SOUTH CHARLESTON FACILITY
KANAWHA RIVER
NATURAL RESOURCE DAMAGE ASSESSMENT
FINAL ASSESSMENT PLAN

May 1, 2023

Prepared by:

United States Department of the Interior

West Virginia Division of Natural Resources

West Virginia Department of Environmental Protection

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPCs	Contaminants of Potential Concern
CWA	Federal Water Pollution Control Act (Clean Water Act)
DOI	United States Department of the Interior
ESA	Endangered Species Act
HEA	Habitat Equivalency Analysis
HMW	High Molecular Weight
LMW	Low Molecular Weight
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRDA	Natural Resource Damage Assessment
NRDAR	Natural Resource Damage Assessment and Restoration
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
PAH	Polyaromatic Hydrocarbons
PAS	Preassessment Screen
PRP	Potentially Responsible Party
REA	Resource Equivalency Analysis
RCRA	Resource Conservation and Recovery Act
SGCN	Species of Greatest Conservation Need
SVOC	Semi-volatile Organic Compound
TDCC	The Dow Chemical Company
UCC	Union Carbide Corporation
USFWS	United States Fish and Wildlife Service
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources

1 INTRODUCTION AND BACKGROUND INFORMATION

The West Virginia Department of Environmental Protection (WVDEP), the West Virginia Division of Natural Resources (WVDNR),and the United States Fish and Wildlife Service (USFWS) acting on behalf of the U.S. Department of the Interior (DOI) are designated to act on behalf of the public as Trustees for natural resources in the State of West Virginia (40 CFR §§ 300.600-605). Natural resource trustees are authorized to pursue claims for natural resource damages under Section 107(f) of the Comprehensive Environmental Response, Compensation, and Liability Act as amended (CERCLA), 42 USC § 9607(f), and Section 311 of the Federal Water Pollution Control Act (also known as the Clean Water Act (CWA)), as amended, 33 USC § 1321. The Trustees undertake this task when natural resources have been, or may have been, injured by releases of hazardous substances. CERCLA regulations (43 CFR Part 11) establish an administrative process for conducting a natural resource damage assessment and restoration (NRDAR) to determine and quantify injury, determine the damages, and identify, select, and implement restoration to compensate the public for the injured natural resources and lost services. While following these regulations is optional (43 CFR § 11.10), trustees who conduct an assessment consistent with these regulations are entitled by law to a rebuttable presumption in any subsequent litigation concerning the natural resource damages claim (42 U.S.C. § 9607(f)(2)(C); 43 CFR § 11.10). This Assessment Plan is one of the documents identified in the CERCLA NRDAR regulations. Its purpose is "to ensure that the assessment is performed in a planned and systematic manner and that methodologies selected…can be conducted at a reasonable cost" (43 CFR § 11.30(b)). The Trustees are making this Assessment Plan available for public comment, including comment by the Potentially Responsible Party, for a period of thirty days (43 CFR § 11.32(c)).

The South Charleston Facility ("Facility") is located on both the southern bank and Blaine Island of the Kanawha River in South Charleston, West Virginia (Figure 1.1). The Facility, owned and operated by Union Carbide Corporation (UCC), is approximately 200 acres and consists of the Mainland and Blaine Island. The address for the Site is 437 MacCorkle Avenue, SW, South Charleston, WV 25303. The Facility has been in continuous operation since the early 1920s. Currently, most of the plants produce specialty chemicals, such as surfactants, de-icers, and lubricating fluids.

The Facility and the surrounding Kanawha River ("the Site") are undergoing corrective action through the U.S. Environmental Protection Agency's (USEPA) authority under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901 *et seq*. Thus far, the RCRA actions have been focused on source control and groundwater contamination. In July 2017, a small intermittent sheen was observed on the back channel of the Kanawha River near the

Middle Island Area. A sediment investigation was completed in September 2017 and November 2018 to evaluate the extent of impacted sediments that are causing the sheen. UCC's 2020 draft ecological risk assessment, which is currently being updated with additional data at USEPA's request, determined risk to benthic invertebrates immediately adjacent to the Facility in two areas (Chlorohydrin Area and Middle Island Area) as a result of high concentrations of hazardous substances in the sediment. Initially, UCC proposed to address this risk via sediment removal/capping. At this time, exposure of upper trophic levels (e.g., fish feeding on benthic invertebrates, birds feeding on emergent insects) to the hazardous substances identified in the sediments has not been evaluated. For purposes of the NRDAR, the South Charleston Facility Kanawha River Assessment Area ("Assessment Area") includes the Facility and anywhere hazardous substances and/or oil released at and from the Facility ("Releases") have come to be located, including the Kanawha River.

The Trustee Council (TC), consisting of representatives from WVDEP, WVDNR, and USFWS (the "Trustees"), is proposing to gather ephemeral data at and from the Kanawha River. This early sampling and data collection (43 C.F.R. § 11.22), prior to the anticipated sediment removal action under RCRA, will be used to document the nature and extent of the injury to mussels and other natural resources as a result of releases at and from the Facility into the Assessment Area. The anticipated sediment removal actions to address contamination are not expected to fully restore or compensate for natural resource injuries. This NRDAR Assessment Plan (Assessment Plan) serves as the guiding document for all damage assessment activities related to the Releases at or from the Facility.

Figure 1.1 Map of Assessment Area (orange polygon) with UCC South Charleston Facility identified (red polygons).

1.1 Purpose of the Assessment Plan

The purpose of this Assessment Plan is to describe the Trustees' approach for conducting a damage assessment in a cost-effective manner. This Assessment Plan outlines the Trustees' proposed approaches for determining and quantifying natural resource injuries and damages associated with those injuries which includes two primary components of a damages claim: 1) the cost to restore, rehabilitate, replace, and/or acquire equivalent resources for the injured resources, and 2)"compensable value," or the monetary value of the natural resource services that were lost pending the restoration of injured resources to their "baseline" condition. *Injury* means a measurable adverse change, either long- or short-term, in the chemical or physical quality or the viability of a natural resource, resulting either directly or indirectly from exposure to a discharge of oil or release of a hazardous substance (43 CFR § 11.14(v)). *Damages* is a legal term for the amount of money sought by Trustees as compensation for injury, destruction, or loss of natural resources; damages include the costs of assessing injuries, as well as the costs of restoration (42 U.S.C. §§ 9601(6), 9607(a)(4)(C); 43 CFR § 11.14(l) and §11.15). By developing an Assessment Plan, the Trustees ensure that the NRDAR will be completed at a reasonable cost relative to the magnitude of damages sought. The Trustees also intend for this Plan to communicate proposed assessment methodologies to the public, including the potentially responsible party (PRP), so that these groups can productively participate in the assessment process.

The Assessment Plan, as currently written, describes the Trustees' understanding of the studies (e.g., benthic invertebrate community survey, porewater toxicity testing) and identifies other processes (e.g., data review and analysis) that may be needed to confirm exposure to the Releases and quantify injury to natural resources and their services. Inclusion of a study within this Plan does not guarantee that it will be undertaken, and studies not included within the Plan may be deemed necessary at a later date. The Assessment Plan provides an initial prioritization of efforts the Trustees will take during the Injury Assessment process. Additional plans describing assessment studies, if any, will be tiered off this Assessment Plan, and made available for public comment prior to finalization.

1.2 Authority to Conduct a NRDAR

The NRDAR is being conducted jointly by the Trustees pursuant to their respective authorities and responsibilities as natural resource trustees. The Trustees have each been designated as a natural resource trustee pursuant to Section 107(f) of CERCLA, 42 U.S.C. § 9607(f); Section 311(f)(5) of the CWA, 33 U.S.C. § 1321(f)(5); and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR §§ 300.600 - 300.615. Under these authorities, the Trustees act on behalf of the public to seek damages for the injury, loss, or destruction of natural resources belonging to, managed by, controlled by, or appertaining to the State or United States, that resulted from releases of hazardous substances. This authority includes implementing a NRDAR to evaluate the injury, loss, or destruction of natural resources and their services due to releases of hazardous substances.[1]

The President has designated federal resource trustees in the NCP (40 C.F.R. § 300.600) and through Executive Order 12580, dated January 23, 1987, as amended by Executive Order 13016, dated August 28, 1996. Pursuant to the NCP, the Secretary of the DOI acts as a Trustee for natural resources and their supporting ecosystems, managed or controlled by the DOI. In this matter, the USFWS is acting on behalf of the Secretary of the DOI as Trustee for natural resources under its jurisdiction, including but not limited to migratory birds and endangered and threatened species and their habitats.

In addition to the NCP and CERCLA NRDAR regulations, the West Virginia Code 22: Water Pollution Control Act Natural Resources Game Fish and Aquatic Life Fund §22-11-25 provides for recovery of costs to replace lost game fish or aquatic life. Trustees are authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore natural resources and their services that are injured or lost as the result of hazardous substances released at or from a Facility.

The Trustees decided to proceed with this NRDAR based on the results of a Preassessment Screen (PAS) dated May 17, 2021 (fully executed on 7/8/2021, Natural Resource Trustees 2021a); 43 CFR §§ 11.23-11.25).

[1] The trustees must use CERCLA NRDAR regulations for injuries resulting from a discharge or release of a mixture of oil and hazardous substances. 15 CFR 990.20.

In the PAS, the Trustees determined:

- A discharge of oil and/or a release(s) of a hazardous substance occurred;
- Natural resources the Trustees may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the release;
- The quantity and concentration of the discharged oil or released hazardous substance is sufficient to potentially cause injury to natural resources;
- Data sufficient to pursue an assessment are readily available or likely to be obtained at a reasonable cost; and
- Corrective action carried out or planned do not or will not sufficiently remedy injury to natural resources without further action.

The Trustees therefore concluded that all preassessment screening criteria were met, natural resources over which Trustees may assert trusteeship have been or may have been impacted, and UCC is a viable PRP.

1.3 NRDAR Process Overview

It is the intent of the Trustees to conduct the South Charleston Facility Kanawha River NRDAR consistent with the CERCLA NRDAR regulations at 43 CFR Part 11. These regulations describe the process by which Trustees may conduct a NRDAR. This process includes the following three phases:

- Preassessment,
- Assessment (including the Assessment Plan, injury determination, quantification, and damages determination phases), and
- Post-Assessment (i.e., damages recovery and restoration planning and implementation).

To date, as noted above, the Trustees have completed the Preassessment Phase. The following administrative and preassessment planning documentation is available on the DOI NRDAR website for UCC Kanawha River.

