ARF-022732

Savannah River
NUCLEAR SOLUTIONS℠
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

Post-Construction Report for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U)

SEMS Number: 71

SRNS-RP-2020-00003

Revision 0

June 2020

SAVANNAH RIVER SITE • AIKEN, SOUTH CAROLINA

DISCLAIMER

Printed in the United States of America

Prepared for
U.S. Department of Energy
and
Savannah River Nuclear Solutions, LLC
Aiken, South Carolina

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

~	approximate, approximately
>, ≥	greater than, greater than or equal to
<, ≤	less than, less than or equal to
ac	acres
BMP	Best Management Practices
C&D	Construction and Demolition
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CMI	Corrective Measures Implementation
CMIR	Corrective Measures Implementation Report
CMS	Corrective Measures Study
FFA	Federal Facility Agreement
ft	feet
FS	Feasibility Study
GPS	global positioning system
ha	hectares
in.	inch
IOU	Integrator Operable Unit
LUC	Land Use Controls
LUCIP	Land Use Control Implementation Plan
m	meters
m^3	cubic meters
NARA	North Ash Remediation Area
PAB	P-Area Ash Basin
pCi/g	picocuries per gram
PCR	Post-Construction Report
RA	Remedial action
RACR	Remedial Action Completion Report
RAIP	Remedial Action Implementation Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RG	Remedial Goal
ROD	Record of Decision
SCDHEC	South Carolina Department of Health and Environmental Control
SEMS	Superfund Enterprise Management System
SARA	South Ash Remediation Area
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SWPPP	Storm Water Pollution Prevention Plan
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
WADB	Wetland Area at Dunbarton Bay
WSRC	Washington Savannah River Site, LLC
yd^3	cubic yards

This page was intentionally left blank.

1.0 INTRODUCTION

1.1 Purpose and Scope

This Post-Construction Report (PCR) documents the completion of remedial action (RA) construction activities in support of the closure of the Wetland Area at Dunbarton Bay (WADB) in Support of Steel Creek Integrator Operable Unit (IOU). It summarizes construction activities performed to partially implement the RA requirements in the WADB in Support of Steel Creek IOU Record of Decision (ROD) (Savannah River Nuclear Solutions [SRNS] 2018a) in accordance with the approved Corrective Measures Implementation (CMI)/Remedial Action Implementation Plan (RAIP) (SRNS 2018b). This PCR specifically addresses construction activities in the North Ash Remediation Area (NARA) and Zone 1 of the South Ash Remediation Area (SARA). Figure 1 depicts the locations of the NARA and SARA.

The RA for the remainder of the Wetland Area at Dunbarton Bay and other post-construction activities (see Section 7.0) will be completed in the future and documented in the Corrective Measures Implementation Report (CMIR)/Remedial Action Completion Report (RACR) in accordance with the Federal Facility Agreement (FFA).

This report includes the following items:

- A brief description of the WADB in Support of Steel Creek IOU (here after referred to as WADB) background including RA requirements and objectives;
- A chronology of completed events related to remediation of the WADB;
- A summary of construction activities performed;
- Deviations from the original design per the approved CMI/RAIP;
- Performance standards and quality control inspections, including a summary of performance test results documenting verification of compliance with the acceptance criteria in the CMI/RAIP;
- Verification of construction completion;

- As-Built drawings;
- Forecasts of post-construction activities required for the RA and refers to the CMI/RAIP and the ROD (as appropriate); and
- Project costs.

1.1.1 Document Format

This PCR was prepared in accordance with the requirements for submittal of regulatory documents as identified in the FFA (1993) and the latest format for the PCR. The format of this document is consistent with the FFA protocol format approved by the United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) in March 2003.

1.2 Operable Unit Background

The WADB, a subunit of Steel Creek IOU, is listed as a Resource Conservation Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Unit in Appendix C of the FFA for SRS. The WADB is located southeast of the P-Area Ash Basin (PAB) within the Steel Creek IOU boundary near the headwaters of Meyers Branch (see Figure 1). During remediation of PAB and Outfall P-007, ash was discovered at the southern edge of the PAB and was found to extend approximately (~) 762 meters (m [2,500 feet {ft}]) into Dunbarton Bay, a Carolina bay. Since this area was outside the scope of the remedial action for the PAB, the ash overflow area in Dunbarton Bay was administratively assigned as a subunit of the Steel Creek IOU in the SRS FFA and identified as the WADB.

Data collected in accordance with a Sampling and Analysis Plan (SRNS 2011) was used to support a human health risk assessment, a principal threat source material evaluation, an ecological risk assessment, and contaminant migration/ groundwater quality evaluations. The Focused Corrective Measures Study/Feasibility Study (CMS/FS) Report (SRNS 2013) was developed to evaluate remedial alternatives for hazardous substances existing at the WADB. Excavation of 16,820 cubic meters (m^3 [22,000 cubic yard {yd^3}]) of ash and contaminated soil from the boundary of the PAB to the edge of a 30-m (100-ft) buffer at Dunbarton Bay and transporting the waste to an approved containment facility located off-SRS property was selected as the remedy in the ROD (SRNS 2018a). The 30-m (100-ft) buffer was established to protect Dunbarton Bay's sensitive ecosystem from damage caused by excavation and construction activity. LUCs were selected as the remedy for 10 hectares (ha) (25 acres [ac]), of contaminated media that would remain in place at the WADB (Figure 1).

1.3 Remedial Action Requirements and Objectives

1.3.1 Remedial Action Objectives

As stated in the ROD (SRNS 2018a), the remedial action objective (RAO) for the WADB is as follows:

- Prevent the IOU onsite worker from exposure to refined constituent of concern contaminants in surface ash/soil exceeding 1.0E-06 risk or exceeding SRS background concentrations.

1.3.2 Selected Remedial Action

As stated in the ROD (SRNS 2018a), the selected RA for the WADB in Support of the Steel Creek IOU is excavation of 16,820 m^3 (22,000 yd^3) of ash and contaminated soil from the boundary of the PAB to the edge of the 30-m (100-ft) buffer at Dunbarton Bay and transporting the waste to an approved ex situ containment facility located off-SRS property. The 30-m (100-ft) buffer is used to protect Dunbarton Bay's sensitive ecosystem from damage caused by excavation and construction activity. Additionally, the selected remedy includes LUCs for 10 ha (25 ac) (i.e., Dunbarton Bay and buffer area), since the entire volume of contaminated media will not be excavated, and some materials would remain in place at the WADB.

LUCs for the WADB will be in effect until concentrations of hazardous substances are at levels that will allow for unrestricted use and exposure and include the following:

- Warning and limited access signs at the subunit boundaries to prevent unrestricted use and access to areas where ash and contaminated soil is present (Dunbarton Bay and buffer area).

- Notifying USEPA and SCDHEC in advance of any major changes in land use that would necessitate re-evaluation of the remedy or excavation of waste.

- Institutional controls (i.e., administrative controls) and use restrictions for onsite workers via the Site Use/Site Clearance Program. Other administrative controls to ensure worker safety include work controls, worker training, and worker briefing of health and safety requirements.

- SRS access controls against trespassers as described in the 2013 RCRA Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary.

This remedy was selected because it meets the RAOs, provides overall protection of human health and the environment, complies with Applicable or Relevant and Appropriate Requirements, and is cost-effective. The remedy provides a high level of long-term protection to the radioactive and hazardous constituents that remain in place.

1.4 Chronology of Events

A tabular summary of major milestones related to the RA for the WADB is provided in Table 1. The ROD was signed in June 2018 and announcement of the availability of the document was issued to the public on June 20, 2018. In November 2018, a subcontract to implement the RA was awarded to a team of subcontractors; TerranearPMC, LLC and Envirocon Inc. The subcontract team included two subtier contractors, Trotter Inc. and Carolina Sodding, LLC, for clearing/grubbing activities and sod placement, respectively.

The RA implementation began on January 17, 2019, with initial land clearing activities in accordance with the activities described in the *Corrective Measures Implementation/ Remedial Action Implementation Plan* (SRNS 2018b) for the WADB in support of Steel

Creek IOU. Construction activities were sequenced as prescribed in the CMI/RAIP and design documents.

During the excavation activities in Zone 1 of the SARA, unexpected site conditions were encountered that delayed completion of the remaining zones in the SARA. A meeting was held in June 2019 with the U.S. Department of Energy (USDOE), USEPA, and SCDHEC to discuss the site conditions and a decision was made to postpone remediation of the remaining SARA. A detailed discussion of the changed site conditions is provided in Section 3.0 of this report.

Construction activities associated with the NARA and Zone 1 of the SARA were complete in November 2019. After demobilization, SRNS performed a final acceptance inspection to ensure completion of scope.

A Land Use Control Implementation Plan (LUCIP) (SRNS 2018c) was approved in 2018 for the installation of warning signs at ingress points to the Dunbarton Bay and buffer area. The warning signs were installed following completion of construction activities in the NARA and Zone 1 of SARA. In accordance with the LUCIP, a survey plat of the LUC boundary was prepared.

2.0 CONSTRUCTION ACTIVITIES

2.1 Construction Team

SRNS provided project management, oversight, stormwater inspections, confirmation sampling, worker protection, and regulatory integration. During the construction phase of the project, SRNS Design Engineering provided Title 3 (Construction) support.

The prime contractor, responsible for implementation of the remedial action at WADB, was a partnership between TerranerPMC, LLC and Envirocon, Inc. TerranerPMC was primarily responsible for contract management and Envirocon maintained a constant field presence and was responsible for erosion and sediment control measures, stormwater controls, excavation and hauling of ash and contaminated soil, and grading. Sub-tier contractors included the following: Carolina Sodding LLC for the installation of sod and watering of the sod; Trotter Site Preparation for clearing, grubbing and transportation of root balls and vegetation; and GEL Engineering, LLC for surveying and as-built preparation.

2.2 Equipment

Table 2 identifies the general equipment types used during construction. Sediment migration from the construction areas via equipment operation was mitigated via equipment brushing prior to leaving the waste area and through the use of a construction entrance. In accordance with the Storm Water Pollution Prevention Plan (SWPPP), a construction entrance was installed at egress areas to minimize off-site tracking of sediments from equipment. The construction entrance consisted of a 15-centimeter (cm [6-inch {in.}]) thick aggregate pad. Maintenance and inspections of the equipment construction entrance were performed per the schedule in the SWPPP.

2.3 Remedial Action Implementation

The following provides a summary of construction activities performed during the RA. Due to the requirement to re-route storm water away from the areas to be excavated and specific sediment control requirements required to protect the wetlands, the project was divided into two general areas: the NARA and the SARA. Construction sequencing in each of these areas, as prescribed in the design documents and summarized in the CMI/RAIP, was necessary for sediment control. Within these general areas, remedial activities were performed in two phases. Phase I included the installation of initial stormwater/sediment perimeter controls and the construction of the stormwater diversion channel and flow dissipater. Phase II included the clearing and grubbing, ash removal, confirmation sampling, final grading, and stabilization activities. The remedial activities in each phase, as well as pre-mobilization and mobilization activities, are described in the following subsections.

2.3.1 Pre-Mobilization and Mobilization Activities

Initial land clearing was performed to allow access to the site, establish laydown and stockpile areas, and to improve road shoulder conditions. The sub-tier subcontractor performed initial surveying to establish the boundaries of the limits of ash and the limits of disturbance. All surveying was performed by a South Carolina licensed Professional Land Surveyor. Existing topography and design elevations were loaded into the global positioning system (GPS) equipment used by Envirocon. The GPS used Digital Terrain Models and electronic background maps to ensure continuous control of excavation grades. Underground interferences and above ground interferences were surveyed and marked to ensure safety and prevent inadvertent contact.

A laydown area was established for office trailers, communication systems, fuel tanks, material storage and employee parking. A generator provided power for the office trailers, and the communication systems. The fuel station included three double-walled tanks stored on a concrete pad. Near the laydown area, a water fill station was established to fill water trucks used for dust control and sod watering. In accordance with the SWPPP, dust control methods were implemented during the mobilization activities and throughout all phases of the project. Dust control measures included the frequent watering of unpaved access roads, watering during excavation, and watering of stockpiles. The subcontractor dedicated a water truck and driver for the project duration for dust control. The water supply was a Savannah River water supply line. Figure 2 shows the location of the laydown area and water source with respect to the project boundaries.

Road improvements were also made as part of the mobilization activities. Road improvements included grading SRS Road 74-28 to allow drainage, removal of potholes, widening, and installation of aggregate as needed. A traffic safety plan was developed which included one-way traffic patterns along P-Area access roads used by heavy equipment. Road signs and SRS-wide communication were used to alert drivers of heavy equipment entering primary SRS roads.

2.3.2 Phase I Initial Sediment and Erosion Control Construction Activities

Initial sediment and erosion control activities varied between the NARA and the SARA. The design documents required a specific sequencing of construction activities. Although the NARA and the SARA activity sequencing was relatively independent, most activities in these two areas could be performed concurrently. For example, the initial sediment and erosion control features (Phase I) were not required to be completed in the NARA prior to beginning the ash removal activities in the SARA (Phase II). The following subsections describe the Phase I activities for each area.

2.3.2.1 SARA Phase I Activities

The SARA includes ~1.6 ha (4 ac) of ash and contaminated soil plus an additional 1.3 ha (3.1 ac) that were used for stormwater conveyance and access corridors. Initial stormwater and sediment control activities in the SARA included the installation of a flow dissipater. This dissipater directed stormwater from an existing triple culvert beneath SRS Road 74-28 (away from the ash and contaminated soil in in the SARA and reduced the flow velocity allowing stormwater to sheet flow overland toward the wetlands (Figure 3). Prior to land disturbance activities associated with the construction of the dissipater, silt fencing was placed along the down slope area to prevent sediment migration. The dissipater was immediately sodded to stabilize the area and the silt fencing was removed.

Initial clearing and grubbing was performed in the SARA to allow for the installation of the dissipater and access corridors along the east and west boundaries of limits of ash. Minor clearing and grubbing activities were also performed on the southern boundary of the SARA to allow for the installation of a double row of silt fencing. The double row of silt fencing was installed to mitigate sediment migration from the disturbed areas in the SARA to the 30-m (100-ft) buffer area to protect the wetlands.

During the installation of the access corridors on the east and west sides of the SARA, additional ash was found outside of the limits of ash boundary as identified on the design drawings. Along the western corridor, this additional ash was excavated between the limits of ash and limits of disturbance (Figure 4). The excavated ash was stockpiled in the NARA and aerated prior to disposal in Three Rivers Landfill. The western corridor was the primary access path for heavy equipment into the SARA, and because the subgrade was found to be a saturated clay material, stabilization with large stone, fabric, backfill and smaller stone was required. Within the eastern corridor, ash found between the limits of ash and limits of disturbance was excavated and stockpiled along the edge of the ash remediation area (Figure 5). The eastern corridor was backfilled, and a diversion berm was constructed as part of the initial sediment and erosion control features. This diversion berm prevented stormwater from entering the contaminated area from the western higher elevation side.

2.3.2.2 NARA Phase I activities

The NARA includes an ~2.5 ha (6.1 ac) of ash remediation plus an additional 1.9 ha (4.7 ac) that were used for stormwater conveyance, temporary stockpiles, and erosion and sediment control measures. This ~4.4-ha (10.8-ac) lies between the now closed PAB and the SRS Road 74-28. Initial stormwater and sediment control activities (perimeter controls) in this area included the construction of a sediment trap at the southern end of the NARA, a stormwater diversion channel, and diversion berms (Figure 6). During Phase I, clearing and grubbing activities in the NARA were limited to the area required for construction of the stormwater channel, sediment trap and diversion berms to prevent contaminated ash and sediment migration during land disturbing activities.

The sediment trap construction included the excavation of a low-lying area to allow runoff from within the contaminated area to pond, and a rock outlet structure to trap sediment and prevent release of sediment outside of the NARA. Once the sediment trap was constructed, excavated ash from the SARA was temporarily stockpiled adjacent to the sediment trap. Temporarily stockpiling ash was required for construction scheduling due to daily volume limits imposed by the disposal facility and to allow the ash to dry prior to transporting in order to meet the moisture limits required by the operators of Three Rivers Landfill.

The stormwater channel was constructed to direct stormwater from the closed PAB around the ash and contaminated soil into an existing triple culvert at SRS Road 74-28. The stormwater diversion channel is ~323-m (1,060-ft) long, much of which was outside the limits of ash. Clean soil excavated to construct the channel was stockpiled in the western stockpile area and used as fill material as needed throughout the project. Ash excavated during the construction of the stormwater diversion channel was stockpiled within the

NARA or directly disposed of at Three Rivers Landfill. Seven rock check dams were installed within the stormwater channel to reduce the speed of the concentrated storm runoff flow. Sod was installed in the stormwater channel for stabilization.

Two diversion berms were installed in the NARA for sediment and erosion control. These diversion berms ran north-south along the east and west sides of the contaminated ash and prevented sheet flow from the adjacent areas from entering the contaminated area.

2.3.3 Phase II Construction and Stabilization

Phase II activities included clearing and grubbing, excavation of ash, confirmation sampling, grading, and stabilization. Similar to Phase I activities, the design specified a particular sequencing of activities in order to mitigate sediment migration and to protect the wetlands associated with Dunbarton Bay. Phase II activities in the SARA were divided into four (4) zones with the requirement to begin construction activities and complete stabilization in each zone before proceeding to the next zone. In the NARA, there were no design requirements for a particular sequence for Phase II activities. Details of the Phase II activities performed in each of the remediation areas are described in the following subsections.

2.3.3.1 Phase II Activities in the SARA

After completion of Phase I activities in the SARA, clearing and grubbing activities were performed in Zone 1. Zone 1, the southernmost zone, included ~0.4-ha (1-ac) adjacent to a 30-m (100-ft) buffer area that was established to protect the wetlands -associated with Dunbarton Bay. Vegetation was disposed of at the Construction and Demolition (C&D) Landfill at SRS. Root balls, and any vegetation contaminated with ash were disposed of at the Three Rivers Landfill.

Following clearing and grubbing, silt fencing was installed at the boundary between Zones 1 and 2 and excavation of ash began in Zone 1. Ash excavation in Zone 1 was initiated on the east side and proceeded to the west. During excavation activities, saturated conditions, like those encountered during the establishment of the western corridor, were found in Zone 1. A dense clay layer just beneath the ash restricted rainwater infiltration resulting in pockets of perched water. As ash was being excavated in Zone 1, water began seeping from the midpoint of the Zone 1/Zone 2 interface. This seepage resulted in unstable soil conditions which significantly hampered excavation activities (Figure 7). After the ash was removed the area was graded to direct water to the low point at the southeast corner of the zone, where it ponded. A check dam was installed at the seepage point to mitigate the potential for ash migration from Zone 2 to Zone 1.

The saturated conditions required the use of a long reach excavator due to the unstable ground surface. Excavated ash exceeded the moisture content allowed by Three Rivers Landfill and thus had to be stockpiled, aerated, and measured for moisture content prior to disposal. Ash stockpiles were managed in the NARA just upgradient of the sediment trap.

Once the excavation reached the design/planned depths, an inspection was performed by SRNS Engineering which included a field walkdown of the excavated area, visual inspection of soil color and grain size distribution, and a textural examination to ensure that no ash deposits remained. Ash deposits were still evident in many locations and the subcontractor was instructed to excavate additional material until no ash could be observed during subsequent inspections.

