following ESP-900. When multiple samples are to be processed on a given date, sampling equipment to be reused will be rinsed and rinsate blanks collected between samples. Liquids and materials from rinse operations will be handled in accordance with ESP-1000. When sample contamination is suspected, personnel shall wear chemical resistant gloves to handle sampling equipment and samples. Gloves will be disposed of between samples.

Normally, filtrate will be disposed of as sanitary waste water. If contamination above levels of concern is suspected, filtrate will be disposed of appropriately, depending upon the predominant contaminant present.

Quality control

If a sample carboy or tubing are to be reused, rinsate blanks, consisting of 1 liter of deionized water passed through a filter cartridge shall be collected between each use. Steps 1 through 12 should be repeated using sample identification, processing and custody procedures appropriate to quality control rinsate blank samples.

APPENDIX C

Sample ID codes for water sampling

Water sample container labels include DATE, SITE, River Mile (or Kilometer), TIME of collection, and sample collection DEPTH. Regular water samples use a four character code. QA/QC samples require a five character code.

Character	Explaination
1 2 3 4	
1 2 3	Unique sample identification code in a sequential series. Each unique combination of DATE SITE RM TIME DEPTH receives a new sequential number. Ending '0' is reserved for trip blanks.
4	Identifies the type of analysis to be performed on the sample: A Alkalinity titration; G Gamma spectroscopy; O Organics; P Particulate matter; R alpha-beta Radionuclides (^{3}H and ^{90}Sr); Z Inorganics, to be split in the lab (see following); I Ion chromatography (major ions such as Cl^- and S_2O_4.); M dissolved Metals (inorganics); N Nutrients (eg. nitrate, phosphate); T Total metals (inorganics) (I, M, N and T are derived from field inorganic samples processed in the lab).

QA/QC samples replace the fourth character above with the following:

4	QA sample identifier; i) '0' denotes field blank (ID# reflects blank opened coincident with the collection of the unique three digit DATE SITE RM TIME DEPTH); ii) '1' denotes duplicate sample (ID# reflects duplicate of the unique DATE SITE RM TIME DEPTH); iii) '2' denotes rinsate blanks, collected after cleaning and between sites on the same day (ID# reflects rinsate blank after the unique DATE SITE RM TIME DEPTH).
5	Identifies the type of analysis to be performed on the QA sample, as for character #4 above.

Trip blanks, field blanks, duplicate samples and rinsate blanks will be collected for inorganic (Z) lab splits (I, M and T) and Organic analyses. QA sample collection frequencies will be as follows:

TRIP BLANK (* * 0 *): 1/d
FIELD BLANK (* * * 0 *): 1/d
DUPLICATE (* * * 1 *): 1/site
RINSATE BLANK (* * * 2 *): 1 after cleaning and between each site