- Notice of Intent. The Trustees sent a notice of intent (NRDAR 2021b) to initiate a NRDAR to UCC on August 2, 2021 (43 CFR § 11.32(a)(2)(iii)(A)-(B)).
- Preassessment Screen and Determination. The Trustees finalized a Preassessment Screen and Determination on July 8, 2021 which provided the basis for the Trustees' determination that further investigation was warranted based on review of readily available information of the effects of Releases associated with the South Charleston Facility (Natural Resource Trustees 2021a).
- Memorandum of Agreement Between the State of West Virginia and United States Department of the Interior Regarding Natural Resource Damage Assessment and Restoration for the South Charleston Facility and Kanawha River (Fully executed June 20, 2021).

The Trustees are now in the Assessment Phase, which may include, as necessary:

- Assessment Plan Phase (43 CFR §§ 11.30 - 11.38),
- Injury Determination Phase, including pathway determination (43 CFR §§ 11.61-11.70),
- Quantification Phase, including baseline services determination and resource recoverability analyses (43 CFR §§ 11.70-11.73), and
- Damages Determination Phase (43 CFR §§ 11.80-11.84).

1.4 Identification of the Potentially Responsible Party (PRP)

The UCC, which is a wholly owned subsidiary of The Dow Chemical Company (TDCC), is the owner and operator of the South Charleston Facility at and from which hazardous substances and oil have been released into the Assessment Area. Thus, pursuant to Section 107(a) of CERCLA, the Trustees are identifying UCC as the potentially responsible party. This is consistent with the USEPA, as the lead agency for the corrective action, and WVDEP, as the state agency providing responsible party oversight for corrective action activities.

1.5 Coordination with Other Activities

The CERCLA NRDAR regulations support the coordination of a damage assessment, to the extent possible, with corrective actions or other investigations being performed pursuant to the NCP (i.e., cleanup activities). Consistent with 43 CFR § 11.31(a)(3), the Trustees recognize the benefit of coordinating assessment activities associated with sites that may have significant contaminants of potential concern (COPCs). Integration of Trustee considerations into corrective action decisions may resolve certain natural resource damages liability or decrease the cost of assessment activities.

The Trustees intend to continue to coordinate with the corrective action activities for the Site. Trustee assessment activities discussed in this Plan make use of existing data generated through the corrective action process, and other research and data collection efforts.

1.6 Public Participation

Public participation is an important part of the NRDAR process. To that end, the Trustees made this Assessment Plan available to the public, including the PRP, for review and comment for a thirty-day period (43 CFR § 11(c)). The Trustees reviewed and considered all public comments and input on the Assessment Plan received during the public comment period prior to finalizing the Assessment Plan. The Trustees prepared a responsiveness summary to the comments that is included as Appendix F of this Assessment Plan. Development of the Assessment Plan, the public comment process, and finalization of the Assessment Plan is performed solely by the Trustees. Based on the public's comments or other information, the Trustees may modify the Assessment Plan at any time. In the event of a significant modification, the Trustees will provide the public with an opportunity to comment on that amendment (43 CFR § 11.32(e)).

1.7 Timeline

The activities in this plan are expected to take a reasonable amount of time to accomplish. If new

information becomes available as this assessment progresses, and additional study is deemed warranted, updates to this plan and the timeline will be made publicly available.

2 ASSESSMENT AREA

Assessment Area is defined as:

> *The area or areas within which natural resources have been affected directly or indirectly by the discharge of oil or release of a hazardous substance and that serves as the geographic basis for the injury assessment* (43 CFR 11.14(c)).

The Assessment Area, also referred to as the Site, for the South Charleston Facility Kanawha River NRDAR includes the location of hazardous substances and oil after release from the Facility. The Facility had Releases into groundwater on Blaine Island and the river bank (Jacobs 2020a). Based on the revised conceptual site model, groundwater beneath Blaine Island flows into porewater in the sediments of both the river main and back channels, while groundwater from the southern river bank flows into porewater in sediments located in the back channel (Figure 2.1). Porewater discharges into the back channel occur from two contaminated groundwater plumes on the river bank and three contaminated plumes on Blaine Island. Porewater discharges to the Main Channel emanate from three contaminated plumes on Blaine Island. Three historical outfalls (two on the river bank and one on Blaine Island) have been identified as potential direct sources of contamination in sediments.

The area for corrective action associated with the Releases was considered along with surface water, porewater, and sediment data, aerial photography, biological data, human use data, and other relevant information to determine the bounds of the Assessment Area. Additionally, the Assessment Area includes areas that may have suffered from losses to recreation and use of environmental resources, and locations of supporting habitat for natural resources which may have been exposed to hazardous substances and/or oil as a result of the Releases. Reference Locations have also been proposed to establish baseline conditions (Fig. 2.2)

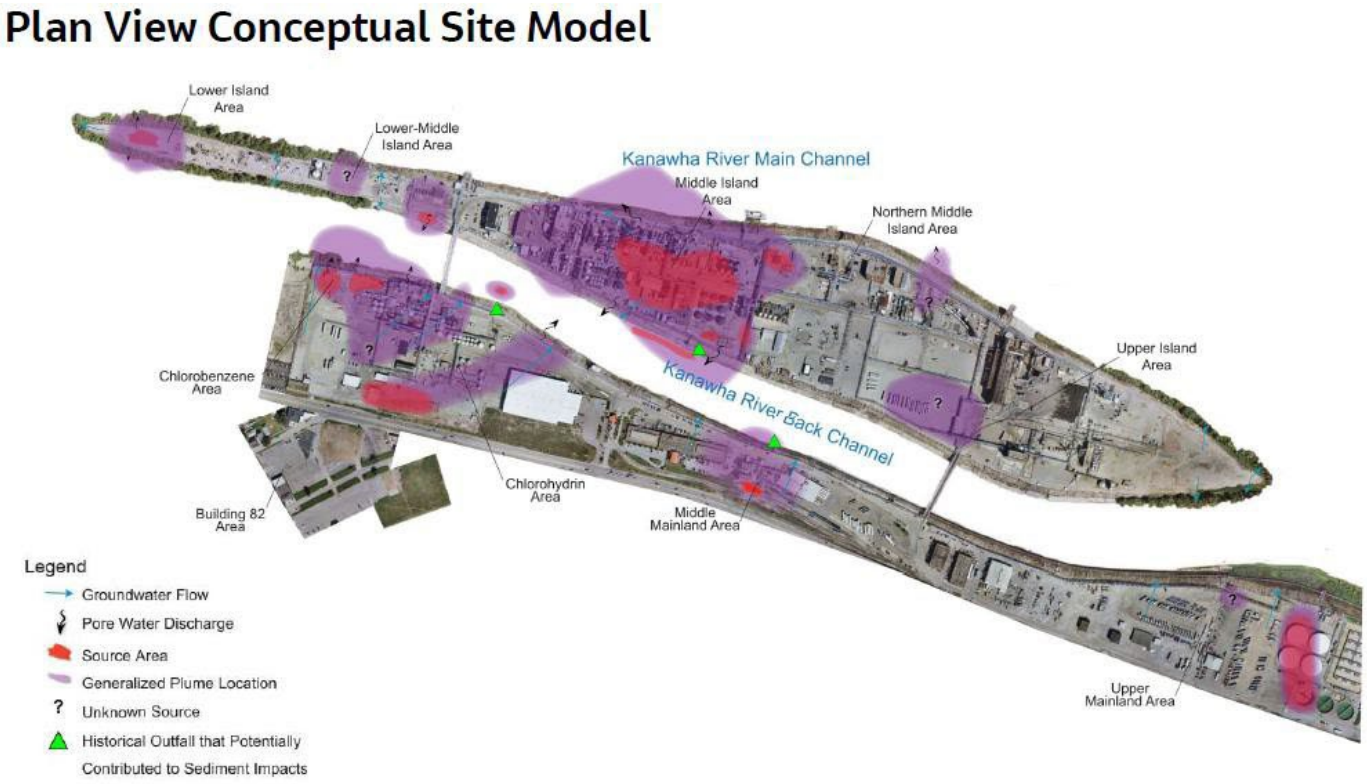

Figure 2.1 Revised Conceptual Site Model for Groundwater Discharges and Three Historic Outfalls (Jacobs 2020a).

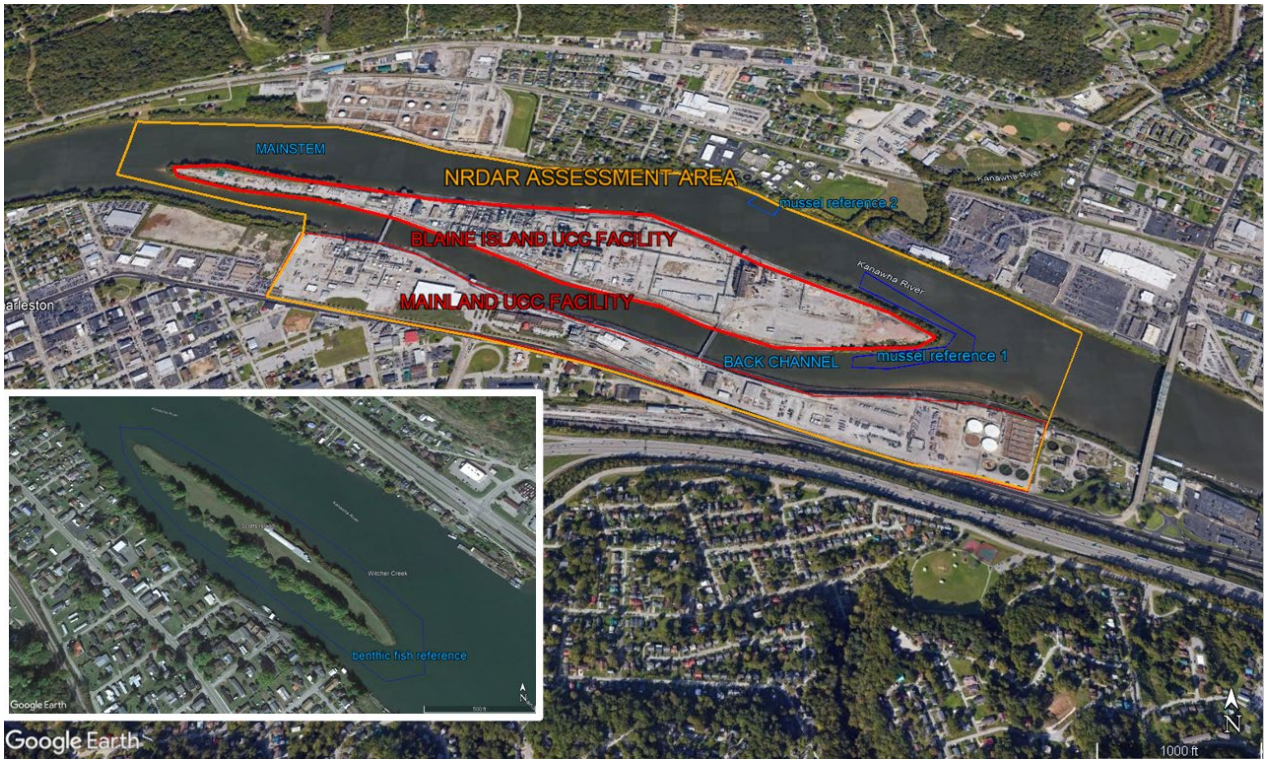

Figure 2.2 NRDAR Assessment Area (orange polygon) including reference locations (blue polygons).