Confirmation samples were collected from two locations within Zone 1. The first sample was collected from location S-08 on May 1, 2019 (Figure 8). The results of all constituents except radium-226 (Ra-226) were below the remedial goal (RG). Radium-226 was detected at a concentration of 1.29 pCi/g (J qualified), slightly higher than the RG of 1.2 pCi/g but lower than the SRS maximum background soil concentration, 1.7 pCi/g. The laboratory duplicate for this sample had a result of 0.701 pCi/g. A sample was collected from location S-09 on May 15, 2019 (Figure 8). All results from this sample were below the RGs. Appendix A provides a description of the confirmation results.

Based on the results from the confirmation sampling, the subcontractor was directed to stabilize Zone 1 with permanent vegetation. Sod was placed on all disturbed areas within Zone 1 (Figure 9).

The unexpected conditions encountered during the remediation of Zone 1 resulted in a suspension of remedial activities in the remainder of the SARA (Zones 2-4). Section 3.0 of this report discuss the deviations from the design and the circumstances of the remediation suspension.

2.3.3.2 Phase II Activities in the NARA

Clearing and grubbing of the NARA began once the SWPPP perimeter controls (e.g., stormwater diversion channel, sediment trap, diversion berms, etc.) were installed. The design documents did not require a specific sequencing of Phase II activities; however, for construction management purposes the subcontractor divided the NARA into seven zones that coincided with the sampling grid (e.g. N-01, N-02,….N-07) as defined in the Field Sampling Plan (FSP) (SRNS 2018d) and shown in Figure 10.

In general, Phase II activities progressed from north to south within the NARA, starting with sampling Grid N-01 and N-02. Conditions in the NARA were much dryer than in the SARA and ash excavation proceeded using standard excavation equipment (e.g., dozer with GPS, track excavator, dump trucks, etc.) with minimal problems (Figure 11). Once ash was removed from each sampling grid, SRNS Engineering performed an inspection which included a field walkdown of the excavated area, visual inspection of soil color and grain size distribution, and a textural examination to ensure that no ash deposits remained. In some cases, small deposits of ash were identified, and the subcontractor removed those with a track shovel until clean soil was observed. After each area was cleared via SRNS inspection, a confirmation sample was collected from the corresponding sampling grid. Sampling Grids N-01, N-02, and N-04 were cleared first and one sample from each sampling grid was collected on June 27, 2019. A similar process was performed for the remaining zones/sampling grids in the following chronological order: N-06 & N-07, N-03 & N-05.

In the southwestern corner of the NARA the subcontractor excavated an additional 0.3- to 0.5-m (1- to 1.75-ft) deeper than the design elevation due to the presence of ash below the estimated depth. This area of sampling Grid N-05 was originally a low point of the NARA where surface water discharge from the area north of the WADB project area ponded prior to the construction of the stormwater diversion channel. After initial excavation, SRNS inspected and cleared the area free of visual ash and a confirmation sample was collected. The results from confirmation sample from sampling Grid N-05 for Cesium-137 (Cs-137) was 4.13 pCi/g compared to the RG of 0.68 pCi/g. The confirmation sample from Grid N-05 for Ra-226 was 1.56 pCi/g compared to the RG of 1.2 pCi/g.

Additional soil was excavated from a portion of sampling Grid N-05 where the original topography indicated a natural drainage channel, and the area was resampled in two more locations: one inside the additional excavated area (location N-05A) and another outside of this area but still within sampling Grid N-05(location N-05B). The Cs-137 result from location N-05A was 0.879 pCi/g, above the RG 0.68 pCi/g but below the SRS maximum background of 3.3 pCi/g. The Cs-137 result from location N-05B was 4.05 pCi/g which triggered additional excavation and resampling. Six additional samples were collected from the sampling Grid N-05 at locations N-05C through N-05H. Results from these locations were below the RGs. Sampling locations are shown on Figure 12, and analysis of the data is described in Appendix A.

Stabilization of the NARA progressed in each sampling grid once the results from the corresponding confirmation samples were determined to be below the RGs. Stabilization included grading to the design contours and the installation of sod on all disturbed areas within the NARA. Sampling Grid N-05 was the last grid to be stabilized. Figure 13 shows the NARA after stabilization.

2.3.4 SWPPP Close-Out and Demobilization

Upon completion of construction activities within the limits of ash boundary, the disturbed areas adjacent to the NARA and SARA were stabilized with sod, seed, or stone. In addition to the excavation areas, disturbed areas that required stabilization included the temporary stockpile areas in the NARA, access corridors in the SARA, trenches from the removed silt fences, and access roads. In the NARA, check dams within the stormwater diversion channel were smoothed to limit ponding and left in place. In the SARA, all disturbed areas along the boundaries of Zones 2 through 4 and between Zone 1 and Zone 2 were sodded or seeded. The check dam at the Zone 1/Zone 2 seepage location was left in place as well as the diversion berm along the eastern boundary of the SARA.

After a final satisfactory inspection in accordance with the SWPPP, a notice of termination was signed by the subcontractor and SRNS. This action terminated coverage of the WADB activities under the general SRS construction permit.

The subcontractor removed equipment, excess materials, temporary office trailers, fuel tanks, and connections to the river water supply. SRNS provided a radiological survey of the equipment (standard SRS operating procedure) prior to equipment demobilization.

2.3.5 Secondary Waste Disposal

Waste management (handling and disposal) and transportation of construction generated wastes have met the requirements of Federal and State regulations and applicable SRS manuals and procedures. Site generated waste consisted of CERCLA Sanitary Waste, Sanitary Job Control Waste, wash and rinse decontamination water, and excess recyclable material. Waste containers, transportation and disposal of all waste were the responsibility of the Subcontractor. SRNS provided waste manifests for CERCLA Sanitary Waste. Ash and contaminated soil as well as root balls were transported to Three Rivers Landfill as CERCLA Sanitary Waste (See Tables 3a and 3b for detail of approximate quantities by volumes and weight). The Three Rivers Solid Waste Authority Class Three Landfill (Three Rivers Landfill [Permit #024202-1101]) is permitted to receive the material. Ash waste and root balls were segregated and transported separately. Above ground vegetation was transported on-site to the C&D Landfill as Sanitary Waste.

3.0 DEVIATIONS FROM ORIGINAL DESIGN

Several design and construction changes were needed throughout the project to resolve construction problems. The project team reviewed all changes prior to implementation to ensure compliance with regulatory requirements in the ROD and the CMI/RAIP. Consistent with the CMI/RAIP, notifications were made to USEPA and SCDHEC as appropriate. Table 4 provides a summary of changes and includes the basis and resolution of deviations from the original design.

The most significant change from the original design was the postponement of remediation of Zones 2 through 4 of the SARA. This design change was made in collaboration with USEPA and SCDHEC after discovery of the presence of shallow perched water in the SARA and the discovery of additional ash outside of the limits of ash boundary in the SARA at greater depths within Zone 1. The perched water and saturated conditions significantly hampered heavy equipment operation due to unstable soils, resulted in the requirement to aerate the ash (additional handling) to reduce the moisture content within the limits allowed by Three Rivers Landfill, and increased disposal cost due to the weight of the wet ash. Additional ash was identified within and outside the limits of disturbance on the west side of the SARA. Upon discovery of additional ash outside of the limits of disturbance, an initial investigation was conducted, and the area of additional ash was estimated to be ~0.4 ha (1 ac). Ash was found at depths varying from 0.5- to 1.2-m (1.5- to 4-ft) deep in this area outside the limits of disturbance. Additional ash found outside of the limits of ash, but within the limits of disturbance was excavated in Zone 1 and within the SARA access corridors. Ash was found to extend 0.9-m (3-ft) deep in locations with Zone 1 in areas that were initially estimated to be between 0.3- to 0.6-m (1- to 2-ft) deep.

Disposal agreements with Three Rivers Landfill limited the amount of ash that could be disposed of to 30,580 m^3 (40,000 yd^3). The presence of additional ash within Zone 1 and outside of the limits of disturbance jeopardized the ability to find a disposal facility for the increased volume of remaining ash that was likely in Zones 2 through 4 of the SARA. A meeting was held with USDOE, USEPA and SCDHEC on June 18, 2019, to discuss the change in conditions. Due to the additional ash discovered, saturated conditions, and disposal volume limits established by Three Rivers Landfill, the USDOE, USEPA, and SCDHEC agreed to postpone the remediation of the SARA Zones 2 through 4 until disposal options for the additional ash at this waste site and other coal combustion residual sites at SRS could be evaluated. SRS is currently conducting an evaluation of ash disposition alternatives for all coal combustion residual waste sites listed in the FFA.

4.0 VERIFICATION SAMPLING, TESTING AND ANALYSIS, PERFORMANCE STANDARDS, AND CONSTRUCTION QUALITY CONTROL

To ensure the performance requirements and standards were achieved, project team personnel comprised of SRNS Engineering, Project Management, Safety, Subcontract Technical Representatives, Quality Assurance and Design Engineering performed routine monitoring/surveillance activities. A Quality Assurance Project Plan was submitted by the subcontractor and reviewed and approved by SRNS Quality Assurance personnel. SRNS Engineering performed routine field oversight, verification of confirmation sampling results, sampling data management, and evaluation and acceptance of the analytical results.

4.1 Design Engineering Title III Construction Support Activities

SRNS Design Engineering provided Title III Construction Support which included the following activities:

- Review of all requests for information by the subcontractor when conditions arose in the field that did not match the original condition as described on the design documents, and clarification of the path forward in response to the identified conditions;

- Review of all vendor submittals for conformance with the design requirements in the CMI/RAIP (SRNS 2018b) and drawings;

- Inspection of the subcontractor's workmanship, materials and equipment;

- Weekly (minimum frequency) inspection of field conditions to ensure that erosion prevention and sediment control features were functioning properly and to identify if maintenance of existing best management practices (BMPs) was required or if additional BMPs were necessary to ensure pollutants were not entering or leaving the established stormwater conveyance system or along the construction site's borders; and

- Verification of as-built record drawings.

4.2 Confirmation Sampling

Confirmation sampling was performed in accordance with the approved FSP (SRNS 2018d). After excavation of ash was complete, SRNS Engineering performed a field walkdown of the excavated area to inspect for discolored soils or material that had texture and grain size distribution that is indicative of ash. If material indicative of ash was still present, the subcontractor was directed to excavate the suspect material. Once the inspection confirmed that the area was free of ash, at least one soil sample was collected from each sampling grid and analyzed for arsenic, Cs-137(+D), potassium-40, Ra-226(+D), and uranium-238 (+D). A hold point was placed to prohibit further construction activities until the analytical results were returned and evaluated against the acceptance criteria.

Once favorable results were confirmed, the excavation areas were graded and stabilized. Confirmation sampling results are provided in Appendix A.

Confirmation sample results from 12 locations in the NARA were evaluated to demonstrate that the ash has been successfully removed and that the remaining soils are below RGs and support unrestricted land use. The residual concentrations of all analytes met the RGs established in the ROD (SRNS 2018a) based on the acceptance criteria outlined in the FSP (SRNS 2018d) for unrestricted land use. Appendix A provides an evaluation of the confirmation sampling results as well as a Data Usability Report (DUR). The evaluation of confirmation sampling results from Zone 1 in the SARA will be performed after remediation of Zones 2 through 4.

5.0 VERIFICATION OF CONSTRUCTION COMPLETION AND FINAL INSPECTION

5.1 Verification of Construction Completion

Per Section 4.0, construction activities required for the RA in the NARA have met the acceptance criteria established in the CMI/RAIP (SRNS 2018b) and the FSP (SRNS 2018d). The confirmation sample results were formally evaluated in Appendix A of this document.

SRNS inspections were held with the subcontractor to review punch list items that were developed to ensure that the end state of the ash excavation project area met the criteria of the design requirements, including the SWPPP requirements. A final acceptance inspection of the ash remediation area was held on November 11, 2019, and SRNS approved the site conditions.

Construction activities in the SARA are incomplete. Completion of the RA in this area has been suspended until completion of an evaluation of ash disposition alternatives. A CMIR/RACR for the entire WADB will be submitted after completion of the SARA construction activities.

5.2 Final Inspection

A field visit to the WADB construction site was held on October 8, 2019, with the participation of USDOE, USEPA, and SCDHEC, after completion of the excavation and at the end of the stabilization. This field visit served the purpose of a final walkdown and inspection by the USDOE, USEPA, and SCDHEC.

6.0 AS-BUILT DOCUMENTATION

6.1 As-Built Drawings

As-Built documentation of the NARA and SARA is provided in Appendix B.

A final as-built survey plat of the area subject to LUCs is provided in Appendix C. This survey plat includes the location for six access control warning signs and the boundary of the ash that is to remain in place in Dunbarton Bay and the 30-m (100-ft) buffer area.

6.2 Well Modifications

Two monitoring wells (PAS-001C and PAS-001D) were abandoned on January 7, 2019, prior to the start of this RA to allow for ash excavation. Well abandonment reports were sent to SCDHEC on August 1, 2019, and are provided in Appendix D.

7.0 POST-CONSTRUCTION ACTIVITIES

The RA for the NARA is complete, and the NARA supports unrestricted land use. Ash remains in Zones 2 through 4 of the SARA and additional ash has been found outside of the original limits of the ash boundary. Further investigation is required to quantify the additional ash. During this further investigation, any migration from Zones 2-4 into the completed Zone 1 will be evaluated.

The dense clay layer discovered beneath the ash in Zones 2 through 4 limits infiltration and during high rainfall events, this area becomes saturated and forms a perched water table. Perched water flows from the higher elevation in Zone 2 toward the lower elevation in Zone 1. This flow pattern was observed during initial construction activities in Zone 1. Final grading in Zone 1 included contouring the natural flow path to direct stormwater to a low area in the southeast corner of Zone 1. A rock check dam, installed as a stormwater construction aid during Zone 1 remediation activities, was left in place to mitigate migration of ash at the interface of Zone 1 and 2 along this flow path. Heavy rainfall in early 2020 resulted in additional flow paths at the Zone 1/Zone 2 interface, and bottom ash, light weight coarse aggregate, overwhelmed the check dam (Figure 14). The extent of this migration is limited to the Zone 1/Zone 2 interface and the established stormwater flow channel. The frequency of future occurrences of this condition is a function of the quantity, intensity, and duration of rain events.

Ash remaining in the SARA, additional ash found outside of the limits of ash boundary, and ash migration into Zone 1 will be addressed at a later date after completion of an evaluation of ash disposition alternatives for all coal combustion residual waste sites listed in the FFA. RA(s) completed for this remaining WADB ash will be documented in the CMIR/RACR.

The selected remedy for ash remaining in the wetlands of Dunbarton Bay and the buffer area was LUCs. Six warning signs were installed at ingress points of the wetland area to control access by preventing unknowing entry and ensure that unrestricted use of the waste unit does not occur while the unit is under ownership of the USDOE. A survey plat of the

LUCs for the wetland area and buffer area was prepared by John M. Bailey, a professional surveyor registered in the State of South Carolina. The location of the warning signs is shown on the survey plat provided in Appendix D. A photo of two of the access control signs is provided in Figure 15.

The SRNS post-closure maintenance organization will perform inspections in accordance with the inspection checklist for the WADB (Appendix E) per the requirements of the LUCIP (SRNS 2018c). The checklist as presented in the LUCIP initially listed 5 warning signs. The checklist has been revised to account for an additional warning sign (i.e., six total signs) that was installed during field implementation of the RA. Maintenance and LUCs per the LUCIP will be reported during the five-year review of the remedy.

8.0 PROJECT COSTS

The estimated capital cost as detailed in the Focused CMS/FS for the WADB (SRNS 2013) was prepared in 2011 and is provided in Table 5. This estimated cost was for the entire NARA and SARA portions of the remediation area. The actual cost includes remediation costs associated with Zone 1 of the SARA and the entire portion of the NARA. Although the total actual capital cost is only nine percent (9%) greater than the estimated cost, only 60% of original project area was remediated. The increased cost per area is due to the extremely wet conditions in the SARA access corridors and in Zone 1, as well as increased disposal costs and tipping fees. Ash found outside of the initial limits of ash boundary resulted in additional costs for excavation and reconstruction of a stable surface for heavy equipment travel. The high moisture content of the ash resulted in increased equipment costs and costs for additional handling (e.g., farming/aerating). Increases in the disposal cost per ton and tipping fees increased the initial estimate (SRNS 2018a) of $43 per ton to $63 per ton for disposal.

9.0 REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site*, Administrative Docket No. 89-05-FF (Effective Date: August 16, 1993)

USEPA, 2000. *Closeout Procedures for National Priorities List Sites*, #EPA-540-R-98-016, January 2000

SRNS, 2011. *Sampling and Analysis Plan for the Wetland Area at Dunbarton Bay (NBN) in support of Steel Creek Integrator Operable Unit (U)*, SGCP-SAP-2010-00007, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (June).

SRNS, 2013. *Focused Corrective Measures Study/Feasibility Study (CMS/FS) Report for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U)*, SRNS-RP-2012-00252, Rev. 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (April)

SRNS, 2018a. *Record of Decision Remedial Alternative Selection for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U)*, SRNS-RP-2013-00730, Rev. 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (April).

SRNS, 2018b. *Corrective Measures Implementation/Remedial Action Implementation Plan for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U)*, SRNS-RP-2018-00481, Rev. 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (November).

SRNS, 2018c. *Land Use Control Implementation Plan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U),* Revision 1, SRNS-RP-2018-00479, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC (November).

SRNS, 2018d. *Field Sampling Pan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U),* Revision 1, SRNS-RP-2018-00480, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC (November).

This page was intentionally left blank.