2.1.1 Summary of Releases

The South Charleston Facility Kanawha River Natural Resource Damage Assessment (NRDA) will focus on direct and indirect injuries stemming from exposure to released hazardous substances and oils, including mixtures as defined in Section 101(14) of CERCLA. COPCs, as understood at the time of publication, which were released at and from the Facility include VOCs, SVOCs, and metals (APPENDIX A). The COPCs that will be the focus of the injury analysis will be chosen as part of the assessment process.

2.1.2 Confirmation of Exposure

Natural resources under the jurisdiction of the Trustees have been exposed[2] to hazardous substances and oil released at and from the Facility (Table 2.1).

[2] Exposed means "all or part of a natural resource is, or has been, in physical contact with oil or a hazardous substance, or with media containing oil or a hazardous substance" (43 CFR § 11.14(q)).

Table 2.1 Examples of resources that have been exposed to hazardous substances released at and from the Facility.

Resource Category	Description	Information Source
Surface Water	Releases at and from the Facility migrated into the groundwater which flows into porewater and surface water of the Kanawha River.	Facility-Wide Porewater Characterization Report (CH2M Hill 2013) and 2017 Porewater Follow Up Investigation Report (in Jacobs 2020a)
Sediment	Releases at and from the Facility migrated into the sediment of the Kanawha River.	2017 Middle Island Sediment Investigation Results (in Jacobs 2020b), Biological Assessment, Kanawha River Sediment Remediation (Jacobs 2018), and UCC SCF Back Channel Investigation (Jacobs 2020b)
Biological	Mussels located in the Kanawha River are exposed via filter and pedal feeding.	Mussel surveys documented the presence of 25 species, including one federally listed, one federally proposed, and two WV SGCN (Allstar Ecology 2018, 2019).
Biological	Benthic invertebrates located in the Kanawha River ingest contamination from water and sediment.	Benthic surveys have not been conducted in this reach of the river, but BMI are known to be present upstream and in tributaries (WVDEP unpublished data).
Biological	Fish located in the Kanawha River may be exposed directly or indirectly through prey.	Fish surveys have documented 53 species including 17 benthic fish species (Owens 2019).

3 AFFECTED NATURAL RESOURCES

Natural resources for which natural resource damages may be sought include land, sediment, biota, air, water, groundwater, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States… [or] State…" (43 CFR § 11.14(z)). The CERCLA NRDAR regulations group these natural resources into five categories: surface water resources, ground water resources, air resources, geologic resources, and biological resources.

The Assessment Area supports a variety of natural resources and services potentially affected by hazardous substances and oil released at and from the Facility. The following paragraphs briefly summarize select features of the natural resources that the Trustees are currently considering assessing for injury.

3.1 Surface Water Resources

Surface water resources in the Assessment Area include water, suspended sediment, and bed and bank sediments (43 CFR § 11.14(pp)). Surface water may be considered injured if, for example, there is an exceedance of an applicable water quality or drinking water standard as a result of an unpermitted release (43 CFR § 11.62(b)(1)) or if other resources (e.g., fish) are injured as a result of exposure to the concentrations in the surface water (43 CFR § 11.62(v)). Surface water supports other biological resources, so surface water has both direct and indirect impacts on the health of biological resources. For example, contaminated sediments can cause injury to benthic invertebrate populations, which in turn can result in injuries to resident fish populations for whom the invertebrates are a source of food. Similarly, injury to invertebrates and/or fish resulting from exposure to contaminated sediments and surface water can lead to injury in local insectivorous (insect eating) or piscivorous (fish eating) bird populations. In addition, contaminated sediments serve as a source of continuing Releases of hazardous substances to water.

Surface water resources provide a suite of ecological and human services. Ecological services include, but are not limited to, habitat for trust species, including food, shelter, breeding areas, and other factors essential to survival. Human use services provided by surface water resources include, but are not limited to, recreational fishing, boating, and canoeing.

3.2 Groundwater Resources

Groundwater resources include the water in a saturated subsurface zone and the rocks or sediments through which this water flows. Groundwater resources serve as a potential pathway for contaminants to migrate from their source to surface water resources. Groundwater may be determined to be injured if concentrations of substances are in excess of applicable water quality criteria for public water supplies or the contaminated groundwater causes injury to other resources (43 CFR § 11.62(c)).

3.3 Geologic resources

Geologic resources include soils and sediments that are not otherwise accounted for under the definition of surface water or groundwater resources. Geological resources, including soil and sediment resources in riparian and other wetland areas, provide habitat for natural resources such as migratory birds and also provide other services that regulate ecosystems and water quality, while also offering human services and access to recreational fishing. Geologic resources may be injured if, for example, concentrations of substances in the soil are sufficient to cause injury to groundwater or a toxic response to soil invertebrates (43 CFR § 11.62(e)).

3.4 Biological resources

Biological resources include natural resources, as defined earlier, and other biota, including, terrestrial and aquatic plants, threatened, endangered, or state sensitive species, other legally protected species, and other living organisms not listed (43 CFR § 11.14(f)). Insects, amphibians, reptiles, birds, mussels, fish, and small mammals serve as food sources for higher trophic level animals including raptors and predatory mammals. Biological resources also provide a range of human services including fishing and wildlife viewing. Among other causes, injury to a biological resource could occur if exposure to released hazardous substances and oil cause the biological resource death, disease, or reduction in reproduction or if there is a directive to limit or ban consumption (43 CFR § 11.62(f)). Additionally, the Trustees may choose to focus the NRDA on a few representative resources.

3.4.1 Aquatic Organisms

The Kanawha River near South Charleston provides habitat for 14 freshwater mussel species including one federally listed species, one species proposed for federal listing and two state Priority 1 species, 53 species of fish including seven state Priority 1 species, four amphibian species, six turtle species, snails, crayfish, and benthic macroinvertebrates. One federally listed fish, diamond darter, occurs in a tributary but surveys for this species in the river have not been conducted. Benthic macroinvertebrate organisms known to inhabit the river downstream of the assessment area include 11 genera (ORSANCO 2021), whereas at least 13 genera were observed upstream (Kirk and Perry 1994).

Important habitats for aquatic organisms found within the assessment area include island perimeters, gravel/sand substrates, riverbank shelves, and gravel/sand bars.

Table 3.1 Federally listed threatened or endangered aquatic species that may inhabit the Assessment Area.

Taxon	Scientific Name	Common Name	Federal ESA Listing Status
Bivalve	*Epioblasma triquetra*	Snuffbox	endangered
Bivalve	*Obovaria subrotunda*	Round Hickorynut	threatened
Fish	*Crystallaria cincotta*	Diamond darter	endangered

3.4.2 Birds and Mammals

Birds and mammals are known to occur in the assessment area. Semi-aquatic and terrestrial species are exposed to aquatic contaminants primarily through consumption of contaminated prey. The contaminants associated with the Facility are not highly bioaccumulative, are metabolized by aquatic organisms, or are toxic only via direct exposure. Based on these characteristics, at this time, the Trustees have chosen to focus on injury to aquatic organisms. However, the Trustees may revise this determination if additional information or data becomes available indicating a higher level of exposure.

4 INJURY ASSESSMENT AND PATHWAY DETERMINATION APPROACH

This Assessment Plan sets forth assessment studies or activities the Trustees intend to pursue as part of the South Charleston Facility Kanawha River NRDA.

During the injury assessment, the trustees quantify the effects of the release(s) of hazardous substances and oil on the natural resources to determine whether there is a measurable adverse effect ("injury") to the resource as a result of the exposure. For purposes of NRDAR, the trustees measure the extent of the injury, estimate the baseline condition and/or baseline services of the injured natural resources, determine the recoverability of the injured natural resources, and estimate the reduction in services that resulted from the release(s) of hazardous substances (43 CFR § 11.70(c)). Baseline is defined as the condition or conditions that would have existed in the assessment area had the releases of the hazardous substances under investigation not occurred (43 CFR § 11.14(e)). Baseline conditions may be established based on the review of historical, pre-release data and information, or by control areas that exhibit similar physical, chemical, and biological conditions as the assessment area and lack exposure to the releases (43 CFR § 11.72).

At this time, the Trustees have determined that further assessment is appropriate for (1) surface water, sediment, groundwater and porewater resources; and (2) biological resources including benthic invertebrates, mussels, and fish.

4.1 Temporal

The temporal scope of this NRDA will be based on determining injuries to natural resources and corresponding reductions in natural resource services from the time of the initial release through the return of the injured resource to baseline conditions. This scope may change as more information is revealed through the corrective action process or other means discovered during the assessment.

4.2 Use of Available Data

The Trustees' general approach to the NRDA is to review the existing data, analyze gaps, and then undertake additional studies or activities including testing and sampling as needed. This approach minimizes the cost of the assessment and maximizes the use of existing information.

4.3 Intent to Perform a Type B Assessment

As part of the assessment planning process, the Trustees decide whether to conduct a simplified assessment (Type A) or a comprehensive assessment (Type B) (43 CFR §§ 11.33-11.36). The Type A procedures, which use minimal field observations and computer models to generate a damage claim, are limited to the assessment of relatively minor, short duration discharges or releases (43 CFR § 11.34). Considering the Releases and that additional site-specific data can be collected at reasonable cost, the Trustees have concluded that the use of Type B procedures is appropriate and justified.

The Trustees must confirm that at least one of the natural resources identified as potentially injured in the PAS has been exposed to released hazardous substance before including any Type B

methodologies in the Assessment Plan (43 CFR § 11.37). The PAS identified several resources and their services that were potentially exposed as a result of the Releases of hazardous substances from the Facility, including:

- Fish
- Freshwater mussels
- Aquatic invertebrates
- Surface water, including sediments
- Groundwater
- Supporting habitat for natural resources, including food, shelter, breeding, foraging, rookeries, and other factors essential for survival

Multiple natural resource categories are confirmed as exposed to hazardous substances (see Section 2.1.2 Confirmation of Exposure) released from the Facility. Information describing the methods that confirm additional resources have been exposed and potentially injured will be described in the sections below under Pathway Determination and Injury Assessment.

4.4 Pathway Determination

Pathway is defined as the "route or medium through which oil or a hazardous substance is or was transported from the source of the… release to the injured resource" (43 CFR § 11.14(dd)), Determinations involve identifying the sources of hazardous substances and tracing the fate and transport of the substances through the environment to the resources (e.g., through surface water, sediments, to mussels). Pathways may be determined by demonstrating the presence of a hazardous substance in a resource or by using a model that demonstrates that the route served as a pathway (43 CFR §11.63(a)(2)).

Abiotic media (i.e., groundwater, porewater and sediment) are known to be contaminated with hazardous substances released from the Facility based on analysis submitted to USEPA and WVDEP by UCC. As part of the assessment activities, the Trustees will trace contamination of biota (i.e., mussels) via tissue analysis for site-related hazardous substance. Aquatic-dependent biological resources within the Assessment Area may have been injured by direct contact with dissolved or suspended chemicals in the porewater or water column, direct contact with contaminated sediments, ingestion of contaminated surface water, porewater, and sediment during foraging or feeding, inhalation of chemicals, and/or indirect contact through ingestion of contaminated prey species.

5 INJURY ASSESSMENT

The Trustees expect to evaluate injury associated with the natural resources and services described below. The Trustees' defined injury assessment categories and combined multiple natural resources

that are defined in the regulations (43 CFR §11.14(z)) (i.e., surface water resources, geologic resources, and biological resources). Trustee assessment study plans and reports will be made available on DOI's Damage Assessment and Restoration Tracking System website.

5.1 Injury Assessment for Aquatic Resources

The Trustees anticipate focusing assessment of aquatic resources on porewater, sediment, and mussel tissue analytical data to establish the pathway(s), and survey and in situ techniques for biological resources. The Trustees will review data and information gathered as part of the RCRA corrective action, data collected by the PRP, USEPA screening values, published injury thresholds, and other relevant published screening values, standards, and/or benchmarks. The Trustees will consider peer-reviewed literature on the harmful effects of COPCs released at and from the Facility on porewater, groundwater, sediment, and biological resources that reside in the river. During the NRDA, the Trustees will continue to evaluate any new or relevant data sources that may inform the injury assessment.

5.1.1 Aquatic Resources Evaluation

The Trustees will evaluate the concentrations of SVOCs (APPENDIX A) in porewater, sediments, and mussels to determine injury to aquatic-dependent biological resources and establish exposure pathways. To assess the degree to which these substances may be causing injury to biota, the Trustees will use standardized surveys and in situ testing. Specific assessment activities include:

A. Screening of chemical contaminants in surface waters, porewater, sediment, and mussels

This assessment activity will:

- Establish exposure pathways from groundwater, porewater, and sediment to biota.
- Apply ecological benchmarks and injury thresholds for COPCs to determine the spatial extent of contamination and injury to porewater, groundwater, and sediments relative to background;
- Collect mussel samples for COPC analysis, respectively across a gradient of COPC concentrations in the assessment area and reference areas; and
- Compare the highest tissue concentrations to the lowest and most conservative applicable ecological benchmark or injury thresholds.

The Trustees will use a data quality objectives approach (USEPA 2000, 2006a, 2006b, 2006c) including, but not limited to:

- Identify the frequency of detection of chemical concentrations in surface water, sediment, and mussels, by geographic sub-areas and time;
- Analyze and apply appropriate statistics on selected data to compare chemical concentrations in the Assessment Area to baseline concentrations or other appropriate chemical observations;

- Visualize data using charts and graphs; and
- Describe and document analysis results.

B. Assessing trends in benthic fish communities, mussel, and benthic macroinvertebrates (Appendices B, C and D)

This assessment activity will evaluate mussel and benthic invertebrate communities via standardized survey methods.

- The mussel survey, conducted following the WV Mussel Survey Protocol (WVDNR 2022), will target Back and Main Channel areas not previously surveyed by AllStar Ecology (2018, 2019) focusing on areas with sediment and porewater contamination,
- Benthic macroinvertebrate communities will be assessed using Hester-Dendy traps following the Ohio River protocol (ORSANCO 2020) in the Back and Main Channel based on sediment and porewater contamination except for the removal area sediments already tested by USGS, and
- The benthic fish survey, conducted following the protocol outlined in Owens (2019), will target Back and Main Channel areas not previously surveyed focusing on areas with sediment and porewater contamination.

C. Assessing Caged Mussel Toxicity (Appendix E)

This assessment activity will provide data with which to determine toxicity to mussels across a range of contaminant exposures.

- Target areas spanning the contaminant mixtures and concentrations for porewater and sediment not previously tested by USGS.
- Cages with juvenile *Lampsilis cardium* mussels (USFWS White Sulphur Springs National Fish Hatchery) will be paired with Hester-Dendy traps in the Back and Main Channel.
- Comparisons in mussel survival, growth and biomass will be made between contaminated and reference areas.

D. Performing geospatial analysis

This assessment activity will delineate the geographic and temporal extent of injury and/or contamination using existing data and data generated from the proposed assessment studies. ArcGIS™ will be employed to perform data interpolation and visualization techniques that can quantify the geographical extent of injury.

5.2 Groundwater Resources

The RCRA corrective action investigation has indicated that COPCs associated with the Releases leached through the substrates and entered the groundwater. The groundwater resources in this area

have been shown to connect with sediments via porewater, thereby transporting COPCs from ground water to other resources. The Trustees will focus on assessing groundwater resources as a pathway for the Releases to make their way to porewater, sediment, and aquatic biota being evaluated as part of the injury assessment.

6 APPROACH TO DAMAGES DETERMINATION

In the damages determination phase, the Trustees determine the monetary value (damages) of the compensation for injuries to natural resources and their services resulting from the Releases of hazardous substances (CERCLA §§ 107(a)(4)(C), 107(f)(1); 43 CFR § 11.15). The measure of damages is the cost of (i) restoration, or rehabilitation of the injured natural resources to a condition where they can provide the level of services available at baseline, (ii) the replacement and/or acquisition of equivalent natural resources capable of providing such services, and/or (iii) the compensable value[3] of all or a portion of the services lost to the public for the time period from the release pending restoration to baseline (43 CFR § 11.80(b)). The CERCLA NRDAR regulations provides a non-exhaustive description of various methodologies the Trustees may use in their damages determination, including Habitat Equivalency Analysis (HEA), Resource Equivalency Analysis (REA), and Habitat-Based Resource Equivalency (HaBREM;) and travel cost (43 CFR § 11.83). REA is a resource-to-resource approach to injury quantification that assumes that services lost and restored are comparable, an approach similar to HEA (National Oceanic and Atmospheric Administration (Desvousges et al. 2018)). REA generally refers to a stepwise replacement model for killed or injured species. HEA is a service-to-service or resource-to-resource approach that can account for changes in baseline services while estimating interim losses of services. The fundamental concept in HEA is that compensation for lost ecological services can be provided by restoration projects that provide comparable services. HaBREM refines the use of organism-based metrics to integrate injuries to multiple species (Baker et al. 2020). During the assessment process, the Trustees will determine the most appropriate method to determine damages which may include other models.

6.1 Baseline

In order to quantify injuries, the Trustees must quantify baseline conditions, which include the physical, chemical, and biological conditions and their associated services for natural resources. Baseline is “the condition or conditions that would have existed at the assessment area had the discharge of oil or release of the hazardous substance under investigation not occurred” (43 CFR § 11.14(e)). The baseline conditions for each resource and/or service will be taken into account when determining the level of injury and the amount of restoration required to offset the injury.

[3] Compensable value is the amount of money required to compensate the public for the loss in services provided by the injured resources between the time of the release and the time the resources are fully returned to their baseline conditions, or until the resources are replaced and/or equivalent natural resources are acquired (43 CFR §11.83(c)). This is also referred to as “interim loss.”

6.2 Aquatic Damages Determination

The Trustees are assessing exposure of natural resources to the Facility-related hazardous substances and oil and are determining whether natural resources or their services have been injured or lost. As part of the assessment, the Trustees determine the amount of restoration that is necessary to compensate the public for identified injuries to these resources and their associated services for the period between the onset of injury and the resource's return to baseline ("scaling").

Trustees will likely use models, such as HEA or REA, to scale losses associated with aquatic resources with restoration. The Trustees plan to use a restoration-based approach to determine damages for ecological injuries (43 CFR § 11.83(b)). This means that the damages sought would equal the costs associated with restoring the natural resource and associated services that were injured. For example, this could include costs associated with acquiring, preserving, and restoring habitat that supports the injured resource(s).

7 DATA MANAGEMENT

Assessments employing Type B methods are required to develop a Quality Assurance Plan (QAP) that adheres to the requirements of the NCP and guidance provided by USEPA (43 CFR § 11.31(c)(2)). The purpose of the QAP is to ensure that data are of sufficient quality to be used for injury assessment and damage determination. For any new Trustee-led data collections, there will be an associated QAP that will be made publicly available. The data management procedures described below are general and will pertain to existing data or data collection activities not led by the Trustees.

Data will be managed in compliance with USFWS procedures to ensure that it is accurate and accessible for this NRDAR. The final study plans and other documents for this case are housed on the DOI Damage Assessment and Restoration Tracking System website and are available to the public. Raw data will be housed within the USFWS network and will be available upon request to USFWS with concurrence by the DOI solicitor.

Various data sources are available to assess baseline conditions and inform understanding of natural resource injuries that occurred as a result of Releases from the Facility. Data sources will be screened to verify that supporting documentation is sufficient to allow for an evaluation of the reliability and usability of the information. Required information will differ with data and information types, but may include:

- Sampling methodology, including information on sample locations, environmental media sampled, and measurement units;
- Chemical analysis, including information on detection limits and methodology accompanying quality assurance/quality control (QA/QC) data or separate QA/QC report;
- Raw data or data tabulations (e.g., rather than figures only); and
- Agreement from a governing body that the data collection methods/analysis were appropriate (e.g., published in a peer reviewed journal; approved for use in the remedial process or by the Trustees).