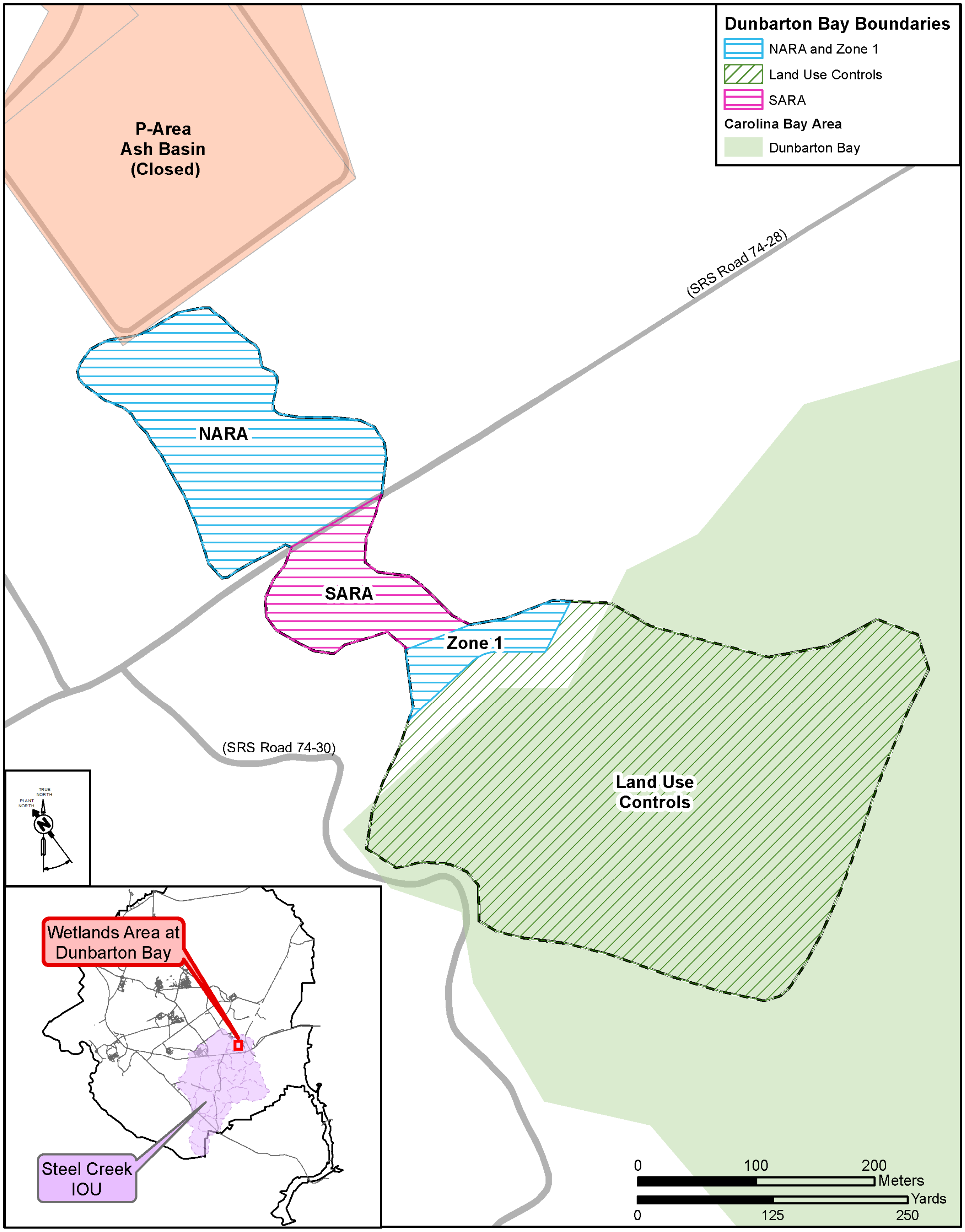


Figure 1. WADB Location and Project Areas

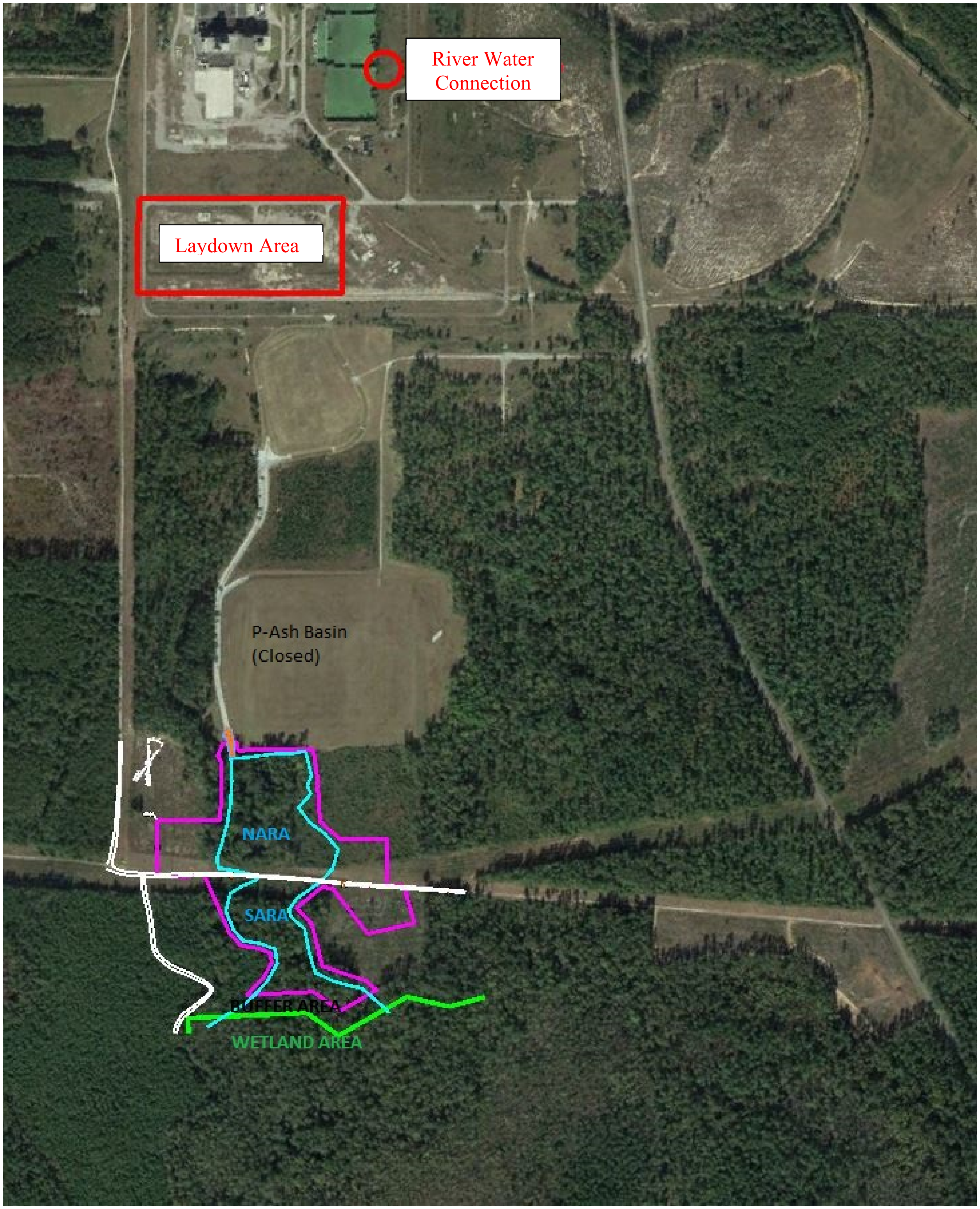


Figure 2. WADB Project Boundaries, Laydown Area and Water Supply Location

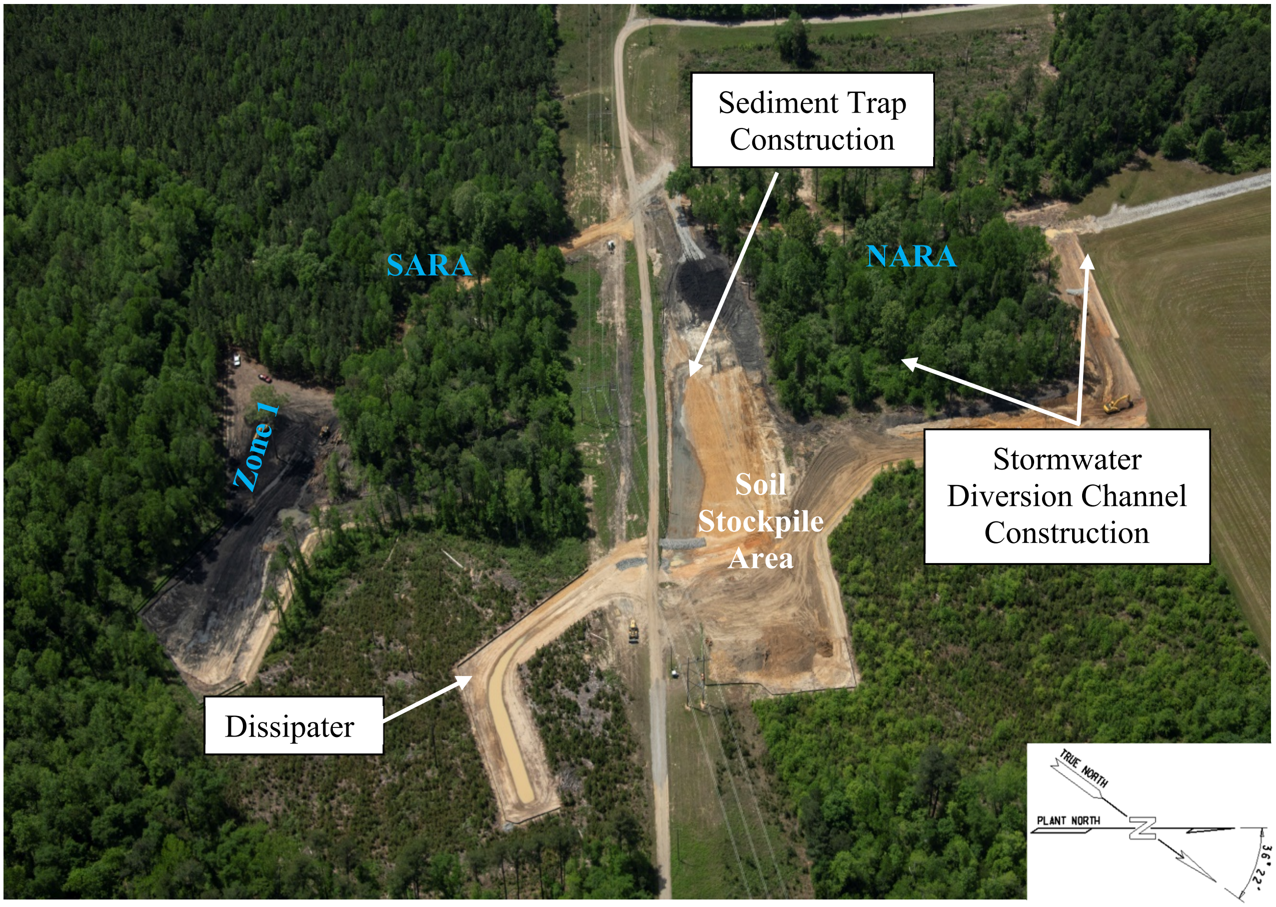


Figure 3. Phase I – Construction of Dissipater and Stormwater Channel/Sediment Trap

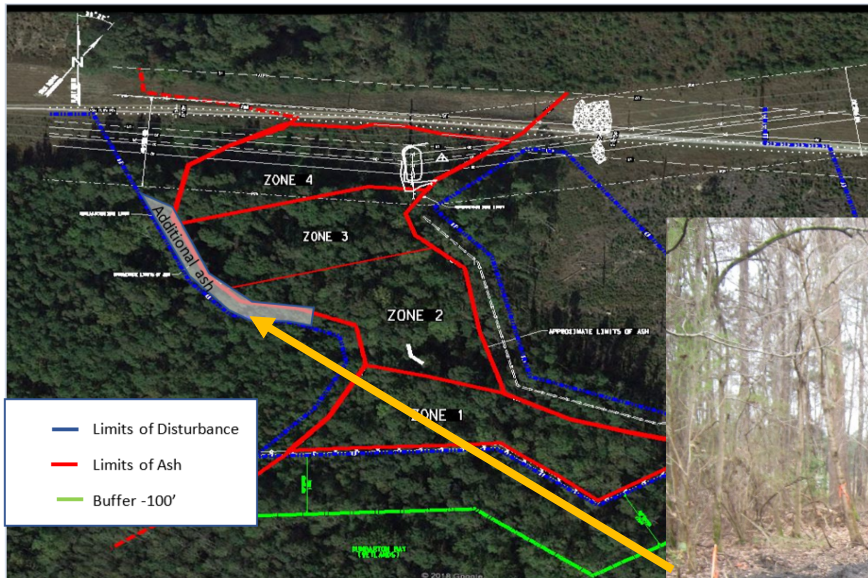


Photo on the right shows additional ash found in the access corridor on the western side of the SARA. The photo below shows excavation of the ash between the Limits of Ash and Limits of Disturbance boundaries.