The Trustees may compile data from multiple sources to assess injury. Quality checks will be made on all data that is keyed into an electronic format. Metadata will meet an acceptable metadata standard such as FGDC CSDGM or ISO 19115. Digital repositories will meet appropriate guidelines with persistent identifiers and machine-readable open formats.

8 REFERENCES

AllStar Ecology. 2018. Phase I & Phase II Mussel Survey Report. Union Carbide Corporation South Charleston Facility Maintenance Dredging Project, Kanawha River, Kanawha County, West Virginia. 62 pp.

AllStar Ecology. 2019. Phase I & Phase II Mussel Survey Report. Union Carbide Corporation South Charleston Facility Chlorohydrin Remediation and Loading Dock, Kanawha River, Kanawha County, West Virginia. 32 pp.

Baker, M., Domanski, A., Hollweg, T., Murray, J., Lane, D., Skrabis, K., Taylor, R., Moore, T. and DiPinto, L. 2020. Restoration Scaling Approaches to Addressing Ecological Injury: The Habitat-Based Resource Equivalency Method. *Environmental Management* **65:** 161–177. https://doi.org/10.1007/s00267-019-01245-9

CH2M Hill 2013. Facility-Wide Porewater Characterization Report, UCC South Charleston Facility, South Charleston, West Virginia.

Desvousges, W.H., Gard, N. Michael, H.J., and Chance, A.D. 2018. Habitat and resource equivalency analysis: a critical assessment. Ecol. Econom. 143:74-89. https://doi.org/10.1016/j.ecolecon.2017.07.003

Hudson, P. 2017. The toxicity to fish embryos of PAH in crude and refined oils. Arch. Environ. Contam. Toxicol. 73:12-18. 17) 73:12–18 https://doi.org/10.1007/s00244-016-0357-6

Jacobs. 2020a. Union Carbide Corporation South Charleston Facility: Current Conditions Report. Indianapolis, Indiana. pp. 271. May 2020.

Jacobs. 2020b. Kanawha River Back Channel Investigation and Risk Assessment Summary Memorandum, South Charleston Facility, South Charleston, West Virginia. December 2020.

Jacobs. 2018. Biological Assessment, South Charleston Facility Middle Island Kanawha River Sediment Assessment and Remediation. Kanawha County, West Virginia. August 2018.

Kirk, E.J. and Perry, S.A. 1994. Macroinvertebrate production estimates in the Kanawha River, West Virginia. Hydrobiologia. 281:39-50. https://link.springer.com/article/10.1007/BF00006554#Bib1

Le Bihanic, F., Clerandeau, C., Le Menach, K., Morin, B., Budzinski, H., Cousin, X., and Cachot, J. 2014. Developmental toxicity of PAH mixtures in fish early life stages. Part II: adverse effects in Japanese medaka. Environ. Sci. Poll. Res. 21:13732-13743. https://doi.org/10.1007/s11356-014-2676-3

Natural Resource Trustees. 2021a. South Charleston Facility Kanawha River: Preassessment Screen and Determination. https://www.cerc.usgs.gov/orda_docs/CaseDetails?ID=1422 (Accessed January 18, 2023).

Natural Resource Trustees. 2021b. Notice of Intent to Perform a Natural Resource Damage Assessment. https://www.cerc.usgs.gov/orda_docs/CaseDetails?ID=1422 (Accessed January 18, 2023).

ORSANCO. 2021. Benthic macroinvertebrate database. https://www.orsanco.org/data/macroinvertebrates/ (Accessed January 18, 2023)

ORSANCO. 2020. *Standard Operating Procedures for Macroinvertebrate Sampling Using Modified Hester-Dendy Samplers.* http://www.orsanco.org/wp-content/uploads/2020/03/2020-ORSANCO-Biological-Programs-Standard-Operating-Procedures.pdf

Owens, N. 2019. Distribution and habitat use of benthic fishes in the lower Kanawha River, West Virginia. West Virginia University Thesis.

USEPA. 2000. Guidance for Data Quality Assessment: Practical Methods for Data Analysis. EPA QA/G-9. EPA/600/R-96/084

USEPA 2006a. Guidance on Systemic Planning Using the Data Quality Objectives Process. EPA QA/G-4. EPA/240/B-06/001

USEPA 2006b. Data Quality Assessment: A Reviewer's Guide. EPA QA/G-9R. EPA/240/B-06/002

USEPA 2006c. Data Quality Assessment: Statistical Methods for Practioners EPA QA/G-9S. EPA/240/B-06/003

U.S. Geological Survey [USGS]. 2023. Evaluation of the effects of mixtures in sediment contaminanted by unregulated industrial discharges to a Unionid mussel (Fatmucket, Lampsiilis siliquiodea) and a common test benthic organism (Amphipod, Hyalella Azteca). *In prep.*

van Leeuwen, C.J., Adema, D.M., and Hermens, J. 1990. Quantitative structure-activity relationships for fish early life stage. Aquat. Toxicol. 16:321-334. https://doi.org/10.1016/0166-445X(90)90044-P

WVDNR. 2022. West Virginia Mussel Survey Protocol. West Virginia Division of Natural Resources, Wildlife Resources Section, Elkins, WV. 29 pp.

APPENDIX A

CONTAMINANTS OF POTENTIAL CONCERN RELEASED FROM THE SOUTH CHARLESTON FACILITY INTO THE ASSESSMENT AREA

CONTAMINANTS of POTENTIAL CONCERN	GROUNDWATER	SEDIMENT	POREWATER
VOCs			
Benzene	X	X	X
Carbon Disulfide		X	
1,1,2,2-Tetrachloroethane	X	X	X
1,1,2-Trichloroethane	X	X	X
1,2-Dichloropropane	X	X	X
Cis-1,2-Dichloroethylene	X	X	X
Tetrachloroethylene(PCE)		X	
Trichloroethylene (TCE)	X	X	X
1,1-Dichloroethene	X	X	X
Vinyl Chloride	X	X	X
Chlorobenzene	X	X	X
Trans-1,2-Dichloroethene	X	X	X
Xylenes, Total	X	X	X
1,2-Dichloroethane	X		X
Chloroform	X		X
1,4-Dichlorobenzene	X		X
1,2,4-Trichlorobenzene	X		X
1,2-Dichlorobenzene	X		X
1,3-Dichlorobenzene	X		X
1,4-Dichlorobenzene	X		X
Ethyl benzene	X		X
Toluene	X		X
SVOCs			
Bis(2-Ethylhexyl)phthalate		X	
Dibenzofuran		X	
Acenaphthylene		X	
Anthracene		X	
Benzo (g,h,i)perylene		X	
Benzo(a)anthracene		X	
Benzo(a)pyrene		X	
Benzo(b)fluoranthene		X	
Benzo(k)fluoranthene		X	
Chrysene		X	

CONTAMINANTS of POTENTIAL CONCERN	GROUNDWATER	SEDIMENT	POREWATER
Dibenzo (a,h)anthracene		X	
Fluoranthene		X	
Fluorene		X	
Indeno(1,2,3-cd)pyrene		X	
Naphthalene	X	X	X
Phenanthrene		X	
Pyrene		X	
Total LMW PAHs		X	
Total HMW PAHs		X	
Total PAHs		X	
INORGANICS			
Arsenic		X	
Barium		X	
Chromium		X	
Lead		X	
Mercury		X	
Nickel		X	

APPENDIX B

SOUTH CHARLESTON FACILITY KANAWHA RIVER NRDA: BENTHIC FISHES ASSESSMENT STUDY PLAN

BACKGROUND

Benthic fishes are a natural resource over which the West Virginia Division of Natural Resources (WVDNR) and FWS exercise trusteeship. Benthic fishes (BF) are an integral part of the aquatic community in large river systems. They fill a wide variety of ecological niches and provide integral functions to the persistence of other organisms such as acting as host species (Percina spp.) for freshwater mussels or as forage for other piscivores fish species. In addition to providing required ecological functions to the aquatic ecosystem, many of the species present around Blaine Island are recognized by the WVDNR as Species of Greatest Conservation Need (SGCN) due to their relative imperiled status. Many of these SGCN benthic fish are generally considered to be intolerant to anthropogenic perturbations to their physiochemical environment such as water pollution, sedimentation, and river modification (i.e., channelization). Contaminants present in porewater and sediment within the Kanawha River NRDAR assessment area are documented to cause lethal and sub-lethal effects to fishes in both laboratory and field testing (van Leeuwen et al. 1990, Le Bihanic et al. 2014, Hudson 2017). Benthic fishes inhabit the substrate on the river bottom, where they are directly exposed to contaminants in porewater and sediment. This study will generate data to evaluate if the relative abundance and diversity of benthic fishes have been altered by exposure to site-related contaminants. These data will inform the injury determination and quantification phases of the assessment, as well as provide some information about the pathway(s) and extent of contamination.

SAMPLING METHODS

Because of gear biases associated with the sampling of small bodied benthic fishes in deep waters in large rivers with traditional gears (i.e., seining and electrofishing), we will implement benthic otter trawling to sample within the industrialized zone in the Kanawha River including the areas of contamination around Blaine Island. We will use downstream trawling with a 2.4-meter-wide Gerken Siamese Trawl (Innovative Net Systems) with 3.2mm mesh to collect benthic fishes. The net will be fitted with a break-away system that will release if the net catches on structures or logs on the river bottom. This net and mesh size has been used during previous studies in the Kanawha River and other large systems because it allows for small benthic fishes (approx. ≥20mm) to be fully recruited to the gear. Each trawl haul will be treated as an individual sample with a target distance of 25 meters. Five hauls will be conducted within the nine available habitat types; main channel (MC), main channel border (MCB), island main

channel border (IMCB), island head (IH), island toe (IT), island side channel border (ISCB), side channel (SC), side channel border (SCB), and tributary (TRIB) (Table 1; Figure 1). Forty-five samples will be collected from Blaine Island. This data will supplement existing species and community information that the WVDNR collected in 2017 and 2018 with these methods at Blaine Island and Scotts Island (reference), to fill in data gaps in relation to porewater and sediment contamination. Each sample will be preserved as an independent sample on 10% formalin, later washed and placed on 45% isopropanol until laboratory identifications may take place.

Habitat variables to be collected as needed within each haul include but are not limited to: dominate and co-dominant substrate class; water depth; surface and bottom water velocity; surface and bottom water quality parameters including dissolved oxygen, oxygen concentration, conductivity, water pH, and bottom oxidation reduction potential (ORP); water turbidity (Secchi depth), and linear distance to nearest bank. GPS coordinates will be recorded at the start and completion of each trawl.

DATA QUALITY AND MANAGEMENT

All individuals will be identified to species level if ontogenetic state and physical condition allow by the WVDNR ichthyologist. When necessary, identifications will be discussed and verified by regional experts for identification QA/QC. The data will be used to derive information for both the contaminated and reference locations such as catch per unit effort both expressed by (#/time and #/distance or area sampled), species observed, average relative naïve abundance for each species by habitat type and contamination status, benthic species richness, and darter species richness. Data for each species, site, and sample will be compared to the reference location using both univariate and multivariate statistical techniques to evaluate if relationships between contamination status of sample and species catch per unit effort or benthic community structure is associated with the contaminate zones around Blaine Island. Univariate statistical approaches that may be used, but are not limited to, consist of two-way ANOVA, Kruskal-Wallis, or other suitable test based on data distribution. Multivariate techniques include, but are not limited to, ordination, clustering analyses, and associated hypothesis testing such as principal component analysis (PCA), conical correspondence analysis (CCA), or non-metric multidimensional scaling (nMDS), and multi-response permutation procedures (MRPP). These techniques will be used to evaluate if any differences observed in the community structure of the benthic fishes are associated with the contaminated areas around Blaine Island.

LOCATIONS

Sampling within the Kanawha River NRDAR assessment area is based on the Revised Conceptual Site Model (Figure 2.1) and targets porewater contamination or a combination of porewater and sediment contamination. Sampling locations will consist of the immediate area

around Blaine Island concentrated within the contaminated zone. This strategy will include the samples (collected in this effort or from the 2017/2018 survey) from all nine habitat types available near the island (Table B1 and Figure B1). Trawls will be placed to avoid active pipelines while adhering to the sampling protocol. One upstream reference site (Scotts Island), surveyed in 2018, was selected to represent the nine habitat types available in the Kanawha River. Scotts Island was selected as it was the nearest comparable island in the Kanawha River, located approximately 24.5 river kilometers upstream of Blaine Island, that contained a reasonably similar benthic fish species assemblage and physical habitat to Blaine Island within each habitat type in the contaminated area (i.e., IT, ISCB, SC, SCB, IMCB; Table B1).

Table B1: Table containing habitat names, codes, and descriptions of sampled habitats.

Habitats Sampled	**Code**	**Description**
Main channel	MC	Not located within 30 meters of a bank normally associated with the navigation channel or thalweg
Main channel border	MCB	Located within 30 meters of a main channel bank that is not an island
Island main channel border	IMCB	Located within 0-30 meters from the island bank into the main channel; between the head (first 100 meters) and toe (most downstream 100 meters) of an island
Island head	IH	Located within 0-30 meters from the island bank within the first upstream 100 meters of an island
Island toe	IT	Located within 0-30 meters from the island bank within the downstream last 100 meters of an island
Island side channel border	ISCB	Located within 0-30 meters from the island bank into the side channel; between the head (first 100 meters) and toe (most downstream 100 meters) of an island
Side channel	SC	Secondary channel flowing around an island that is not within 30 meters from a bank (not main channel)
Side channel border	SCB	Area of the river extending up to 30 meters from the side channel bank (non-island)
Tributary	TRIB	Area located within 30 meters of the bank or confluence of a tributary; extending 100 meters upstream and downstream in the main river (Kanawha)

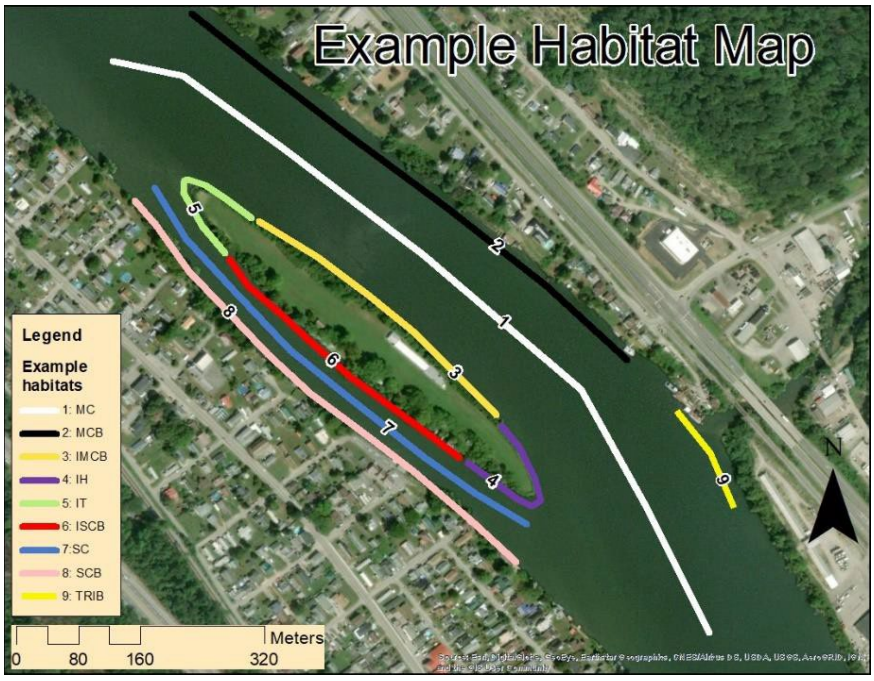

Figure B1: Map depicting various habitats to be sampled. These consist of: 1. Main Channel (MC), 2. Main Channel Border (MCB), 3. Island Main Channel Border, 4. Island Head (IH), 5. Island Toe (IT), 6. Island Side Channel Border (ISCB), 7. Side Channel, 8. Island Side Channel Border (ISCB), and 9. Tributary (TRIB). See table 1 for definition of habitat types.

APPENDIX C

SOUTH CHARLESTON FACILITY KANAWHA RIVER NRDA: MUSSEL SURVEY STUDY PLAN

BACKGROUND

Freshwater mussels are a natural resource over which the State and FWS exercise trusteeship. In addition, recent surveys have documented the presence of federally listed mussels (snuffbox; *Epioblasma triquetra* and round hickorynut; *Obovaria subrotunda*) in the Kanawha River NRDA assessment area. As freshwater mussels inhabit the substrate on the river bottom, they are directly exposed to contaminants in porewater and sediment. The contaminant mixture present in sediments within the DNAPL area of the Back Channel was documented to cause lethal and sublethal effects to a freshwater mussel in laboratory testing (USGS 2023). Surveys contracted by the South Charleston Facility were focused in the downstream and upstream areas of the Back Channel where sediment removal activities are planned (Figure C1). Survey data are lacking for the middle section of the Back Channel and the Blaine Island side of the Main Channel of the river. This study will generate data with which to evaluate if mussel diversity and abundance have been affected by exposure to site-related contaminant mixtures at other locations within the assessment area. The TC will use these data to inform the injury determination and quantification phases of the assessment as well as provide some information about the pathway(s) and extent of contamination.

SAMPLING METHODS

The mussel surveys will follow West Virginia Mussel Survey Protocols. The mussel survey window in West Virginia runs from May 1 to October 1. A WVDNR-approved surveyor that is familiar with the Kanawha River mussel assemblage and certified for diving in a hazardous waste area will be contracted to conduct a mussel survey following the WV protocol. The surveyor will obtain a WVDNR scientific collector's permit and sampling plan approval from WV DNR and FWS WVFO. Surveys will be performed on 50 transects beginning in June or as soon thereafter that river conditions permit. To demonstrate exposure to site-related contaminants, one composite sample of a common mussel will be collected at each sediment or porewater contamination area targeted for caged mussel studies and HD sampling (10) and the reference locations (2). These twelve composite samples will be analyzed for site-related contaminants at an FWS-approved laboratory following EPA analytical methods (see attached mussel tissue sampling protocol).

DATA QUALITY and MANAGEMENT

The surveyor will provide the verified quantitative spatially referenced data for 50 transects to the TC in report and spreadsheet formats. Analytical data will be verified by the FWS Analytical Control Facility and provided to the TC electronically. The TC will compare diversity, abundance, and analytical data in contaminated locations to the reference locations using one-way ANOVA, Kruskal-Wallis, or other suitable test based on data distribution. Data will be stored according to the case data management plan.

LOCATIONS

Mussel survey data are needed for the entire area within the Kanawha River NRDA assessment area and substrate-matched reference locations. Recent survey data exists for the upstream and downstream sections of the Back Channel (Fig C1). Data are lacking for the middle section of the Back Channel and the Blaine Island side of the Main Channel. The transects will target these locations as listed below and encompass documented areas with sediment and/or porewater contamination (Figure C2; coordinates available upon request). Transects in the Back Channel will run from river bank to island bank. Transects in the Main Channel will extend 75 meters from the island bank into the channel. Partial transects will be used to address incomplete transects in 2018/2019 surveys in the Back Channel. Reference locations were selected based on substrate and known presence of a federally listed mussel. A gravel-cobble reference location at the head of Blaine Island will be surveyed. A second reference location (right descending bank of main channel) with finer sediments has recently been surveyed (Figure C3).