Figure 4. SARA Western Access Corridor – Additional Ash

Figure 5. SARA Eastern Access Corridor – Additional Ash

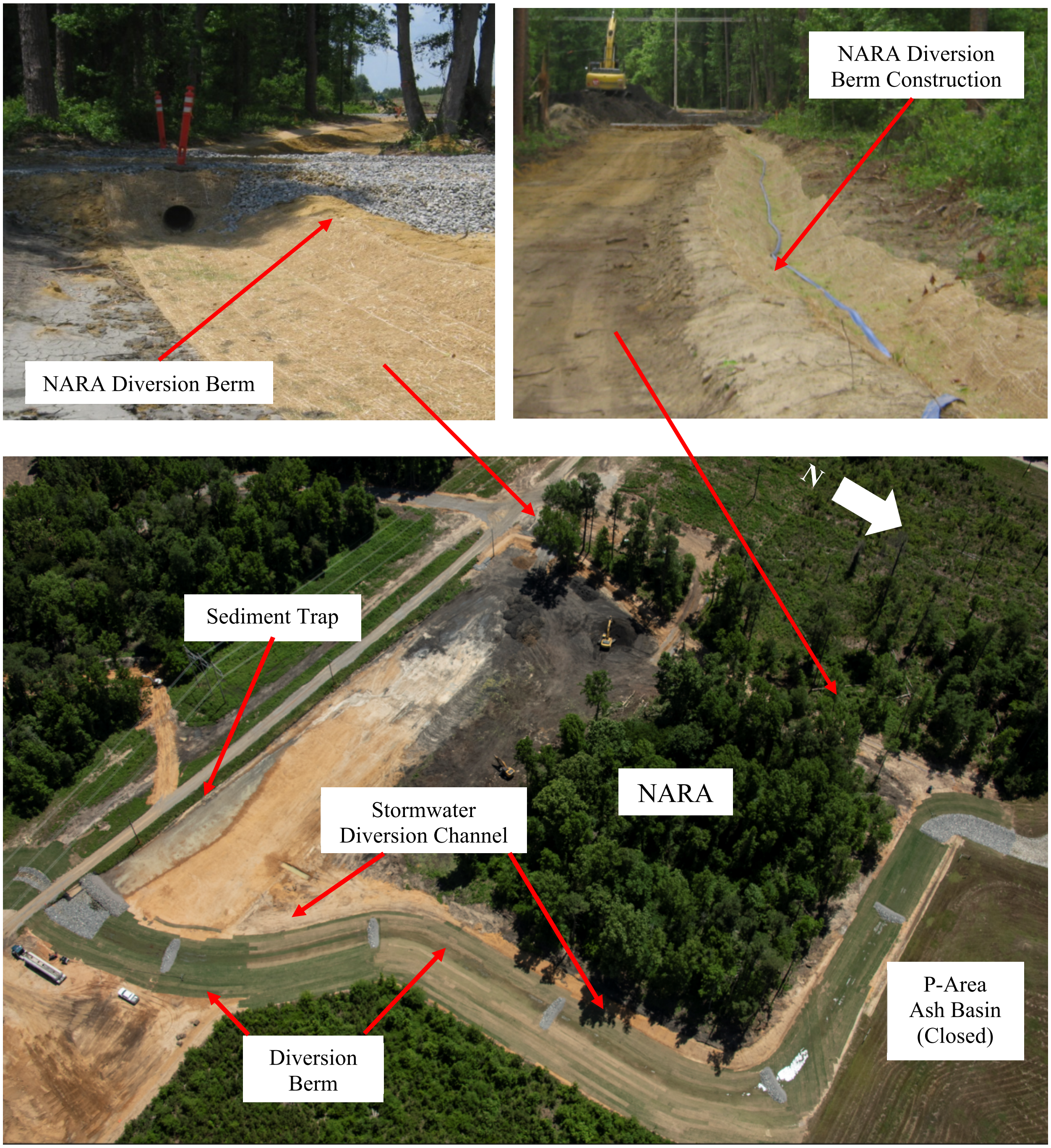


Figure 6. NARA Phase I Construction Activities

SARA – Zone 1/Zone 2 Interface – Water Seepage

SARA – Zone 1 – Seeping Water Was Directed To Southeast Corner of Zone 1

Figure 7. SARA Phase II Excavation of Ash in Zone 1

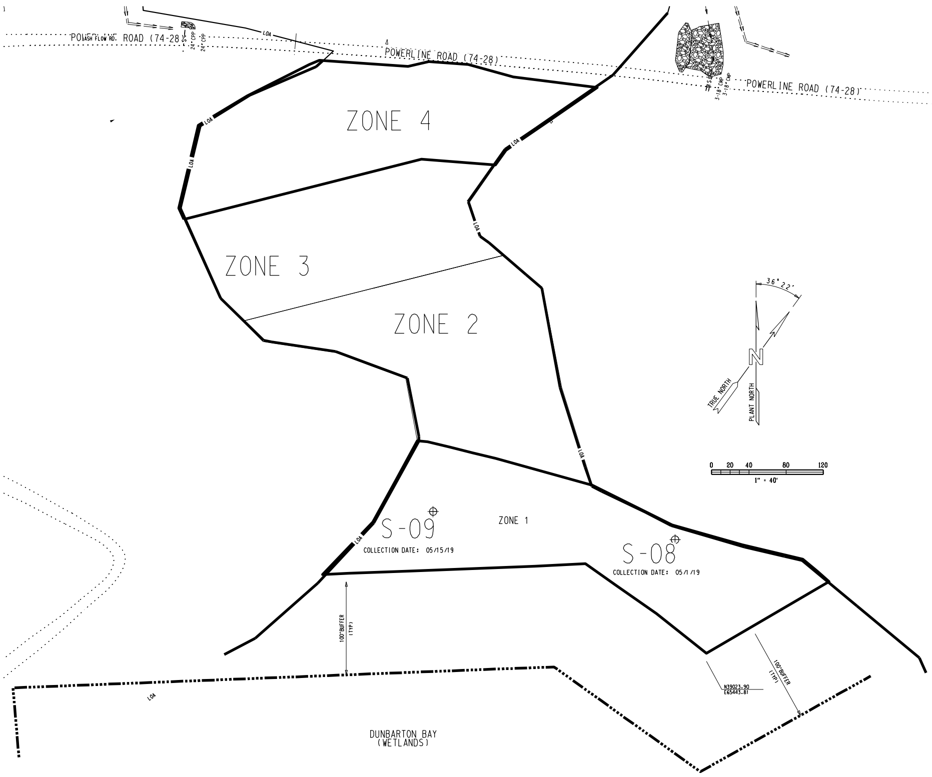


Figure 8. SARA Zone 1 Excavation Complete and Confirmation Sample Locations

Figure 9. SARA Zone 1 Stabilization

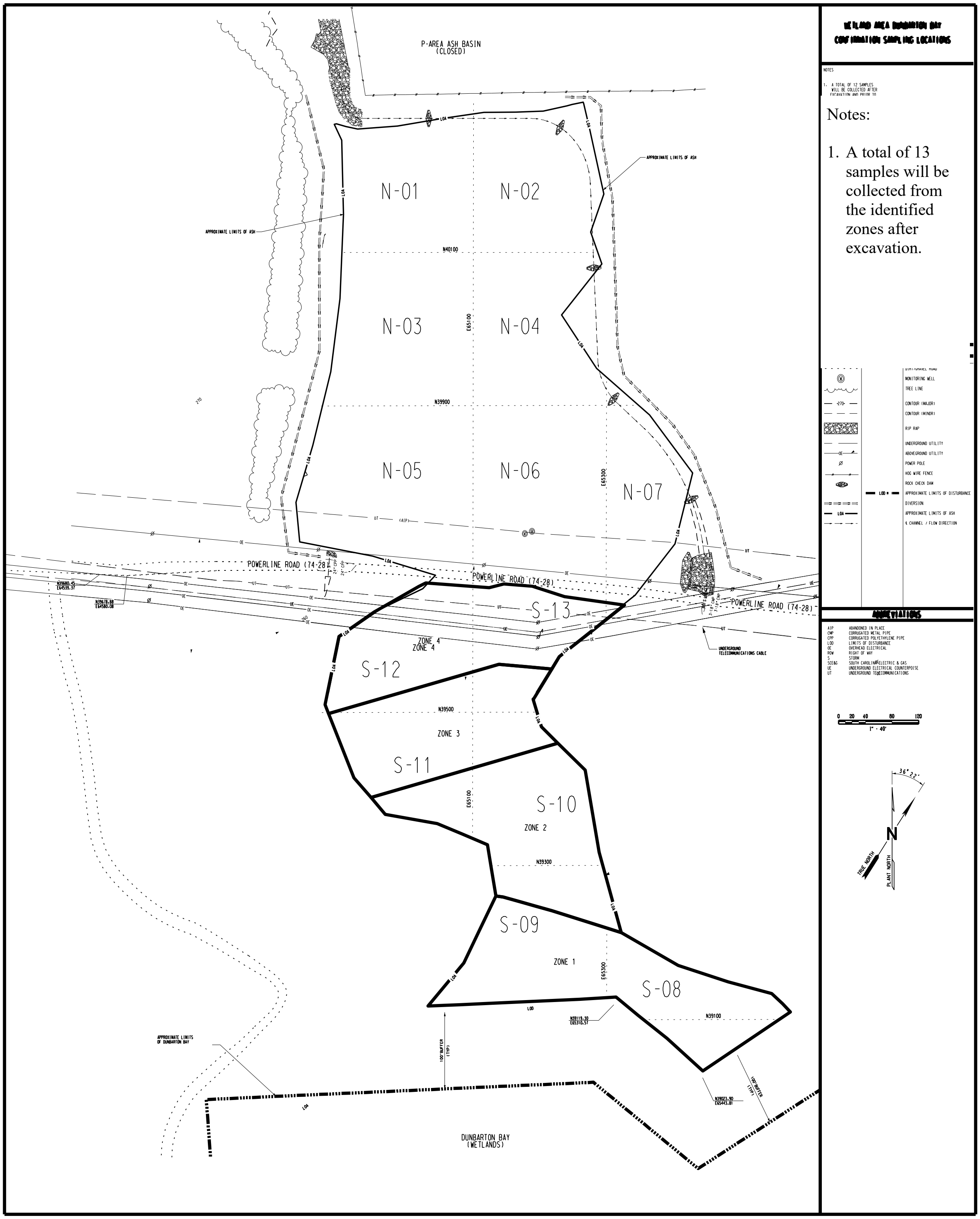


Figure 10. Sampling Grid Map (2018d)

Figure 11. NARA Phase II- Clearing and Grubbing and Excavation Activities

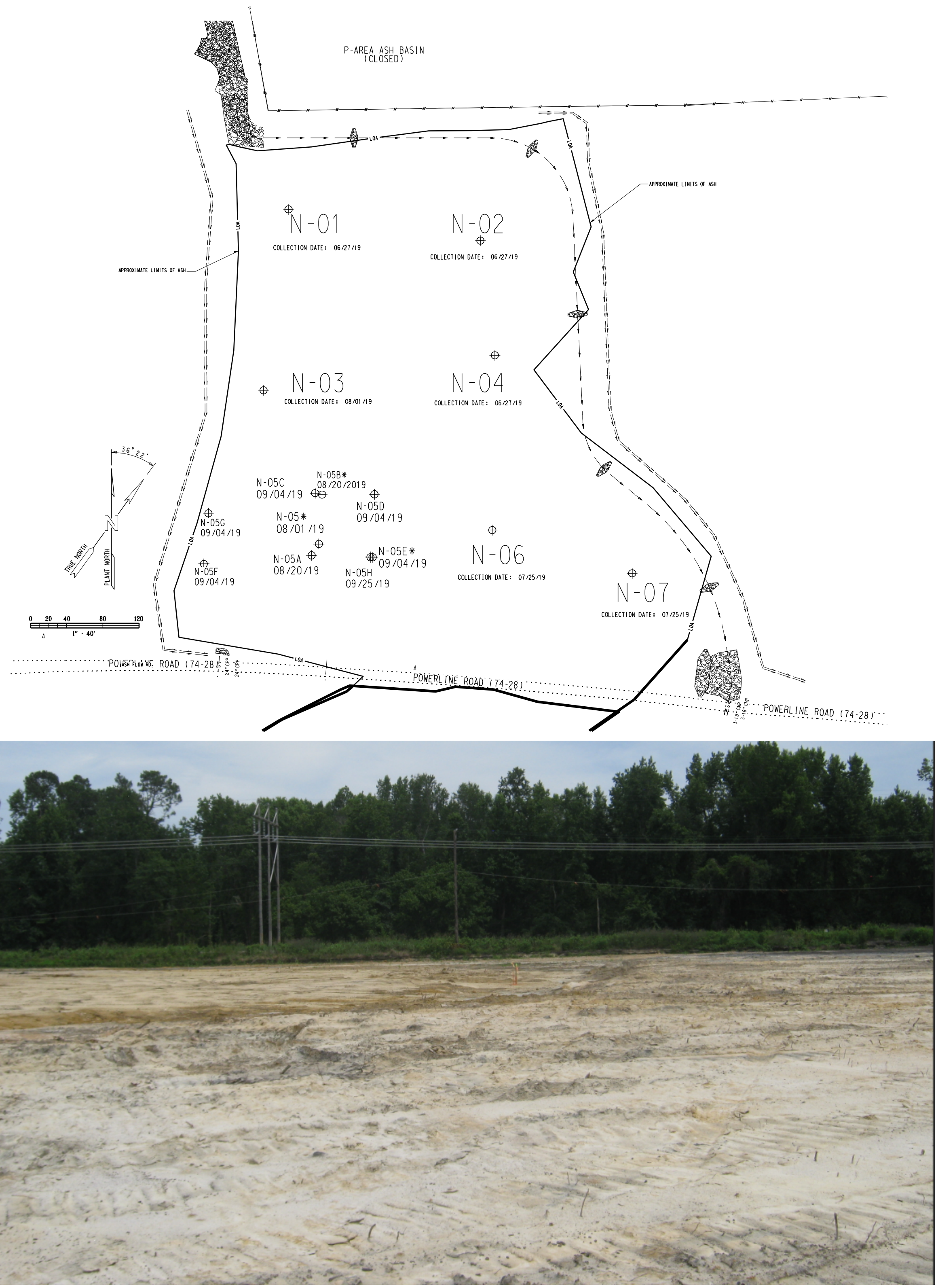


Figure 12. NARA Phase II Confirmation Sampling

Figure 13. NARA Phase II Stabilization Activities and Final Stabilization

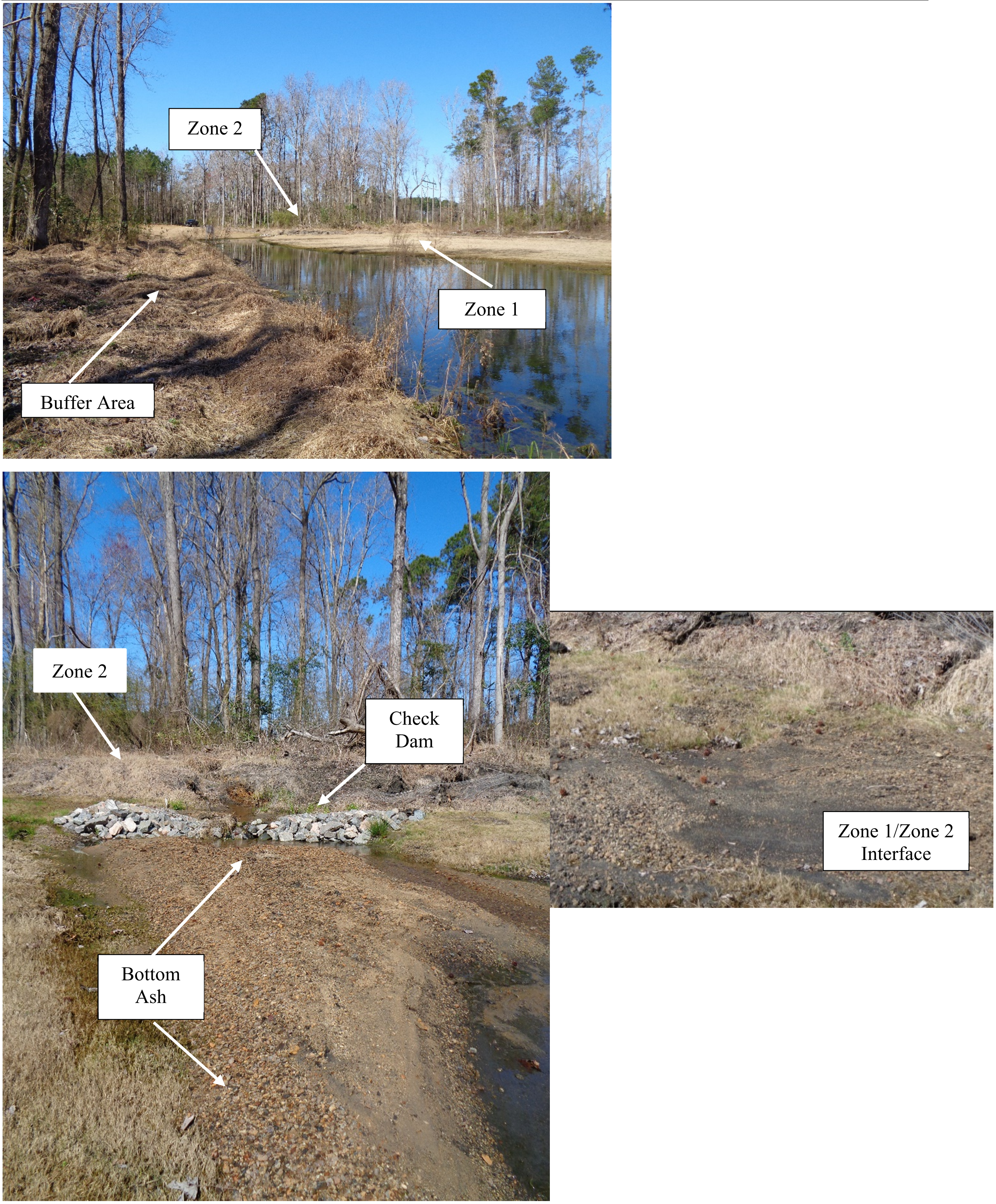


Figure 14 Post Remediation Photo of SARA Zone 1/Zone 2 Interface after Heavy Rainfall Event

Figure 15. Access Control Warning Signs (*typical)*

Table 1. Chronology of Events

Description of Activity	Start Date
ROD (SRNS 2018a) signed	June 20, 2018
Subcontract Award	November 19, 2018
RA start/land clearing	January 17, 2019
Mobilization of office trailers/equipment	February 6, 2019
Improve existing road and install construction entrance	February 18, 2019
SARA – Clear and grub for sediment control features	February 18, 2019
SARA – Install perimeter sediment controls	February 18, 2019
SARA – Additional ash found outside the limits of ash during clearing and grubbing	February 24, 2019
Haul ash and root balls to landfill	February 26, 2019
NARA – Clear and grub for sediment control features	February 27, 2019
SARA – Install flow dissipater	March 7, 2019
NARA – Install initial sediment trap outlet structure	March 7, 2019
NARA – Install stormwater channel and perimeter berms	March 6, 2019 (perimeter berms) April 9, 2019 (channel)
SARA – Clear and grub zone 1	March 28, 2019
SARA – Excavate zone 1 ash, stockpile	April 15. 2019
SARA – Confirmation Sampling (S-08 and S-09)	May 1, 2019 and May 15, 2019
SARA – Stabilization (Zone 1)	Jun 6, 2019
NARA – Clear and grub ash excavation areas	May 7, 2019
NARA – Excavate & Stockpile Ash	May 17, 2019
Core Team Meeting held to discuss SARA changed conditions	June 18, 2019
A de-scope letter was issued to the subcontractor to eliminate the excavation of ash in Zones 2-4 of the SARA	June 24, 2019
NARA – Confirmation Sampling (N-01, N-02 & N-04)	June 27, 2019
NARA – Confirmation Sampling (N-06 & N-07)	July 25, 2019
NARA – Confirmation Sampling (N-03 & N-05)	August 1, 2019 (additional dates for sampling within grid N-05 include August 20, September 4, and September 25)
NARA – Stabilization	August 7, 2019
SARA – As-Built survey	September 5, 2019
Core team meeting held to discuss the end state of the completed portion of the RA and to discuss the path forward for disposition of the ash in the remaining zones	September 17, 2019
NARA – As-Built survey	November 1, 2019
SRNS Final Acceptance Inspection	November 7, 2019
Install access warning signs (wetland area)	January 7, 2020
LUC Boundary Survey	(TBD)

Table 2. Equipment Types and Activities

General Equipment Type	Equipment Use
D-6 Dozer with global positioning system (GPS)	Excavation of ash/finish grading of clean soil.
Excavator	Excavation of ash/loading ash in dump trucks.
Excavator – Long Reach	Excavation of ash in saturated area of SARA and ash excavation in NARA, loading ash in dump trucks
Tandem Axle Dump Trucks	Hauling root balls, ash and contaminated soil to Three Rivers Landfill, hauling vegetation to C&D Landfill, general use for hauling materials within the construction site.
Articulated Dump Truck	Hauling ash within excavation areas.
Water Trucks	Dust suppression, adding water to ash to meet landfill water content and sod watering.
Front End Loader	Load soil into dump trucks/general construction activities associated with stormwater channels and grading.
Skid steer	General site operations.
Pickups	General site operations.
Track Sod Installer	Installation of sod.
All-Terrain Vehicle	General site operations.

Table 3a. Approximate Volumes of Excavated Ash Excavated

Approximate Quantities of Ash and Contaminated Soil Quantities by Area	Volume *(yd^3)*
SARA Zone 1	4,600
SARA Western Corridor	800
SARA Eastern Corridor	850
NARA	15,820
NARA Additional Ash SW Corner	400
NARA Additional Ash East Side at Stormwater Channel	200

Table 3b. Approximate Weights of Ash Disposed of at Three Rivers Landfill

Approximate Quantities of Ash and Contaminated Soil Quantities by Area	Weight *(tons)*
Root balls/ash contaminated vegetation	743
Total Ash Shipped to TRL	29,394

Table 4. Summary of Design Changes

Item	Change	Reason
1	Ash was excavated from the western access corridor of the SARA. Upon verification by SRNS that all ash had been removed, rip rap was placed at the bottom of the excavation. A fabric liner, common fill from within the project limits, and crusher run were then placed to backfill this area.	Additional ash was discovered outside of the original boundary for the limits of ash within the SARA. In order to provide heavy equipment access to Zone 1 of the SARA, the area between the limits of ash initial boundary and established limits of disturbance it was necessary to remove the ash and to a create a suitable/stable subgrade.
2	Three Rivers Landfill temporarily suspended acceptance of ash shipments due to the high moisture content of the ash. Three Rivers Landfill Engineers issued a specification requiring all future shipments of ash to have a moisture content between 21.5% and 25.5%. Ash stockpiles were required to be aerated to reduce water content and sampling was required prior to shipment to Three Rivers Landfill.	Ash excavated from the SARA was saturated and unsuitable for the planned disposal methods by Three Rivers Landfill. Three Rivers Landfill issued acceptance criteria for soil moisture, daily maximum totals, and moisture sampling requirements. During a meeting held with Three Rivers Landfill personnel, a maximum limit of 30,582.2 m^3 (40,000 yd^3) of ash was imposed based on the capacity of the 1.2-ha (3-ac) disposal site dedicated for ash disposal.
3	Ash was excavated from an area within the dissipater channel on the SARA. Upon verification by SRNS inspection that all ash had been removed, the construction of the dissipater channel proceeded as designed.	Additional ash was found outside of the original boundary for the limits of ash on the eastern side of the SARA. This additional ash was discovered approximately (~)0.6-m (2-ft) below ground surface.
4	Ash was excavated at the outfall structure of the sediment trap on the NARA. Upon verification by SRNS inspection that all ash had been removed, the installation of the outlet structure proceeded as designed.	Additional ash was found outside of the original boundary for the limits of ash on the eastern side of the NARA near the sediment trap outlet structure. The additional ash was found 6 inches below original ground surface.
5	Ash was excavated below planned grades in the southwestern section of the sediment trap in the NARA. This area is within sampling grid N-05. Upon verification by SRNS inspection and confirmation sampling the area was backfilled with common fill from within the project limits.	Addition ash was found at greater depths than anticipated in the southern section of the NARA (area of sampling grid N-05).
6	Ash was excavated from the southwest corner of the NARA outside the original boundary of the limits of ash and within the clearing and grubbing limits of the project area. Upon verification by SRNS inspection that the ash had been removed, a diversion berm was constructed as designed and the rest of the area was graded to match adjacent topography.	Additional ash was found outside of the original boundary for the limits of ash on the southwestern corner of the NARA.
7	Ash was excavated below planned grade depths in Zone 1 of the SARA. Upon verification by SRNS inspection that all ash had been removed and the return of the confirmation sampling results, small depressions resulting from over excavation of ash were filled using in situ material adjacent to the depressions. Larger depressions were filled with common fill from within the project limits as necessary to provide positive drainage and to form a smooth surface for the installation of sod.	Additional ash was found at greater depths than anticipated in Zone 1 of the SARA.

Table 4. Summary of Design Changes *(Continued/End)*

Item	Change	Reason
8	Zone 1 of the SARA was graded to direct subsurface seepage water toward the low elevation in the southeast corner of Zone 1. A check dam at the seepage point between Zone 1 and Zone 2 was installed to prevent sediment migration from Zone 2 into Zone 1.	A dense clay layer just beneath the ash restricted rainwater infiltration resulting in pockets of perched water in the shallow sediments. Water seeped from the interface of the Zone 1 and Zone 2.
9	Construction activities were suspended for Zones 2 through 4 of the SARA.	The ash volume in the SARA is greater than anticipated because it was found deeper than previously estimated and additional areas of ash were found outside the initial limits of ash boundary. The additional ash volumes potentially exceed disposal capacity identified by Three Rivers Landfill personnel. Extremely wet conditions were encountered in the SARA which hampered excavation and required stockpiling and drying to meet landfill acceptance criteria, resulting in a significant cost increase.

Table 5. Project Cost Comparison

Project Construction Cost Comparison			
	ROD Cost *($K)*	**Incurred Cost** *($K)*	**Delta Cost** *(%)*
WADB Ash Excavation/Disposal Capital Cost	$9,826	$10,747	(+9%)
WADB Operations and Maintenance Costs	$1,708	NA	NA

This page was intentionally left blank.

APPENDIX A

Evaluation of Confirmation Sampling Results from the Wetland Area at Dunbarton Bay

This page was intentionally left blank.

APPENDIX A — TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

This page was intentionally left blank.

LIST OF ABBREVIATIONS AND ACRONYMS

CMS/FS	Corrective Measures Study/Feasibility Study
USDOE	United States Department of Energy
DUR	Data Usability Report
FD	field duplicate
FSP	Field Sampling Plan
LD	laboratory duplicate
pCi/g	picocurie per gram
QA/QC	Quality Assurance/Quality Control
RCOC	refined constituent of concern
RG	remedial goal
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SPL	split (sample)
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
USEPA	United States Environmental Protection Agency
WADB	Wetland Area at Dunbarton Bay
WSR	Wilcoxon Signed Rank

This page intentionally left blank.

1.0 INTRODUCTION

The purpose of this appendix is to provide an evaluation of the confirmation sampling results from the Wetland Area at Dunbarton Bay (WADB). The confirmation sampling was conducted in accordance with the *Confirmation Sampling and Analysis Plan* (SAP) *for Coal and/or Ash Removal at the Savannah River Site* (SRS) *(U)* (SRNS 2014) and the *Field Sampling Plan* (FSP) *for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U)* (SRNS 2018a). The confirmation sample results provide evidence that the residual concentrations in the remaining soil following ash excavation are below the selected remedial goal (RG) concentrations for the refined constituents of concern (RCOCs) identified in the *Record of Decision* (ROD) *Remedial Alternative Selection for the Wetland Area at Dunbarton Bay in Support of Steel Creek Operable Unit (U)* (SRNS 2018b).

This report applies to the north ash remediation area (NARA) only. The United States Department of Energy (USDOE), United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) agreed to postpone the remaining excavation scope in the south ash remediation area (SARA) until long-term ash disposal options for the SRS have been evaluated. The confirmation sample results from the SARA will be formally presented/evaluated in a future report upon completion of the excavation in this area.

2.0 ANALYTICAL APPROACH / ACCEPTANCE CRITERIA

Arsenic, cesium-137(+D), potassium-40, radium-226(+D) and uranium-238(+D) were identified as human health RCOCs in ash/soil media in the risk assessment portion of the *Focused Corrective Measures Study/Feasibility Study (CMS/FS Report) for the Wetland Area at Dunbarton Bay in Support of the Steel Creek Operable Unit* (SRNS 2013). The final RGs selected in the ROD (SRNS 2018b) and identified in the FSP (SRNS 2018a) for unrestricted land use are presented in Table 1.

The analytical portion of the confirmation exercise is meant to corroborate the visual inspection conclusion that no ash remains. The sampling was conducted as a second level of confirmation/verification that the ash has been removed and the remaining soil concentrations meet RGs. In accordance with the Confirmation SAP (SRNS 2014) and the FSP (SRNS 2018a), the analytical confirmation sample results (mean concentrations) are statistically compared (i.e., hypothesis testing performed) to the RGs as a second level of confirmation/verification that the remaining soil meets unrestricted land use following the initial visual inspection.

The USEPA software package *Statistical Software ProUCL 5.1 for Environmental Applications for Data Sets With and Without Nondetect Observations* (USEPA 2015) contains statistical methods that can be used to evaluate and address various environmental issues. Single sample hypothesis tests are useful when the environmental parameters such as the cleanup standard, RG, or compliance limits are known, and the objective is to compare site concentrations with these known threshold values. Specifically, a t-Test or a Wilcoxon Signed Rank (WSR) Test (for datasets with nondetects) can be used to verify the attainment of cleanup levels within the area of contamination after removal activities.

The decision rule for this confirmation sampling evaluation is expressed as a statistical hypothesis test. To test the hypothesis that RGs are achieved following removal activities, the null hypothesis (H_0) of interest is established as follows: RCOC mean concentration is less than or equal to the RG. The alternative hypothesis (H_A) would then be that the RCOC mean concentration is greater than the RG. These are considered typical statements when the cleanup level has been pre-established. The statistical test for ash removal confirmation sampling is as follows:

Null hypothesis (H_0): RCOC mean concentration less than or equal to ($\leq$) RG
Alternative hypothesis (H_A): RCOC mean concentration greater than (>) RG

For H_A: RCOC mean concentration > RG, if

$t > t_{a(1),v}$, then reject H_0

where
a = 0.05 is the level of significance (i.e., 95% confidence level)
1 = one-tail t-Test
v = degrees of freedom = n-1, where n = number of sample results

With regard to the constituents that have an RG based on the SRS 95th percentile concentration, the SRS maximum background concentration is established as the upper limit for any individual sample (i.e., no single sample result > SRS background maximum concentration). All of the RCOCs have an RG based on the SRS 95th percentile concentration (Table 1); therefore, this additional requirement applies to all constituents.

3.0 DATA COLLECTION AND EVALUATION

The original requirement to collect a total of 13 samples (one sample/acre) to demonstrate ash removal is outlined in the FSP (SRNS 2018a); there are seven locations in the NARA and six locations in the SARA (Figure 1). All data collected as part of the WADB confirmation sampling effort are provided in Attachment 1. The final confirmation sampling data used in this evaluation are provided in Attachment 1a. Confirmation sample results not used in the final evaluation due to re-excavation and resampling are provided in Attachment 1b. Quality Assurance/Quality Control sample results are provided in Attachment 1c.

The construction sequencing requirements were established for the NARA (i.e., N-01, N-02, …N-07) and SARA (S-08, S-09, …S-13); the samples were collected in a progressive fashion to allow construction activities to proceed. The design for the remediation areas had unique sedimentation control measures, and construction activities within these areas were worked in a particular sequence to manage stormwater and to mitigate erosion. The design and construction aspects of the remediation are described in the *Corrective Measures Implementation/ Remedial Action Implementation Plan for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit* (SRNS

2018c). The first samples that were collected were from grids S-08 (5/1/19) and S-09 (5/15/19).

Due to challenges encountered during excavation of Zone 1 in the south ash remediation area (i.e., presence of subsurface water, presence of additional ash within and exterior to the construction site, and insufficient off-site disposal availability), construction activities were not performed in Zones 2 through 4 of the SARA and the corresponding samples from grids S-10, S-11, S-12 and S-13 were not collected. The USDOE, USEPA and SCDHEC decided to postpone the remaining excavation scope in the south ash remediation area until long term disposal options have been evaluated for all SRS Comprehensive Environmental Response, Compensation, and Liability Act ash requiring remediation. Therefore, the samples from grids S-08 and S-09 were not included in this evaluation; they will be used in a separate, future evaluation of the SARA upon completion of the excavation activities for that area.

This data evaluation is for the NARA only, i.e., grids N-01 through N-07. Based on the screening evaluation of the preliminary sample results, portions of grids with a result that exceeded the SRS maximum detected concentration were re-excavated followed by a new sample from that grid. Grid N-05 was the only location that required re-excavation followed by resampling. The resampling in this grid was due to a cesium-137 (Cs-137) concentration of 4.13 picocuries per gram (pCi/g) (sample collected on 8/1/19) that exceeded the SRS maximum background detected concentration of 3.3 pCi/g. The area was re-excavated and samples N-05A and N-05B were collected on 8/20/19. Sample N-05A had a Cs-137 result of 0.879 pCi/g, but sample N-05B had a Cs-137 result of 4.05 pCi/g. The area was re-excavated and samples N-05C, N-05D, N-05E, N-05F, and N-05G were collected on 9/4/19. The 9/4/19 samples were below the Cs-137 SRS maximum detected concentration of 3.3 pCi/g. However, the results from location N-05E had a maximum detected concentration of radium-226 (Ra-226) (3.03 pCi/g) that was above the SRS maximum background concentration of 1.74 pCi/g. Field and laboratory duplicate samples, collected on the same day from this same location showed Ra-226 concentrations of 0.408 pCi/g and 0.462 pCi/g, well below the RG (1.2 pCi/g) and SRS background maximum (1.74 pCi/g). Although the duplicate results indicated that the initial result from N-05E was a false positive, the area surrounding the N-05E was excavated and an additional sample N-05H was collected on 9/25/19 in order to minimize uncertainty and project delays. Results of this sample are below the SRS maximum background concentration and meet this acceptance criteria. Note that the Ra-226 result of 3.03 pCi/g at location N-05E was considered suspect and the sample was re-run in the laboratory. Although the re-run sample result was 0.575 pCi/g and was J-qualified (an estimated value) which met the acceptance criteria, the area had already been re-excavated and new sample N-05H was collected from this location. Therefore, the N-05E sample was not used in this evaluation (see Attachment 1b).

Figure 2 shows the final confirmation sampling locations at WADB, including details of the re-excavation and resampling efforts in grid N-05. A total of 12 confirmation sample results were used in this evaluation. The table below summarizes the confirmation sampling events presented in order of sample collection date.

Collection Date	FSP Grid (WADB-xx)	Comment
5/1/19	S-08*	*Not included in this evaluation
5/15/19	S-09*	*Not included in this evaluation
6/27/19	N-01, N-02, N-04	
7/25/19	N-06, N-07	
8/1/19	N-03, N-05*	*N-05 identified for re-excavation and resampling, not included in this evaluation (Cs-137)
8/20/19	N-05A, N-05B*	*N-05B identified for re-excavation and resampling, not included in this evaluation (Cs-137)
9/4/19	N-05C, N-05D, N-05E*, N-05F, N-05G	*N-05E identified for re-excavation and resampling, not included in this evaluation (Ra-226)
9/25/19	N-05H	

* S-08 and S-09: will be included in future evaluation upon completion of the south ash remediation area.
* N-05: Cs-137 result = 4.13 pCi/g, greater than SRS maximum of 3.3 pCi/g; not included in this report
* N-05B: Cs-137 result = 4.05 pCi/g, greater than SRS maximum of 3.3 pCi/g; not included in this evaluation
* N-05E: Ra-226 result = 3.03 pCi/g (suspect), greater than SRS maximum of 1.7 pCi/g; not included in this evaluation.

Attachment 1b presents the results for the confirmation samples that were not included in this evaluation, including samples from grids N-05, N-05B, N-05E, S-08 and S-09. The results from locations S-08 and S-09 will be used in a future report for the SARA.

Quality Assurance/Quality Control (QA/QC) samples were also collected and analyzed in accordance with the Confirmation SAP (SRNS 2014) and the FSP (SRNS 2018a). These samples (e.g., field duplicates [FD], split samples [SPL], laboratory duplicates [LD], etc.) are used to assess the precision, variability and comparability of the data. The QA/QC sample results are provided in Attachment 1c. A *Data Usability Report* (DUR) *for Confirmation Sampling at the Wetland Area at Dunbarton Bay* is provided as Attachment 2. The DUR presents the data verification, validation and usability assessment results for confirmation sampling for the project.

Table 2 is a comparison of the confirmation sampling maximum detected concentrations to the RGs. If the maximum detected concentration is less than the RG, then formal statistical hypothesis testing is not necessary since the RG is based on the mean concentration (i.e., the mean will also be less than the RG). In the final dataset, cesium-137(+D) is the only constituent that has a maximum detected concentration (1.94 pCi/g) that is greater than the RG (0.68 pCi/g).

Formal statistical hypothesis testing using the ProUCL software is required for Cs-137 only; the ProUCL input/output for this portion of the evaluation is provided in Attachment 3. The WSR test was used for the Cs-137 evaluation because 6 of the 12 samples used in the evaluation were nondetect. Cesium-137(+D) had the following output result indicating cleanup levels have been met (i.e., passing result):

Do not reject $H_{0;}$ Conclude site mean $\leq$ RG (0.68 pCi/g)

All of the RCOCs have an RG based on the SRS background 95th percentile concentration. A comparison of the maximum detected concentration to the SRS background maximum concentration is presented in Table 2. Following excavation, the maximum detected concentration of all five RCOCs is less than the SRS maximum background value and therefore meet the acceptance criteria.

4.0 CONCLUSION

Confirmation sample results from 12 locations were evaluated to demonstrate that the ash has been successfully removed from the WADB NARA and that the remaining soils are below RGs. The residual concentrations of all analytes met the RGs established in the ROD (SRNS 2018b) based on the acceptance criteria outlined in the Confirmation SAP (SRNS 2014) for unrestricted land use. This evaluation applies to the samples collected from the northern ash zone remediation area only. The remaining excavation in the south ash remediation zone and evaluation of the confirmation sampling results from that area will be performed at a later date.

This page intentionally left blank.

5.0 REFERENCES

SRNS, 2013. *Focused Corrective Measures Study/Feasibility Study Report (CMS/FS) for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U),* Revision 1.1, SRNS-RP-2012-00252, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014. *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site (U),* Revision 1.1, SRNS-RP-2013-00332, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC

SRNS, 2018a. *Field Sampling Pan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U),* Revision 1, SRNS-RP-2018-00480, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2018b. *Record of Decision Remedial Alternative Selection for the Wetland Area at Dunbarton Bay in Support of Steel Creek Operable Unit (U),* Revision 1, SRNS-RP-2013-00730, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC

SRNS, 2018c. *Corrective Measures Implementation/Remedial Action Implementation Plan for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit (U),* Revision 1, SRNS-RP-2018-00481, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC

USEPA, 2015. *Statistical Software ProUCL 5.1 for Environmental Applications for Data Sets With and Without Nondetect Observations,* United States Environmental Protection Agency

WSRC, 2006. *Background Soils Statistical Summary Report for Savannah River Site*, Revision 1, ERD-EN-2005-0223, Washington Savannah River Company, Savannah River Site, Aiken SC

This page intentionally left blank.

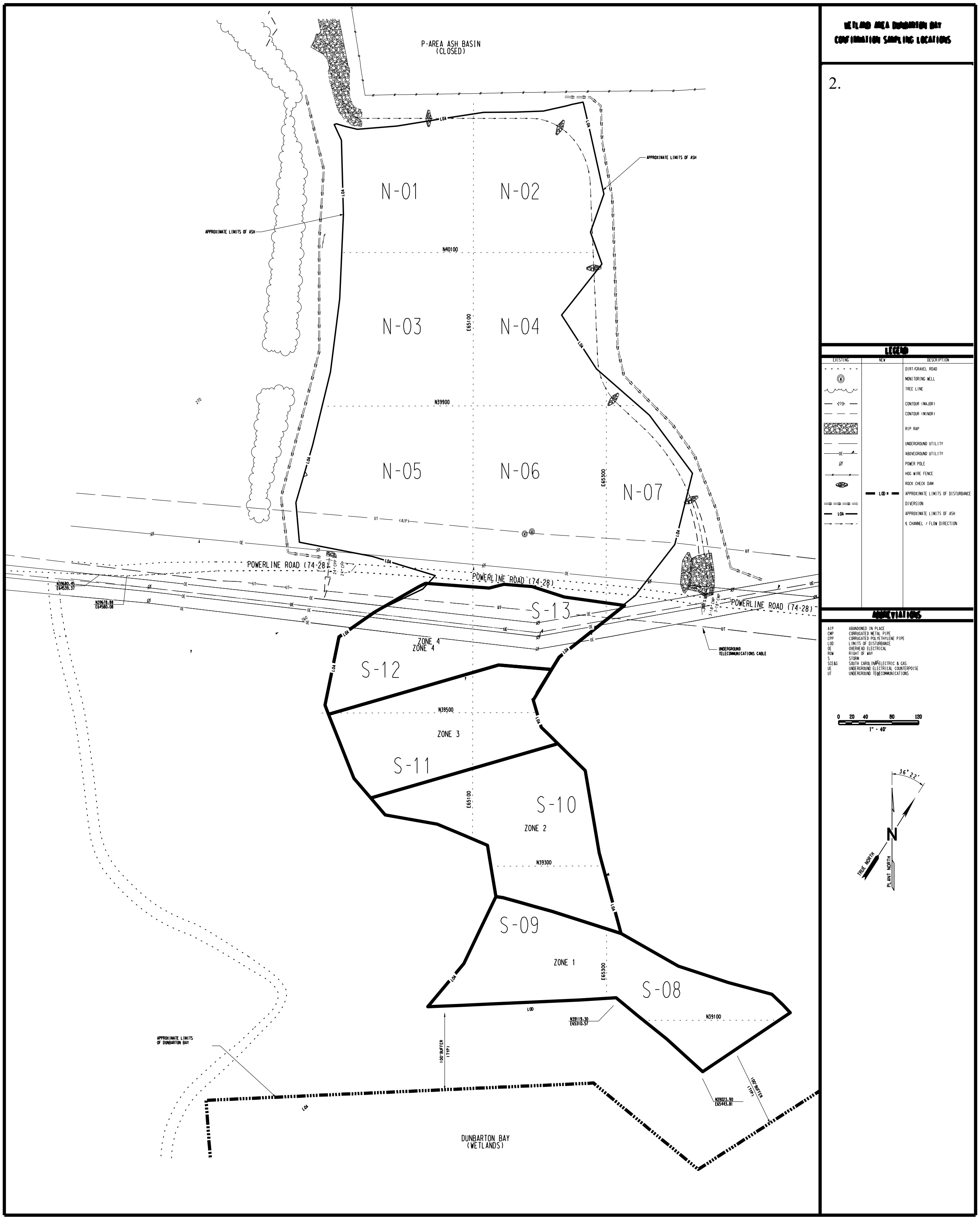


Figure 1. WADB Sampling Grid Locations

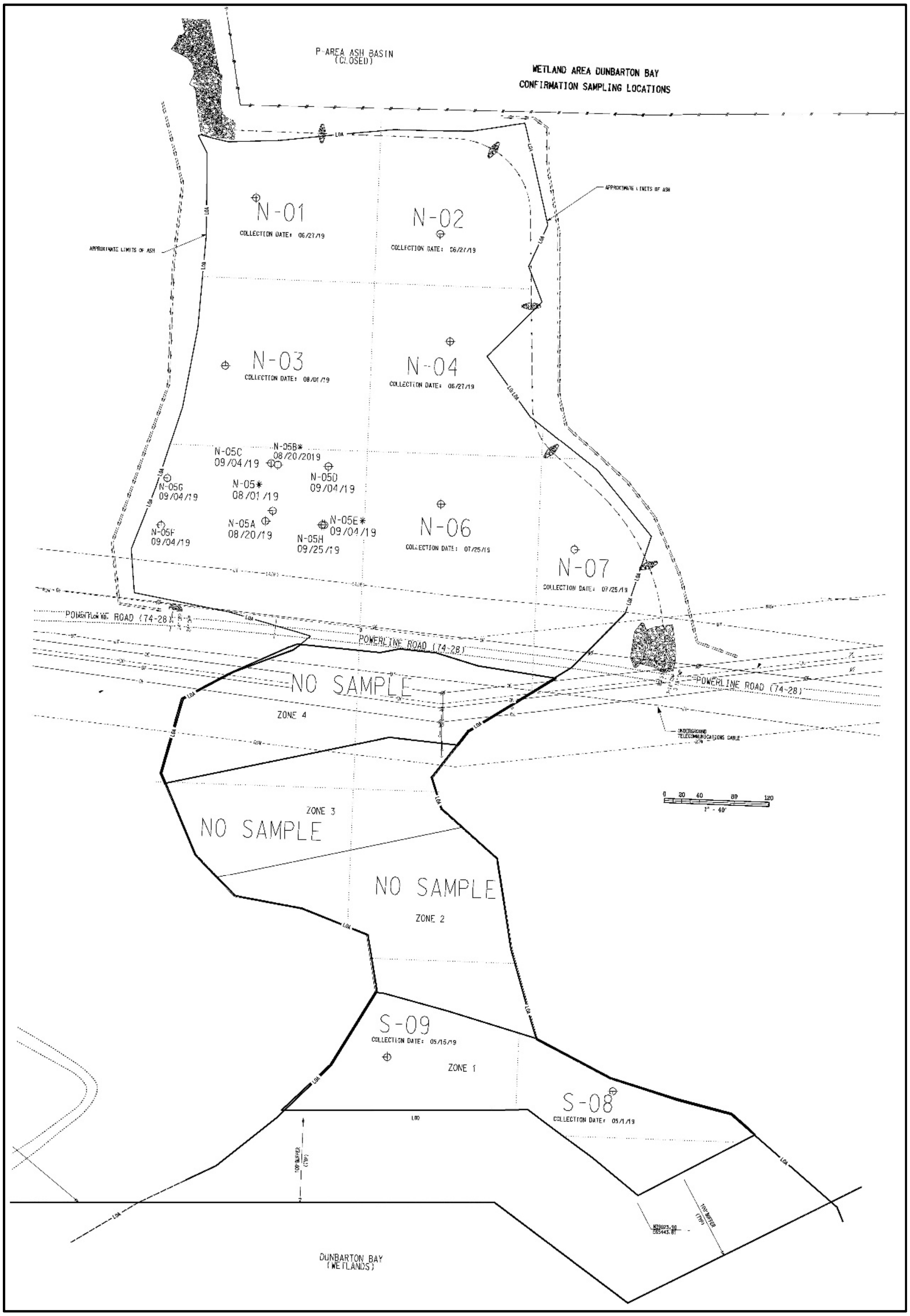


Figure 2. Confirmation Sampling Locations

Table 1. Summary of the Remedial Goals for the Wetland Area at Dunbarton Bay

RCOC[1]	Units	Future Resident[2]	SRS Bkgd 95th %tile[3]	SRS Bkgd Maximum[3]	Selected RG[4]
Arsenic	mg/kg	0.39	*8.2*	22.9	**8.2**
Cesium-137(+D)	pCi/g	0.0623	0.34 *(0.68)*[5]	3.3	**0.68**
Potassium-40	pCi/g	0.150	*3.3*	8.5	**3.3**
Radium-226(+D)	pCi/g	0.0127	*1.2*	1.7	**1.2**
Uranium-238(+D)	pCi/g	0.725	*1.2*	1.9	**1.2**

1 – RCOCs identified in the risk assessment portion of the WADB Focused CMS/FS (SRNS 2013).
2 – Future resident concentration set at 1E-06 risk level (SRNS 2013).
3 – SRS soil background concentration from SRS Background Soils Statistical Summary Report (WSRC 2006).
4 – Selected RG from WADB ROD (SRNS 2018b).
5 – RG for Cs-137 established at 2X SRS 95th %tile concentration (SRNS 2018b).