Table C1. Target Locations for Mussel Transects

Location	**# Transects**
REFERENCE	
Island Head	15
BACK CHANNEL (see Fig C1)	
Middle Mainland/Northern Middle Island	12
Completion of Partial Transects	2
MAIN CHANNEL	
Middle Island	17
Northern Middle Island	4
TOTAL	50

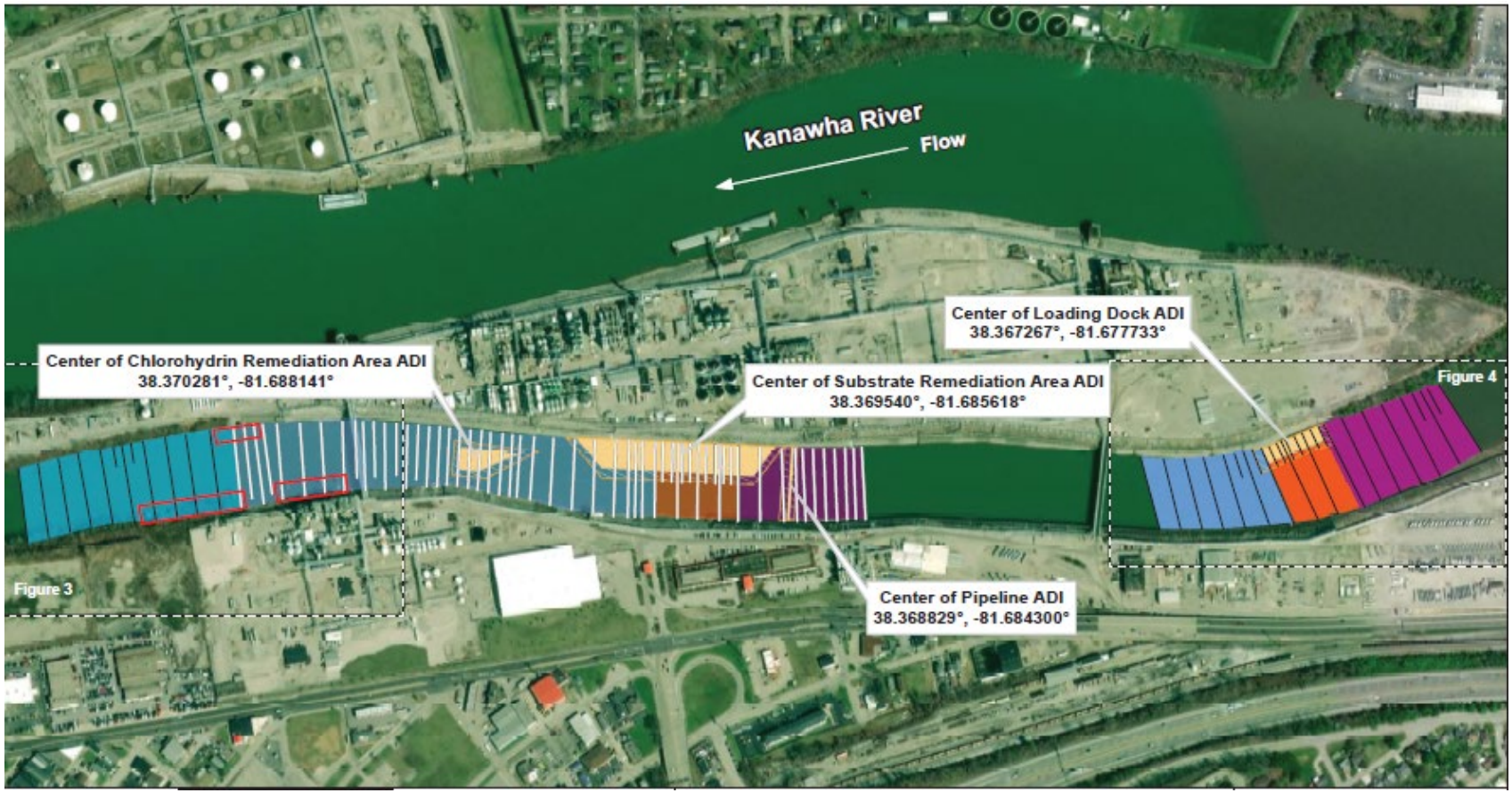

Figure C1. Existing mussel survey data in the Kanawha River Back Channel (Allstar Ecology 2019).

Figure C2. Target mussel survey transects in the Kanawha River for this study.

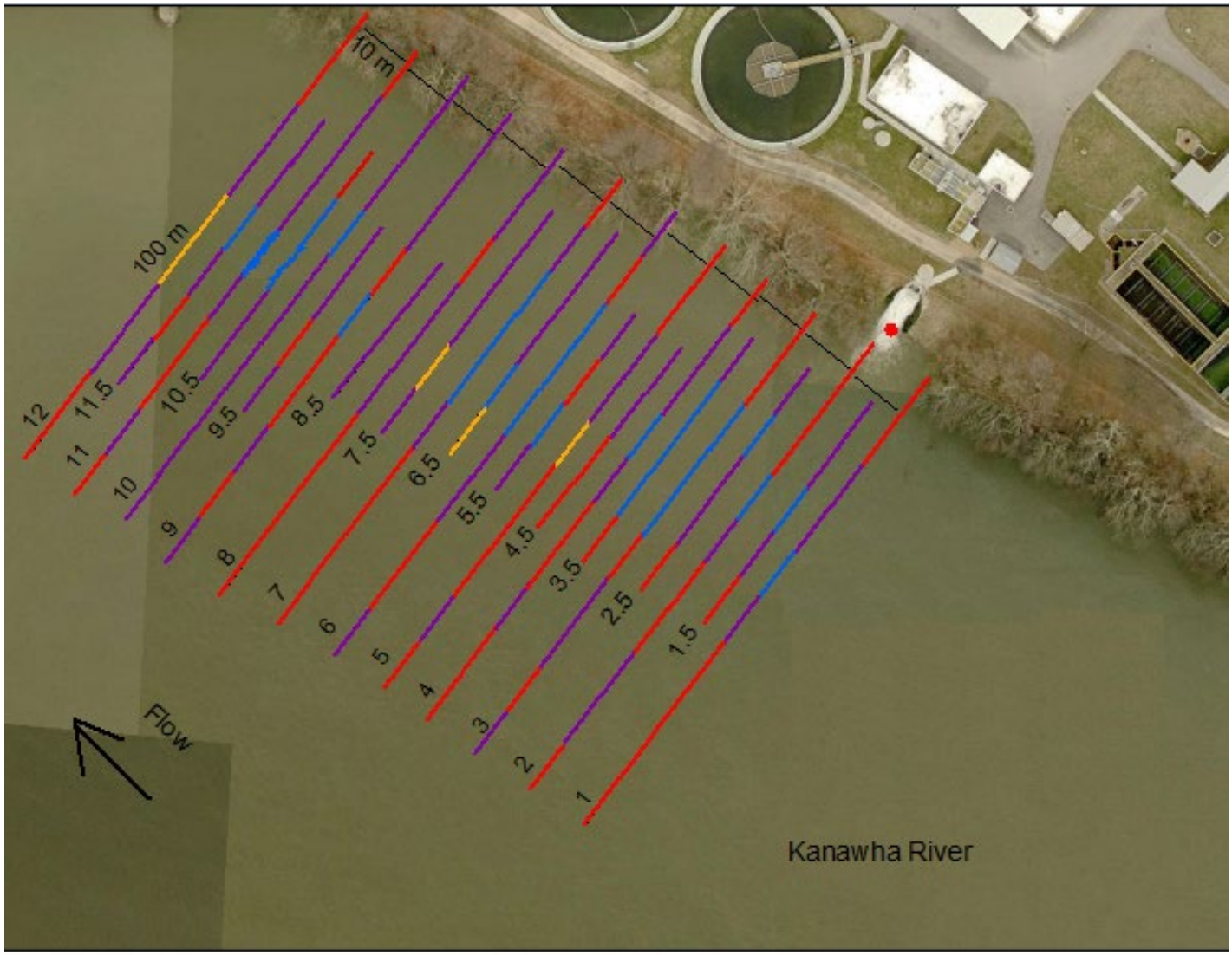

Figure C3. Existing mussel survey data in the Kanawha River Main Channel at Reference 2 (WVDEP 2016).

USFWS

STANDARD OPERATING PROCEDURE

SAMPLE COLLECTION, PROCESSING, AND ANALYSIS OF FRESHWATER MUSSEL

April 2023

1 Sample Program Rationale and Locations

The overall objective of this sampling program is to collect native mussels from the Kanawha River to evaluate exposure to contaminants.

The following activities will be conducted during the biota sampling program:

- Collect native mussels in the areas of the river in the Back Channel and Main Channel that are documented to have contaminated porewater and/or sediment, and
- Collect native mussels from reference locations at the head of Blaine Island and the Main Channel right descending bank.

1.1 Sampling Objectives

A common native mussel species such as pink heelsplitter (*Potamilus alatus*) will be collected from 12 mussel survey transects in each of the identified areas in Table 1. If insufficient native mussels are present on a target transect, mussels will be collected at the next transect with sufficient numbers.

1.1.1 Sample Collection

One composite sample of native mussels from each of the ten locations will be prepared along with a composite sample from each of the mussel reference locations (see Table 1). The FWS will decide the actual number of individuals per composite based on the abundance and size of mussels at the target sampling locations and the tissue mass requirement. These decisions will be made while the sampling crew is in the field. All sample preparation for mussels prior to analysis will be conducted in the field or at the FWS contract laboratory.

1.1.2 Analyses

Each mussel sample will be analyzed for PAHs and chlorinated benzenes by a FWS-contracted laboratory through the FWS mechanism for procuring analytical services. Percent

lipids and percent moisture will also be analyzed. All data will be reported as wet weight.

Table 1. Target Locations (closest point on transect) for Native Mussel Collection

Target Location	Latitude	Longitude
REFERENCE		
Island Head of Back Channel	38.367185	-81.674872
RDB of Main Channel	38.372044	-81.679256
BACK CHANNEL		
Island - Lower/Middle	38.372742	-81.696971
Island – Middle	38.369807	-81.686903
Island - Upper	38.368501	-81.682591
Mainland - Upper	38.36664	-81.677971
Mainland - Middle	38.369425	-81.686635
Mainland (Chlorohydrin)	38.370453	-81.688994
Mainland Lower (Chlorobenzene)	38.371087	-81.692049
MAIN CHANNEL		
Northern Middle Island	38.371357	-81.681399
Middle Island	38.371917	-81.686574
Lower Middle Island	38.372621	-81.693196

2 Field Activity Methods and Procedures

The following sampling-related tasks will be performed by a FWS contractor or FWS personnel:

- Field logbook documentation
- Equipment decontamination
- Biota sampling (mussels)
- Packaging and shipping of samples

Equipment and materials to complete these tasks are listed in Table 2.

2.1 Field Logbook Documentation

All field activities will be documented in a field logbook.