Table 2. Maximum Detected Concentrations Compared to Remedial Goals and SRS Background Maximum Concentrations

RCOC	Units	Maximum Detect	RG	Max Det > RG?	SRS Bkgd Max	Max Det > SRS Bkgd Max?
Arsenic	mg/kg	5.07	8.2	No	22.9	No
Cesium-137(+D)	pCi/g	1.94	0.68	**YES**	3.3	No
Potassium-40	pCi/g	1.59	3.3	No	8.5	No
Radium-226(+D)	pCi/g	0.68	1.2	No	1.7	No
Uranium-238(+D)	pCi/g	0.78	1.2	No	1.9	No

This page intentionally left blank.

ATTACHMENT 1

CONFIRMATION SAMPLE RESULTS

Attachment 1a. **Final Confirmation Sample Results**

Attachment 1b. **Confirmation Sample Results Not Used In Evaluation**

Attachment 1c. **Quality Assurance/Quality Control Sample Results**

This page intentionally left blank.

ATTACHMENT 1a

Final Confirmation Sample Results

This page intentionally left blank.

Attachment 1a
FINAL CONFIRMATION SAMPLE RESULTS

Station Name	Collection Date	Analyte Name	Review Qualifier	Result *(mg/kg or pCi/g)*
WADB N-07	7/25/2019	Arsenic		5.07
WADB N-05 H	9/25/2019	Arsenic		3.92
WADB N-05 F	9/4/2019	Arsenic		3.31
WADB N-06	7/25/2019	Arsenic	J	2.79
WADB N-05 G	9/4/2019	Arsenic	J	2.42
WADB N-04	6/27/2019	Arsenic	J	1.85
WADB N-01	6/27/2019	Arsenic	J	1.79
WADB N-03	8/1/2019	Arsenic	J	1.77
WADB N-02	6/27/2019	Arsenic	J	1.69
WADB N-05 C	9/4/2019	Arsenic	J	1.34
WADB N-05 D	9/4/2019	Arsenic	J	1.16
WADB N-05 A	8/20/2019	Arsenic	J	0.871
WADB N-05 C	9/4/2019	Cesium-137		1.94
WADB N-05 A	8/20/2019	Cesium-137		0.879
WADB N-05 D	9/4/2019	Cesium-137		0.417
WADB N-03	8/1/2019	Cesium-137		0.375
WADB N-01	6/27/2019	Cesium-137		0.0787
WADB N-05 H	9/25/2019	Cesium-137	J	0.0586
WADB N-05 F	9/4/2019	Cesium-137	U	0.0503
WADB N-07	7/25/2019	Cesium-137	U	0.0412
WADB N-06	7/25/2019	Cesium-137	U	0.0228
WADB N-02	6/27/2019	Cesium-137	U	0.0224
WADB N-05 G	9/4/2019	Cesium-137	U	0.0128
WADB N-04	6/27/2019	Cesium-137	U	-0.0166
WADB N-01	6/27/2019	Potassium-40		1.59
WADB N-07	7/25/2019	Potassium-40	J	1.41
WADB N-04	6/27/2019	Potassium-40	J	1.33
WADB N-05 F	9/4/19	Potassium-40	J	1.31
WADB N-06	7/25/2019	Potassium-40	J	1.32
WADB N-05 C	9/4/2019	Potassium-40	J	1.14
WADB N-03	8/1/2019	Potassium-40	J	1.11
WADB N-05 G	9/4/2019	Potassium-40	J	1.07
WADB N-05 A	8/20/2019	Potassium-40	J	0.863
WADB N-02	6/27/2019	Potassium-40	U	0.544
WADB N-05 D	9/4/2019	Potassium-40	U	0.204
WADB N-05 H	9/25/2019	Potassium-40	U	0.19
WADB N-05 F	9/4/2019	Radium-226	J	0.683
WADB N-07	7/25/2019	Radium-226	J	0.676
WADB N-02	6/27/2019	Radium-226	J	0.636
WADB N-05 G	9/4/2019	Radium-226	U	0.605
WADB N-04	6/27/2019	Radium-226	J	0.604
WADB N-05 A	8/20/2019	Radium-226	J	0.581
WADB N-03	8/1/2019	Radium-226	J	0.538
WADB N-05 C	9/4/2019	Radium-226	J	0.517

Attachment 1a
FINAL CONFIRMATION SAMPLE RESULTS

Station Name	Collection Date	Analyte Name	Review Qualifier	Result *(mg/kg or pCi/g)*
WADB N-01	6/27/2019	Radium-226	J	0.511
WADB N-06	7/25/2019	Radium-226	J	0.475
WADB N-05 D	9/4/2019	Radium-226	U	0.414
WADB N-05 H	9/25/2019	Radium-226	U	0.29
WADB N-05 G	9/4/2019	Uranium-238		0.783
WADB N-03	8/1/2019	Uranium-238	J	0.753
WADB N-05 A	8/20/2019	Uranium-238	J	0.719
WADB N-05 F	9/4/2019	Uranium-238	J	0.625
WADB N-05 D	9/4/2019	Uranium-238		0.554
WADB N-07	7/25/2019	Uranium-238	J	0.516
WADB N-05 H	9/25/2019	Uranium-238	U	0.455
WADB N-05 C	9/4/2019	Uranium-238	J	0.449
WADB N-06	7/25/2019	Uranium-238	U	0.396
WADB N-02	6/27/2019	Uranium-238	U	0.0963
WADB N-04	6/27/2019	Uranium-238	U	0.087
WADB N-01	6/27/2019	Uranium-238	U	0.0657

ATTACHMENT 1b

Confirmation Sample Results Not Used In This Evaluation

This page intentionally left blank.

Attachment 1b
CONFIRMATION SAMPLE RESULTS NOT USED IN EVALUATION

Station Name	Collection Date	Analyte Name	Review Qualifier	Result *(mg/kg or pCi/g)*
WADB N-05	8/1/2019	Arsenic	J	1.81
WADB N-05	8/1/2019	Cesium-137	J	4.13
WADB N-05	8/1/2019	Potassium-40	J	1.56
WADB N-05	8/1/2019	Radium-226	J	1.56
WADB N-05	8/1/2019	Uranium-238		1.12
WADB N-05 B	8/20/2019	Arsenic	J	2.78
WADB N-05 B	8/20/2019	Cesium-137		4.05
WADB N-05 B	8/20/2019	Potassium-40	J	1.1
WADB N-05 B	8/20/2019	Radium-226	J	0.7
WADB N-05 B	8/20/2019	Uranium-238	J	0.842
WADB N-05 E	9/4/2019	Arsenic		3.54
WADB N-05 E	9/4/2019	Cesium-137		0.513
WADB N-05 E	9/4/2019	Potassium-40	U	0.334
WADB N-05 E	9/4/2019	Radium-226 (suspect)		3.03
WADB N-05 E	9/4/2019	Radium-226 (rerun)	J	0.575
WADB N-05 E	9/4/2019	Uranium-238	J	0.373
WADB S-08	5/1/2019	Arsenic	J	0.562
WADB S-08	5/1/2019	Cesium-137		0.267
WADB S-08	5/1/2019	Potassium-40		1.06
WADB S-08	5/1/2019	Radium-226	J	1.29
WADB S-08	5/1/2019	Uranium-238	U	0.259
WADB S-09	5/15/2019	Arsenic	J	1.82
WADB S-09	5/15/2019	Cesium-137	U	-0.0348
WADB S-09	5/15/2019	Potassium-40	J	1.64
WADB S-09	5/15/2019	Radium-226	J	0.945
WADB S-09	5/15/2019	Uranium-238	U	0.561

This page intentionally left blank.

ATTACHMENT 1c

Quality Assurance / Quality Control Sample Results

This page intentionally left blank.

Attachment 1c
QUALITY ASSURANCE/QUALITY CONTROL SAMPLE RESULTS

Station Name	Collection Date	Analyte Name	Review Qualifier	Result *(mg/kg or pCi/g)*	Lab	Field QC	Lab QC
WADB N-01	6/27/2019	Cesium-137	J	0.0858	GELFY19	REG	LD
WADB N-01	6/27/2019	Cesium-137	U	0.0744	GELFY19	REG	LD
WADB N-01	6/27/2019	Potassium-40		1.37	GELFY19	REG	LD
WADB N-01	6/27/2019	Radium-226	J	0.716	GELFY19	REG	LD
WADB N-01	6/27/2019	Uranium-238	J	0.261	GELFY19	REG	LD
WADB N-03	8/1/2019	Cesium-137		0.314	GELFY19	REG	LD
WADB N-03	8/1/2019	Radium-226	J	0.895	GELFY19	REG	LD
WADB N-03	8/1/2019	Uranium-238	U	0.321	GELFY19	REG	LD
WADB N-05	8/1/2019	Arsenic	J	1.64	GELFY19	FD	REG
WADB N-05	8/1/2019	Cesium-137	J	2.84	GELFY19	FD	REG
WADB N-05	8/1/2019	Potassium-40		1.53	GELFY19	FD	REG
WADB N-05	8/1/2019	Radium-226	J	0.846	GELFY19	FD	REG
WADB N-05	8/1/2019	Uranium-238	U	0.463	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Arsenic	J	1.52	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Cesium-137		1.04	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Cesium-137		0.947	GELFY19	REG	LD
WADB N-05 A	8/20/2019	Potassium-40	U	0.459	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Radium-226	J	0.732	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Radium-226	J	0.362	GELFY19	REG	LD
WADB N-05 A	8/20/2019	Uranium-238	J	0.722	GELFY19	FD	REG
WADB N-05 A	8/20/2019	Uranium-238	U	0.346	GELFY19	REG	LD
WADB N-05 C	9/4/2019	Cesium-137		1.89	GELFY19	REG	LD
WADB N-05 C	9/4/2019	Potassium-40	J	1.28	GELFY19	REG	LD
WADB N-05 C	9/4/2019	Radium-226	J	0.742	GELFY19	REG	LD
WADB N-05 C	9/4/2019	Uranium-238	J	0.533	GELFY19	REG	LD
WADB N-05 E	9/4/2019	Arsenic		4.73	GELFY19	FD	REG
WADB N-05 E	9/4/2019	Cesium-137		0.536	GELFY19	FD	REG
WADB N-05 E	9/4/2019	Potassium-40	U	0.223	GELFY19	FD	REG
WADB N-05 E	9/4/2019	Radium-226	J	0.408	GELFY19	FD	REG
WADB N-05 E	9/4/2019	Radium-226	J	0.462	GELFY19	REG	LD
WADB N-05 E	9/4/2019	Uranium-238	J	0.584	GELFY19	FD	REG
WADB N-05 H	9/25/2019	Cesium-137	U	0.0156	GELFY19	REG	LD
WADB N-05 H	9/25/2019	Radium-226	J	0.726	GELFY19	REG	LD
WADB N-05 H	9/25/2019	Uranium-238	U	0.448	GELFY19	REG	LD

Attachment 1c
QUALITY ASSURANCE/QUALITY CONTROL SAMPLE RESULTS

Station Name	Collection Date	Analyte Name	Review Qualifier	Result *(mg/kg or pCi/g)*	Lab	Field QC	Lab QC
WADB N-06	7/25/2019	Cesium-137	J	0.117	GELFY19	REG	LD
WADB N-06	7/25/2019	Potassium-40	J	1.69	GELFY19	REG	LD
WADB N-06	7/25/2019	Radium-226	J	0.46	GELFY19	REG	LD
WADB N-06	7/25/2019	Uranium-238	U	0.311	GELFY19	REG	LD
WADB S-08	5/1/2019	Cesium-137		0.27	GELFY19	REG	LD
WADB S-08	5/1/2019	Potassium-40	J	1.15	GELFY19	REG	LD
WADB S-08	5/1/2019	Radium-226	J	0.701	GELFY19	REG	LD
WADB S-08	5/1/2019	Uranium-238	J	0.419	GELFY19	REG	LD
WADB S-09	5/15/2019	Arsenic	J	1.8	TALFY19	SPL	REG
WADB S-09	5/15/2019	Cesium-137	U	0.0148	GELFY19	REG	LD
WADB S-09	5/15/2019	Cesium-137	U	0.009132	TALFY19	SPL	LD
WADB S-09	5/15/2019	Cesium-137	U	-0.0253	TALFY19	SPL	REG
WADB S-09	5/15/2019	Cobalt-60	J	0.05804	TALFY19	SPL	LD
WADB S-09	5/15/2019	Potassium-40	J	1.19	GELFY19	REG	LD
WADB S-09	5/15/2019	Potassium-40	J	1.012	TALFY19	SPL	LD
WADB S-09	5/15/2019	Potassium-40	U	0.53	TALFY19	SPL	REG
WADB S-09	5/15/2019	Radium-226	J	0.711	GELFY19	REG	LD
WADB S-09	5/15/2019	Radium-226		0.5292	TALFY19	SPL	LD
WADB S-09	5/15/2019	Radium-226		0.4	TALFY19	SPL	REG
WADB S-09	5/15/2019	Uranium-238	U	0.635	GELFY19	REG	LD
WADB S-09	5/15/2019	Uranium-238		0.512	TALFY19	SPL	LD
WADB S-09	5/15/2019	Uranium-238		0.572	TALFY19	SPL	REG

REG = regular sample
FD = field duplicate sample
SPL = split sample
LD = laboratory duplicate sample

ATTACHMENT 2

Data Usability Report
for
Confirmation Sampling at the Wetland Area at Dunbarton Bay

This page intentionally left blank.

1.0 PROJECT SUMMARY

This report presents analytical data verification and validation results for the Wetland Area at Dunbarton Bay confirmation sampling events. The sampling was conducted in accordance with the *Field Sampling Plan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U)* (SRNS 2018), following guidance from the *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site* (SAP) (SRNS 2014). The project generated 17 regular field samples, 3 field duplicate samples, and 1 split sample and 1 rinsate blank. The samples, along with the requested analytical analyses, are listed in Table 1.

Table 1. Sample Identification (ID) Summary

Station ID	Sample ID	Sample Type	Sample Date	Sample Time	Matrix	Interval *(ft)*	Analysis Requested
WADB N-01	WADB-00000003	REG	6/27/19	0735	SOIL	0-1	1, 2, 3, 4
WADB N-02	WADB-00000004	REG	6/27/19	0745	SOIL	0-1	1, 2, 3, 4
WADB N-03	WADB-00000005	REG	8/01/19	0802	SOIL	0-1	1, 2, 3, 4
WADB N-04	WADB-00000006	REG	6/27/19	0750	SOIL	0-1	1, 2, 3, 4
WADB N-05	WADB-00000007	FD	8/01/19	0810	SOIL	0-1	1, 2, 3, 4
WADB N-05	WADB-00000008	REG	8/01/19	0810	SOIL	0-1	1, 2, 3, 4
WADB N-06	WADB-00000009	REG	7/25/19	0802	SOIL	0-1	1, 2, 3, 4
WADB N-07	WADB-00000010	REG	7/25/19	0755	SOIL	0-1	1, 2, 3, 4
WADB S-08	WADB-00000011	REG	5/01/19	0840	SOIL	0-1	1, 2, 3, 4
WADB S-09	WADB-00000012	REG	5/15/19	1345	SOIL	0-1	1, 2, 3, 4
WADB S-09	WADB-00000013	SPL	5/15/19	1345	SOIL	0-1	1, 2, 3, 4
WADB S-10	WADB-00000014	REG	-	-	SOIL	-	Unused COC
WADB S-11	WADB-00000015	REG	-	-	SOIL	-	Unused COC
WADB S-12	WADB-00000016	REG	-	-	SOIL	-	Unused COC
WADB S-13	WADB-00000017	REG	-	-	SOIL	-	Unused COC
WADB N-01-RB	WADB-00000018	RB	5/01/19	0950	WATER	-	1, 2, 3, 4
WADB N-05 A	WADB-00000019	FD	8/20/19	0827	SOIL	0-1	1, 2, 3, 4
WADB N-05 A	WADB-00000020	REG	8/20/19	0827	SOIL	0-1	1, 2, 3, 4
WADB N-05 B	WADB-00000021	REG	8/20/19	0828	SOIL	0-1	1, 2, 3, 4
WADB N-05 C	WADB-00000022	REG	9/04/19	0840	SOIL	0-1	1, 2, 3, 4
WADB N-05 D	WADB-00000023	REG	9/04/19	0835	SOIL	0-1	1, 2, 3, 4
WADB N-05 E	WADB-00000024	FD	9/04/19	0825	SOIL	0-1	1, 2, 3, 4
WADB N-05 E	WADB-00000025	REG	9/04/19	0825	SOIL	0-1	1, 2, 3, 4
WADB N-05 F	WADB-00000026	REG	9/04/19	0845	SOIL	0-1	1, 2, 3, 4
WADB N-05 G	WADB-00000027	REG	9/04/19	0850	SOIL	0-1	1, 2, 3, 4
WADB N-05 H	WADB-00000028	REG	9/25/19	0920	SOIL	0-1	1, 2, 3, 4
WADB N-05 I	WADB-00000029	REG	-	-	SOIL	-	Unused COC
WADB N-05 J	WADB-00000030	REG	-	-	SOIL	-	Unused COC

Analyses Requested:

1. Arsenic, ICP-ES
2. Gamma Spectroscopy
3. Uranium-238, Alpha Spectroscopy
4. Radium-226, Lucas Cell

A total of 111 analytical records were produced consisting of 91 regular records and 20 Quality Control (QC) records. See Table 2.

Table 2. Total Number of Records

Number of Records	Chemical	Radiochemical	Totals
Analytical	17	74	91
Field QC	4	16	20
Totals	21	90	111

The verification process was conducted to review completeness of the sampling and analytical requirements. Validation has been performed to assess compliance with methods, procedures, and contracts, and to assess a comparison with measurement performance criteria in the ER-SOP-033, *Analytical Data Qualification* (SRNS 2015). A usability assessment will provide the data user with an assessment of whether the process execution and resulting data meet project quality objectives in the Quality Assurance Project Plan (QAPP) (SRNS 2012) and the *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site* (SAP) (SRNS 2014). These processes involve examination of the FSP (SRNS 2018) and SAP (SRNS 2014), electronic data files, the field data, analytical data, and laboratory records. Computer programs are used to verify that samples were properly preserved and were analyzed within the required holding time, that QC results were within specified acceptable ranges, and that the appropriate detection limits were employed by the laboratories. Additionally, manual reviews of field data and laboratory records are conducted to ensure the quality of these items. Validation summaries for holding time, preservation, calibration, analyte identification, and analyte quantitation can be found in subsections 3.1, *Holding Times*; 3.2, *Preservation*; and 3.3, *Calibration, Identification, and Quantitation*.

The data were validated to determine if the records conform to the technical criteria associated with definitive data per ER-SOP-033 (SRNS 2015b). Table 3 provides a brief validation summary for the project. Review qualifiers are assigned by a data validator internal to Savannah River Nuclear Solutions and external to the analytical laboratory. Environmental records include regular sample, split and field duplicate records.

Table 3. Environmental Record Review Qualifier Summary

	Detects		Non-detects		Rejected	
Method Code	**# NULL Qualifiers**	**# J Qualifiers**	**# U Qualifiers**	**# UJ Qualifiers**	**# R Qualifiers**	**Total**
A-01-RMOD	1	0	0	0	0	1
EPA6010C	0	1	0	0	0	1
EPA6010D	5	15	0	0	0	20
EPA903.0MOD	1	0	0	0	0	1
GA-01-RMOD	0	0	2	0	0	2
RADA-008	1	17	3	0	0	21
RADA-011	3	9	8	0	0	20
RADA-013	15	14	13	0	3	45
Total	**26**	**56**	**26**	**0**	**3**	**111**
% of Total	**23.4**	**50.5**	**23.4**	**0**	**2.7**	**100%**

2.0 ASSESSMENT OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS DATA QUALITY INDICATORS (DQIS) AND MEASUREMENT PERFORMANCE CRITERIA (MPCS)

This section discusses the analytical data in terms of the following indicators of data quality: precision, accuracy, representativeness, comparability, and completeness. Precision is determined from the field and laboratory duplicate analyses and indicates the consistency of field and laboratory techniques. Accuracy is determined from the laboratory control samples (LCS), matrix spikes (MS) and the results of the results of the method blanks, trip and rinsate blanks; it indicates the ability of the laboratory to generate correct results. Representativeness measures how well the data represents the sample population. Comparability expresses the confidence with which data from different laboratories are considered equivalent. Representative completeness measures the amount of data resulting from the data collection activity.

2.1 Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Field duplicates measure the repeatability of the sampling and analytical techniques, and laboratory duplicates measure the ability of the laboratory to reproduce a result. Low precision can be caused by poor instrument performance, poor operator technique, inconsistent application of method protocols, laboratory environment, time between analyses, or by a difficult, heterogeneous sample matrix. Precision is especially important when the action limit approaches the quantification limit. A total of 13.5 % of the samples were collected in duplicate for this project in accordance with the FSP. The laboratory performs duplicate analyses on at least 5% of the samples received.

Precision is expressed in terms of the relative percent differences (RPD) as follows:

$$RPD = \frac{|x - y|}{\left(\frac{x + y}{2}\right)} \times 100$$

where x is the original sample result and y is the duplicate sample result. When one result of a duplicate pair is below the MDL, the sample specific estimated quantification limit (ssEQL) is used for that result in the calculation. When both results are below the MDL, the RPD is not calculated.

The RPD should be less than 20% for water samples and less than 35% for solid samples when results are greater than the ssEQL. In the case where results are between the ssEQL and the MDL, the RPD should be less than 100% for water samples and less than 200% for soil samples. In the event analytical precision goals are not met, a determination of the usability of that information is made through the environmental data assessment process.

No records were rejected due to precision issues. Details for this project can be found in subsections 3.6*, Laboratory Duplicate RPD*; and 3.7, *Field Duplicate RPD*.

2.2 Accuracy

Accuracy is defined as the closeness of agreement between an observed value and an accepted reference value. Accuracy is especially important when the concentration of concern approaches the detection limit and/or the action limit. When the concentration is underestimated near the detection limit, the analyte may be present but reported as not detected. When the concentration is underestimated near the action limit, the analyte may be at a concentration that would require remediation, but the remediation would not be performed. When the concentration is overestimated near the detection limit, the analyte may not be present but reported as detected. When the concentration is overestimated near the action limit, the analyte may not be at a concentration that would require remediation, but the remediation would be performed. The sample types used to evaluate accuracy are performance evaluation studies LCSs, surrogate spikes, MSs, method blanks, trip blanks, and rinsate blanks.

LCSs monitor the performance of all steps in the analytical process, including sample preparation, and are used to identify problems with the analytical procedure. LCSs are deionized water that is spiked with the target analyte, digested, and analyzed with the regular samples. The LCS spiking solution is obtained from a third-party supplier, or is prepared in the laboratory using chemicals from a different source than the calibration standards.

The LCS percent recovery is calculated as follows:

$$\%\ \text{Recovery} = \frac{\text{Blank spike concentration}}{\text{Spike concentration}} \times 100$$

One hundred percent recovery is equivalent to 100% accuracy. Values less than 100% or greater than 100% may indicate a sample matrix effect and a false reading. A periodic program of sample spiking is required (e.g., one MS and one MS duplicate per 20 samples). In the event that analytical accuracy goals are not met, a determination is made through the environmental data assessment process relative to the usability of that information.

No environmental records were rejected because the matrix spike was outside of limits. Details for this project can be found in subsections 3.4, *Trip Blanks*; 3.5, *Method Blanks*; 3.8, *Matrix Spike Recovery*; 3.9, *LCS Recovery*; and 3.10, *Surrogate/Tracer Recovery*.

2.3 Representativeness

The representativeness of samples collected is controlled by adhering to the detailed descriptions of sampling procedures. Representativeness expresses the relative degree to which the data depict the characteristics of a population, parameter, sampling point, process condition, or environmental condition. The objective of this study is to accurately represent the concentrations of target analytes or compounds. Representative samples for this investigation will be required by implementing approved sampling and analytical procedures that will generate data representative of the sampling point location and will be maintained. Analytical methods are selected that will most accurately represent the true concentration of the parameter of interest. The accumulation of QC procedures and information (i.e., RPD values, blank QC concentrations, MS percent recoveries, etc.) employed for a given analysis combine to exhibit the representativeness of the data generated.

The goal for representative sample data will therefore be met by properly documenting field and analytical protocols. In the event these procedures and methods are not able to be implemented, the appropriate corrective action documentation should encompass the impact on the representativeness of the information. When review of the data and documentation determines the data to be non-representative, the information is qualified in its use or is not used by the project.

All samples were collected and analyzed per established procedures.

2.4 Comparability

Comparability is the degree to which different methods, data sets, and decisions agree or can be represented as similar. The comparability of the data from the laboratories is based on the results of the split samples and on confirmation that the laboratories used the same standardized procedures for sample analysis, the same reporting unit, and obtained similar quantitation limits. Comparability of the data produced for this investigation may be obtained by implementing the identified protocols for sampling and analysis of samples. Implementation of traceable reference materials such as laboratory standards, expression of results in standard concentration units, and successful participation by the laboratories in external performance evaluation programs will enable the information produced through this investigation to be compared with future data sets, if required. For this project, 1 split sample was collected and sent to the designated QC laboratory.

2.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal circumstances. The Quality Assurance (QA) completeness objective for RFI/RI projects is to obtain valid field and laboratory analytical results for at least 90% of the samples collected during the project. This implies that completeness of sample collection (i.e., the number of samples collected compared to the number of samples planned) must be virtually 100% to allow for some loss of data during the laboratory analytical process. Accountability of samples collected, from field to final disposal, must be 100%.

Completeness is a measure of the amount of data obtained from a measurement process that achieves the project goals as compared to the amount of data planned to be obtained by the project. Completeness is affected by unexpected conditions during the data collection process that reduce the usable data achieved relative to the data planned.

When review of the data and documentation determines the data to be incomplete, the impact relative to the project objective will be assessed and documented.

The following are measures of completeness:

Sample Collection:

$$\text{Completeness} = \frac{\text{Number of Sample Points Sampled}}{\text{Number of Sample Points Planned*}} \times 100$$

Field Measurement:

$$\text{Completeness} = \frac{\text{Number of Valid Measurements Made}}{\text{Number of Measurements Planned}} \times 100$$

Laboratory Analysis:

$$\text{Completeness} = \frac{\text{Number of Valid Data Points}}{\text{Number of Data Points Planned}} \times 100$$

*Planned sample points were inflated based on uncertainty in sample projections – see below

The completeness numbers for this project are listed below:

Sample Collection Completeness	79%
Field Measurement Completeness	100%
Laboratory Analysis Completeness	100%

Sample collection completeness is skewed based on a change to project objectives. Originally scheduled for a total of 13 regular samples in 13 different areas, the project direction was altered and downsized to include only nine of the original 13 areas at this time. Of those nine areas, one was sampled on three separate occasions based on failed site soil validation data. Additional chains of custody were ordered, but not all were necessary (5 of 7 total) to validate the area meeting remedial goal values. In addition, the four COCs from the four suspended areas were not used during this period.

3.0 VALIDATION FINDINGS

3.1 Holding Times

Holding times for the reported analyses were within the recommended limits, as shown in Table 4. No qualification was required.

Table 4. Holding Time (HT) Review Qualifier Summary

Method Code	Total # of Records	# of Records Qualified for HT	Associated Samples Qualified
A-01-RMOD	1	0	none
EPA6010C/D	21	0	none
EPA903.0MOD	1	0	none
GA-01-RMOD	2	0	none
RADA-008	21	0	none
RADA-011	20	0	none
RADA-013	45	0	none

3.2 Preservation

All chemical and physical preservation for the reported analyses were properly applied. No qualification was required.

Table 5. Preservation Review Qualifier Summary

Method Code	Total # of Records	# of Records Qualified for Preservation	Associated Samples Qualified
A-01-RMOD	1	0	none
EPA6010C/D	21	0	none
EPA903.0MOD	1	0	none
GA-01-RMOD	2	0	none
RADA-008	21	0	none
RADA-011	20	0	none
RADA-013	45	0	none

3.3 Calibration, Identification, and Quantitation

One cesium-137 record was qualified as rejected due to isotope identification criteria not being met, R/1. Two potassium-40 records were qualified as rejected due to isotope identification criteria not being met, R/1. These samples were re-analyzed in the laboratory and yielded acceptable results (i.e., not rejected) for use in this evaluation.

Table 6. Calibration (CAL), Identification (ID), and Quantitation Review Summary

Method Code	Total # of Records	# of Records Qualified for CAL, ID and Quantitation	Associated Samples Qualified
A-01-RMOD	1	0	none
EPA6010C/D	21	0	none
EPA903.0MOD	1	0	none
GA-01-RMOD	2	0	None
RADA-008	21	0	none
RADA-011	20	0	none
RADA-013	45	3	WADB-00000003, WADB-0000020, WADB-00000026

3.4 Trip Blanks and Rinsate Blanks

No trip blanks were taken.

Table 7A. Trip Blank (TB) Review Qualifier Summary

Method Code	Total # of TB Records	# of TB Records Qualified	Associated Samples Qualified

Table 7B. Rinsate Blank (RB) Review Qualifier Summary

Method Code	Total # of RB Records	# of RB Records Qualified	Associated Samples Qualified
EPA6010D	1	0	none
RADA-008	1	0	none
RADA-011	1	0	none
RADA-013	2	0	none

3.5 Method Blanks

<u>EPA6010C, ICP-ES Metals</u>

One arsenic record was qualified as estimated due to the detection of the analyte in the method blank, J/V.

<u>RADA-011, Uranium Series</u>

Two uranium-238 records were qualified as non-detect due to the detection of the analyte in the method blank, U/V.

Table 8. Method Blank (MB) Review Qualifier Summary

Method Code	Total # of MB Records	# of MB Records Qualified	Associated Samples Qualified
A-01-RMOD	1	0	none
EPA6010C/D	10	1	WADB-00000013
GA-01-RMOD	4	0	None
RADA-008	10	0	none
RADA-011	9	2	WADB-00000007, WADB-00000028
RADA-013	20	0	none

3.6 Laboratory Duplicate RPD

Lab duplicate RPD for the reported analyses were within the recommended limits, as shown in Table 9. No qualification was required.

Table 9. Laboratory Duplicate Qualifier Summary

Method Code	Total # of Duplicate Records	# of Duplicate Records Qualified	Associated Samples Qualified
A-01-RMOD	1	0	none
GA-01-RMOD	2	0	none
RADA-008	9	0	none
RADA-011	8	0	none
RADA-013	20	0	none

3.7 Field Duplicate RPD

RADA-013, Gamma Spectroscopy

Two cesium-137 records were qualified as estimated due to the field duplicate RPD was not within control limits, J/9.

Table 10. Field Duplicate Qualifier Summary

Method Code	Total # of Duplicate Records	# of Field Duplicate Records Qualified	Associated Samples Qualified
EPA6010D	4	0	none
RADA-008	4	0	none
RADA-011	4	0	none
RADA-013	8	2	WADB-00000007, WADB-00000008

3.8 Matrix Spike Recovery

Matrix spike recovery criteria for the reported analyses were within the recommended limits, as shown in Table 11. No qualification was required.

Table 11. Matrix Spike (MS) Recovery Qualifier Summary

Method Code	Total # of MS/MSD Records	# of MS/MSD Records Qualified	Associated Samples Qualified
EPA6010C/D	18	0	none
RADA-008	9	0	none

Laboratory control sample criteria for the reported analyses were within the recommended limits, as shown in Table 12. No qualification was required.

3.9 LCS Recovery

Table 12. LCS Qualifier Summary

Method Code	Total # of LCS Records	# of LCS Records Qualified	Associated Samples Qualified
A-01-RMOD	1	0	none
GA-01-RMOD	3	0	none
EPA6010C/D	11	0	none
EPA903.0MOD	1	0	none
RADA-008	9	0	none
RADA-011	10	0	none
RADA-013	12	0	none

3.10 Surrogate/Tracer Recovery

All Surrogate/Tracer recovery criteria for the reported analyses were within the recommended limits. No qualification was required.

Table 13. Surrogate/Tracer Recovery Qualifier Summary

Method Code	Total # of Surr/Tracer Records	# of Surr Records Qualified	Associated Samples Qualified
A-01-RMOD	2	0	none
RADA-011	29	0	none

3.11 Split Samples Comparability

Table 14 Split Samples

Station ID	Sample ID	Interval *(ft.)*	Date/Time	Sample Type	Matrix	Lab
WADB S-09	WADB-00000012	0-1	05/15/19 1345	REG	SOIL	GEL
WADB S-09	WADB-00000013	0-1	05/15/19 1345	SPL	SOIL	TAL

Split soil samples were taken from one location (WADB S-09) and were analyzed by similar methods at different laboratories (General Engineering Labs (GEL), and Test America Labs (TAL).

GEL	TAL
EPA6010D	EPA6010C
RADA-008	EPA903.0MOD
RADA-011	A-01-RMOD
RADA-013	GA-01-RMOD

Radium-226 was detected at 0.945 pCi/g at the General Engineering Lab and 0.4 pCi/g at the Test America Lab, however the GEL result was estimated because the result was above detection but less than the Sample Quantitation Limit and was qualified, J/21.

4.0 DATA USABILITY

The analytical data from this project are considered usable for purposes outlined in the *Field Sampling Plan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U)* (SRNS 2018) and the *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site* (SAP) (SRNS 2014). Qualification details are found in section 3.0, *Validation Findings*.

5.0 REFERENCES

SRNS, 2012. *Area Completion Projects Quality Assurance Project Plan for Environmental; Data Collection and Management*, ERD-AG-2005-00001, Revision 5, Savannah River Nuclear Solutions, Savannah River Site, Aiken SC

SRNS 2014. *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site (U)*, SRNS-RP-2013-00332, Rev. 1.1, July 2014, Savannah River Site, Aiken SC

SRNS 2015. *Analytical Data Qualification*, ER-SOP-033, Revision 6, Environmental Compliance and Area Completion Projects (EC&ACP) Geochemical Monitoring Procedures Manual C-3, Volume 10, Savannah River Nuclear Solutions, Savannah River Site, Aiken SC

SRNS 2018. *Field Sampling Plan for the Wetland Area at Dunbarton Bay of the Steel Creek Integrator Operable Unit (U)* SRNS-RP-2018-00480, Rev. 1, November 2018, Savannah River Site, Aiken SC

This page intentionally left blank.

ATTACHMENT 3

USEPA ProUCL Software Input/Output

This page intentionally left blank.

Station Name	Collection Date	Analyte Name	MDL	PQL	Review Qualifier	Result *(pCi/g)*
WADB N-05	9/4/2019	Cesium-137	0.05012	0.359		1.94
WADB N-05 A	8/20/2019	Cesium-137	0.0501	0.268		0.879
WADB N-05 D	9/4/2019	Cesium-137	0.0503	0.204		0.417
WADB N-03	8/1/2019	Cesium-137	0.0765	0.254		0.375
WADB N-01	6/27/2019	Cesium-137	0.0267	0.075		0.0787
WADB N-05 H	9/25/2019	Cesium-137	0.0566	0.149	J	0.0586
WADB N-05 F	9/4/2019	Cesium-137	0.116	0.22	U	0.0503
WADB N-07	7/25/2019	Cesium-137	0.0694	0.186	U	0.0412
WADB N-06	7/25/2019	Cesium-137	0.0848	0.171	U	0.0228
WADB N-02	6/27/2019	Cesium-137	0.0691	0.133	U	0.0224
WADB N-05 G	9/4/2019	Cesium-137	0.0719	0.142	U	0.0128
WADB N-04	6/27/2019	Cesium-137	0.0627	0.135	U	-0.0166

Pro UCL Input

Cs137	d_Cs137
1.94	1
0.879	1
0.417	1
0.375	1
0.0787	1
0.0586	1
0.116	0
0.0694	0
0.0848	0
0.0691	0
0.0719	0
0.0627	0

One Sample Wilcoxon Signed Rank Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/4/2019 1:59:24 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Action Level	**0.68**
Selected Null Hypothesis	Mean/Median less than (<) = Action Level (Form 1)
Alternative Hypothesis	Mean/Median > the Action Level

Cs137

One Sample Wilcoxon Signed Rank Test

Raw Statistics	
Number of Valid Data	12
Number of Distinct Data	12
Number of Non-Detects	6
Number of Detects	6
Percent Non-Detects	50.00%
Minimum Non-detect	0.0627
Maximum Non-detect	0.116
Minimum Detect	0.0586
Maximum Detect	1.94
Mean of Detects	0.625
Median of Detects	0.396
SD of Detects	0.71
Median of Processed Data used in WSR	0.0583
Number Above Action Level	2
Number Equal Action Level	0
Number Below Action Level	10
T-plus	13
T-minus	65

H0: Sample Median <= 0.68 (Form 1)

Exact Test Statistic	13
Critical Value (0.05)	61
P-Value	0.979

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Mean/Median <= 0.68
P-Value > Alpha (0.05)

Dataset contains multiple Non-Detect values!
All NDs are replaced by their respective DL/2

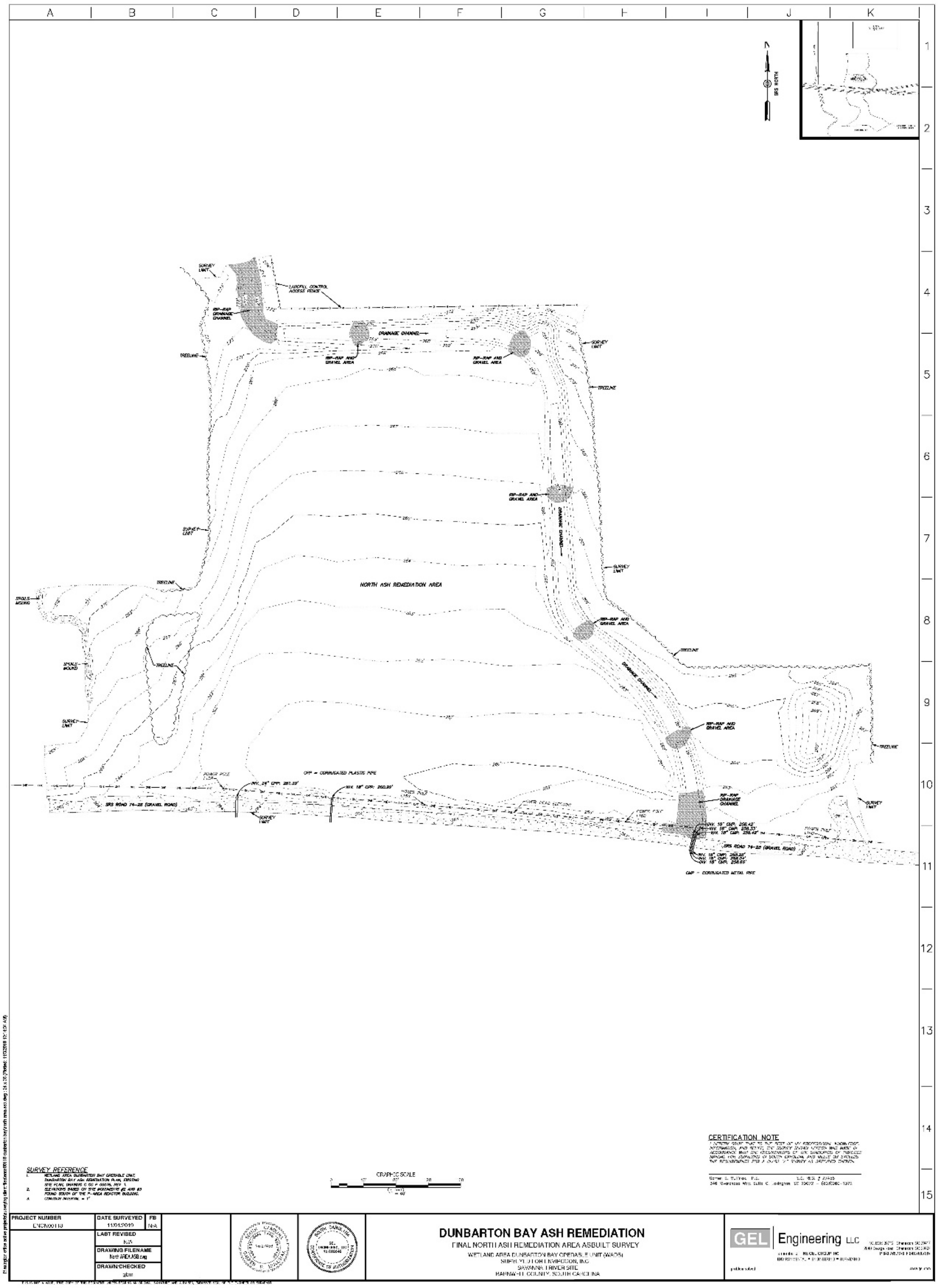
APPENDIX B

As-Builts

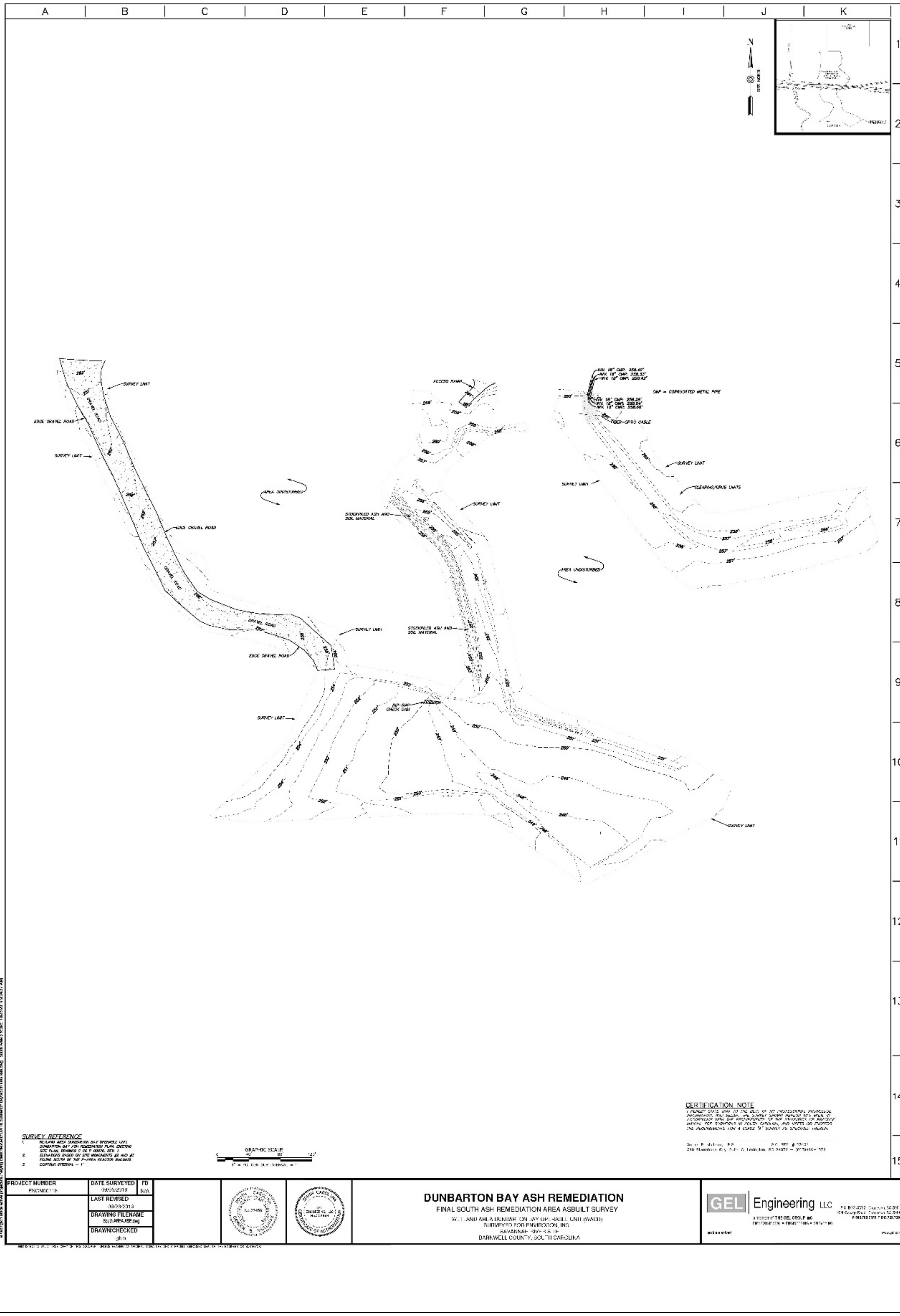
North Ash Remediation Area (NARA)
and
South Ash Remediation Area (SARA) Zone 1

This page was intentionally left blank.

NARA


NORTH ASH REMEDIATION AREA
SURVEY REFERENCE
GRAPHIC SCALE
CERTIFICATION NOTE
PROJECT NUMBER
DATE SURVEYED
11/01/2019
FB
N/A
LAST REVISED
N/A
DRAWING FILENAME
North AREA ASB.dwg
DRAWN/CHECKED
DUNBARTON BAY ASH REMEDIATION
FINAL NORTH ASH REMEDIATION AREA ASBUILT SURVEY
WETLAND AREA DUNBARTON BAY OPERABLE UNIT (WADB)
SAVANNAH RIVER SITE
BARNWELL COUNTY, SOUTH CAROLINA
GEL Engineering LLC

SARA (Zone 1)

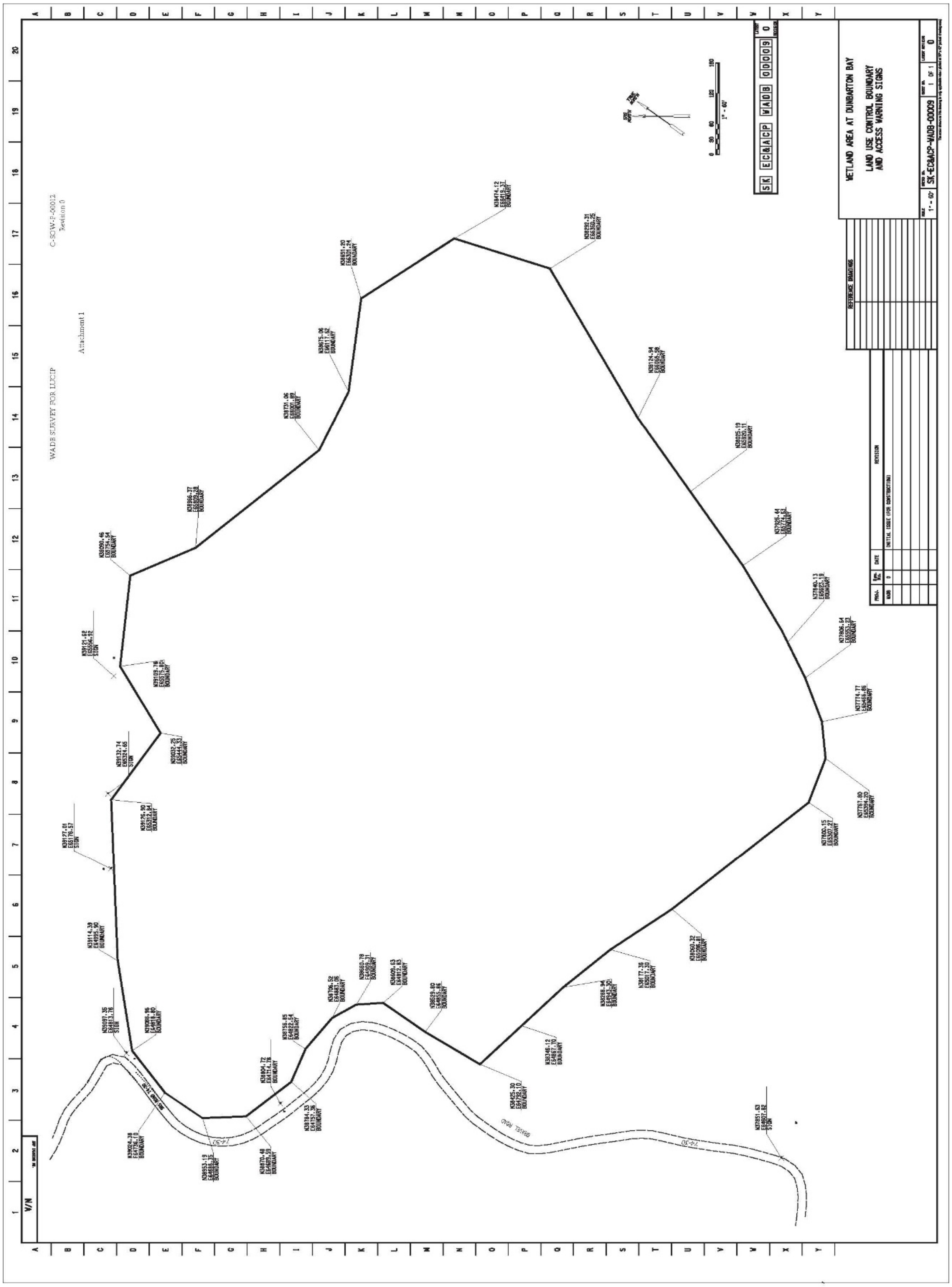

SURVEY REFERENCE
CERTIFICATION NOTE
GRAPHIC SCALE
PROJECT NUMBER
DATE SURVEYED
LAST REVISED
DRAWING FILENAME
DRAWN/CHECKED
DUNBARTON BAY ASH REMEDIATION
FINAL SOUTH ASH REMEDIATION AREA ASBUILT SURVEY
SAVANNAH RIVER SITE
BARNWELL COUNTY, SOUTH CAROLINA
GEL Engineering LLC

APPENDIX C

Survey Platt of Area Subject to Land Use Controls

This page was intentionally left blank.

Survey Platt (Placeholder).
Due to COVID 19 the surveyor has not been able to access the site.



This page was intentionally left blank.

APPENDIX D

Groundwater Monitoring Well Abandonment Records PAS001C and PAS001D

This page was intentionally left blank.

OSR 30-29 (Rev 2-9-2004)

Well Abandonment Report

Project Name: EC&ACP Well Abandonment	Project Manager: Seth Miller	Well Number: PAS001C
		Location Description: P Area
Driller Name/Company/Certification No.: Joshua Justice / Cascade Drilling / D2259		Oversight Name/Company: Bill Joyce / SRNS
Date Well Abandoned: 1/7/2019	Reason for Abandonment: No longer required for monitoring groundwater	
Total Abandoned Footage: 108.25 ft	Geophysical Logs (If applicable, list.): N / A	

Abandonment Method

☒ Pumping/Pouring Grout ☐ Pressure Grout ☐ Perforate Casing/Grout ☐ Over Ream ☐ Drill Out

Other Method (Describe)

Coated Bentonite Pellets (3/8", 5 gallon bucket) used through the screen zone (see below).

Grout is Portland Cement, Type I 46.2 lbs/bag with bentonite.

	Date	Grout Type	Quantity (bags, yds, etc.)	Weight (if applicable)
Grout	1/7/2019	Bentonite Pellets (3/8")	1/2 of a 5 gallon bucket	N / A
	1/7/2019	Bentonite Portland Cement	20 gallons	14.0 - 15.0 ppg

Comments

Final Water Level: 17.32 ft below ground surface (bgs).
Pulled the bollards.
Cut off stick up of protective casing, well, and sign post.
Well pad remains in place.
Well is 2" PVC.
Original pour of HolePlug bridged - bridge was cleared.
Tagged Bentonite Pellets at 88.0 ft bgs.
Grout to surface.

Latitude: 33/13/11.96 (deg/min/sec - as built)
Longitude: -81/34/20.63 (deg/min/sec - as built)

Report Prepared By	Date	Site Inspected By	Date
Bill Joyce	2/6/2019	Bill Joyce	1/7/2019

OSR 30-29 (Rev 2 9 2004)

Well Abandonment Report

Well Number	PAS001D
Project Name	EC&ACP Well Abandonment
Project Manager	Seth Miller
Location Description	P Area
Driller Name/Company/Certification No.	Joshua Justice / Cascade Drilling / D2259
Oversight Name/Company	Bill Joyce / SRNS
Date Well Abandoned	1/7/2019
Reason for Abandonment	No longer required for monitoring groundwater
Total Abandoned Footage	72.25 ft
Geophysical Logs (If applicable, list.)	N / A

Abandonment Method

☒ Pumping/Pouring Grout ☐ Pressure Grout ☐ Perforate Casing/Grout ☐ Over Ream ☐ Drill Out

Other Method (Describe)

Coated Bentonite Pellets (3/8". 5 gallon bucket) used through the screen zone (see below)

Grout is Portland Cement, Type I, 46.2 lbs/bag with bentonite

	Date	Grout Type	Quantity (bags, yds, etc.)	Weight (if applicable)
Grout	1/7/2019	Bentonite Pellets (3/8")	1/2 of a 5 gallon bucket	N / A
	1/7/2019	Bentonite Portland Cement	12 gallons	14.0 - 15.0 ppg

Comments

Final Water Level: 8.78 ft below ground surface (bgs).
Pulled the bollards.
Cut off stick up of protective casing, well, and sign post.
Well pad remains in place.
Well is 2" PVC.
Tagged Bentonite Pellets at 59.5 ft bgs
Grout to surface.

Latitude: 33/13/11.87 (deg/min/sec - as built)
Longitude: -81/34/20.71 (deg/min/sec - as built)

Report Prepared By	Date	Site Inspected By	Date
Bill Joyce	2/6/2019	Bill Joyce	1/7/2019

APPENDIX E

Inspection Checklist

This page was intentionally left blank.

FIELD INSPECTION CHECKLIST FOR WADB

❑ **SCHEDULED** ❑ **UNSCHEDULED**

A= Satisfactory **X**= Unsatisfactory (Explanation required)	**A** or **X**	Observation of Corrective Action Taken
1. Verify that the roads are accessible.		
2. Verify that the waste unit signs [6 signs] are in acceptable condition, have the correct information, and are legible from a distance of 25 feet.		
3. Verify that there are no excavation, digging, or construction activities in the area.		

Inspected by:

_______________ / _______________ _______________
(Print Name) (Signature) (Date)

Post-Closure Manager:

_______________ / _______________ _______________
(Print Name) (Signature) (Date)

CAUTION: The inspector shall notify the Post-Closure Manager and Environmental Compliance Authority **IMMEDIATELY** if there has been a breach or compromise of the land use controls of this waste unit. The notification shall be in accordance with SRS post-closure inspection procedures.

This page was intentionally left blank.