2.2 Equipment Decontamination

All sampling equipment will be decontaminated as described below. Sampling equipment will be wrapped in aluminum foil following each decontamination. The following steps will be taken to ensure equipment is properly decontaminated and ready for field use:

1. Liquinox detergent scrub
2. Rinse with clean potable water
3. Rinse with distilled water
4. Rinse with methanol
5. Rinse with distilled water
6. Air dry
7. Wrap with aluminum foil (shiny side out)

2.3 Mussel Sampling

1. When selected from the mussel survey bag, mussels will be placed in a plastic bag to form a composite sample and stored in a cooler with a temperature between 0.1° and 4°C until further processing.
2. Each mussel will be scrubbed to remove fouling growth and blotted to remove excess water prior to measuring and weighing. Mussel length (hinge to anterior margin) will be measured to the nearest 0.5 mm using a mechanical caliper, and the whole mussel (i.e., with shell) weighed to the nearest 0.1 g using a top-loading balance with a minimum accuracy of 0.1 g. All measurements will be recorded in a laboratory notebook.
3. Each mussel will be opened using a stainless-steel shucking knife and **all tissue and fluid** will be placed in a weighing boat and weighed to the nearest 0.1 g fresh weight. The shucking knife will be decontaminated between each replicate sample.
4. Care will be taken to remove all tissue (especially adductor muscle) and liquid. All measurements will be recorded in a laboratory notebook. In addition, the condition of the mussel will be noted (e.g., presence of parasites, etc.).
5. After all weights have been recorded, the **tissue and fluid** will be slid off and drained from the weighing boat into sample jars and frozen for later analysis.
6. All sample preparation (cleaning, shucking, weighing, and compositing of individuals) will be conducted by a FWS biologist before shipment to the FWS-contracted laboratory conducting the analysis. The total weight of each mussel in

the composite, and total weight of soft tissues in the composite (target 80-100g) will be measured. Mussel **soft tissue and fluid** will be homogenized prior to analysis.

2.4 Packaging and Shipping of Environmental Samples

Once soft tissue and fluids are placed into sample jars, the samples will be delivered under chain of custody to the designated FWS-contracted laboratory following the laboratory's shipping and handling protocol

Table 2. Field Equipment, Supplies, and Containers

Sampling	**Sample Packaging and Shipping**
Polyethylene sheeting, 100feet	Lab sample jars
Paper towels	Adhesive labels
Scraper	Plastic zip type bags (large and small)
Shucking Knife	Tape – clear strapping
Coolers with PAFO return address labels.	Custody seals
Wet Ice	Bubble wrap
Dry ice	Completed chain of custody record
Tape - duct	Completed catalog submission form
Heavy-duty plastic garbage bags	FedEx preprinted airbills
Liquid detergent	FedEx airbill pouches
Distilled Water	FedEx handle tags
Methanol	"This End Up" and directional arrow labels
Aluminum foil	
General	**Health and Safety**
Field logbooks	Gloves, nitrile
Waterproof pens	Gloves, cotton, work gloves
Permanent pens	Tyvek coveralls
Digital Camera	Over boots (if coveralls are footless)
	Rainsuit
	Life vest

3 Project Management

The Quality Assurance Project Plan (QAPP) for mussel sampling was prepared in accordance with EPA QA/R-5 guidance for preparing QAPPs (EPA 2001) and EPA Region III requirements. This section covers the basic area of project management, including the project organization, background and purpose, project description, quality objectives and criteria, special training, and documentation and records. Organization and responsibilities specific to this investigation are discussed in this section.

Mussels will be collected from transect survey hauls. FWS biologists will be responsible for the selection, processing, custody, packaging, and transport of the mussels to the FWS-contracted laboratory for analysis. FWS will also provide technical staff to manage the

associated analytical data and reporting requirements. Laboratory services will be provided by a contract laboratory identified by the FWS's Analytical Control Facility. It is anticipated that the West Virginia Division of Natural Resources (WVDNR) will provide a boat and operator. FWS is responsible for obtaining theses services.

3.1 Background and Purpose

The mussel sampling event, which will be performed in conjunction with the mussel survey, focuses on the collection of adequate data to demonstrate the extent of exposure in aquatic organisms. The purpose of this QAPP is to provide specific guidelines for the field activities, sampling, and measurement procedures, analytical support, data validation, and data evaluation associated with the native mussel sampling event. This document is to ensure that the samples collected, and the data generated are scientifically sound, statistically valid, and of known documented quality conducted in accordance with the requirements of the project.

3.2 Project Description

The QAPP addresses the field work that will be performed during the mussel sampling event and the sample preparation and analysis requirements.

The goals of the investigation are to:

- Collect a common species of native mussel at ten locations with known porewater and/or sediment contamination
- Collect the same mussel species at two mussel reference locations

4 Quality and Data Management Objectives

4.1 Quality Objectives and Criteria for Measurement

This section provides internal means for control and review so that environmentally related measurements and data collected by FWS are of known quality. When conducting this investigation, all measurements will be made so that results are reflective of the medium and conditions being measured. The subsections below describe the DQOs and data measurement objectives developed for this assignment.

Step 1: State the Problem

The purpose of the first step of the DQO process is to describe the problem to be studied so that the focus of this native mussel investigation will be unambiguous.

Records have shown that contaminants are present in porewater and sediment in the Kanawha River at the South Charleston Facility. Previous investigations of the South Charleston Facility have shown that significant contamination exists in the river sediments in the Back Channel adjacent to Blaine Island and in porewater in seven identified plumes in both the Back Channel and Main Channel of the river. A Screening Level Ecological Risk Assessment also determined that there was risk to the environment.

This SMP is designed to guide the field collection, preparation, and analysis of native mussel samples. These activities are part of the Trustee Council's Assessment Plan. The collection of these data will be combined with mussel survey and *in situ* and laboratory mussel toxicity testing results to determine the extent of exposure and injury. Decisions and actions relating to these questions will be determined by the Trustee Council.

Step 2: Identify the Decision

The purpose of the second step of the DQO process is to identify multiple decisions that the study attempts to address, organize the decisions sequentially (or logically), and examine the decisions to ensure consistency with the statement of the problem in Step 1.

This QAPP is intended to guide the collection of field data to help answer the primary questions defined above. The field investigation and sample analysis activities will provide the data to determine the concentration of site-related contaminants in native mussels. These data will be used in the injury determination.

Step 3: Identify the Inputs to the Decision

The purpose of the third step of the DQO process is to identify the information and data that need to be obtained and the measurements that need to be taken to resolve the decision statement. The Trustee Council has compiled and evaluated all currently available information from previous investigations in the preparation of this SMP. N ative mussels, including federally listed species, are being evaluated for injury from site-related contaminants. An analysis of native mussel tissue contamination is deemed necessary to complete this NRDA. The actions to be taken to provide the data for the NRDA include:

- Analyze native mussel samples composited from locations identified in Table 1 in the Back and Main Channels surrounding Blaine Island to determine concentrations of PAHs and chlorinated benzenes in soft tissues.
- Analyze native mussel samples collected at reference locations including the head of Blaine Island and the Main Channel right descending bank to determine concentrations of PAHs and chlorinated benzenes in soft tissues.

Step 4: Define the Study Boundaries

The purpose of the fourth step of the DQO process is to define the target population of interest, specify the spatial boundaries, and determine the time frame for collecting data.

This investigation will concentrate on native mussels found in the river within the NRDA Assessment Area. Adult native mussels will be collected in the period from May to October 2023 which encompasses the West Virginia native mussel survey period.

Step 5: Develop the Decision Rule

The purpose of the fifth step in the DQO process is to define the parameter of interest, specify the action levels, and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.

The development of decision rules for determining exposure to contaminated porewater and/or sediment involves using the data collected in the field investigation to determine the

concentration of site-related contaminants in the soft tissues. The parameters of interest are concentrations of PAHs and chlorinated benzenes. The decision rules are:

- If concentrations of site-related PAHs and chlorinated benzenes in native mussel tissue are elevated compared to the reference location, the exposure will be considered attributable to the South Charleston Facility

- If the concentrations of site-related PAHs and chlorinated benzenes in native mussel tissue are not elevated compared to the reference location, the Trustee Council will determine if additional assessment is warranted.

Step 6: Specify Tolerable Limits on Decision Errors

The purpose of the sixth step in the DQO process is to examine the consequences of making an incorrect decision.

A decision error occurs when the sample data set misleads investigators into making a wrong decision, and therefore, taking an incorrect response action. The possibility of a decision error exists because decisions are based on sample data that are incomplete and imperfect. Contaminant concentrations in native mussel tissue can vary due to the length of time that individual native mussels are exposed to contaminated media and the proximity of the native mussels to contaminated media.

The total study error consists of:

- Sampling design error, influenced by the inherent variability of the population over space and time, the sample collection design, and the number of samples collected, and
- Measurement error, influenced by imperfections in the measurement and analysis system

The combination of sampling design and measurement errors is the total study error. Since it is impossible to completely eliminate total study error, basing decisions on sample concentrations may lead to a decision error. The probability of decision error is controlled by adopting a scientific approach in which the data are used to select between one condition (the null hypothesis or $H_{0)}$ and another (the alternative hypothesis or HA). The null hypothesis is presumed to be true in the absence of evidence to the contrary. For this project, the null hypothesis is that the true values of the constituents are below the reference concentrations. The alternative hypothesis is that the true values of the constituents are above the reference concentrations.

The largest source of error in the study design is the spatial variability of contamination and its associated accumulation in the sampled native mussels. This error is partly mitigated through the compositing of individual native mussels to make a combined sample. Multiple individuals will be collected and composited to eliminate the consequences of relying on an individual sample result. The number of native mussels per composite and the number of replicate composite samples will depend on the amount of legal-sized native mussel species that are able to be collected and the tissue mass requirements for analysis.

Sample collection equipment, analytical methods, and instruments are never absolutely perfect. Hence, a measurement can only estimate the true value of an environmental sample. Measurement error refers to a combination of random systematic errors that inevitably arise during the various steps of the measurement process. These errors have been minimized in this investigation through the careful selection of written Standard Operation Procedures to guide sample preparation, and the use of standard laboratory procedures that achieve detection limits that are compatible with the use of the data for injury determination. These field and laboratory procedures are discussed in this SMP.

Step 7: Optimize the Design
The seventh step in the DQO process identifies a resource-effective data collection design for generating data that are expected to satisfy the DQOs. The sampling program to collect these data is described in the SMP.

4.2 Data Measurement Objectives

FWS ACF will contract the laboratories to be used to analyze the native samples for PAHs and chlorinated benzenes. Every reasonable attempt will be made to obtain a complete set of usable analytical data. If a measurement cannot be obtained (for a reason other than lack of sufficient sample mass) or is unusable for any reason, the effect of the missing data will be evaluated by the Trustee Council. The impact of data missing due to insufficient sample mass will be evaluated in the injury determination.

Other data that will be collected includes water temperature, pH, salinity and turbidity, as well as native mussel weight, size and mortality.

5 Quality Assurance Guidance

5.1 Precision, Accuracy, Representativeness, Completeness, and Comparability Criteria

Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters are indicators of data quality. PARCC goals are established for the site characterization to aid in assessing data quality. The following paragraphs define these PARCC parameters in conjunction with this project.

Precision. The precision of a measurement is an expression of mutual agreement among individual measurements of the same property taken under prescribed similar conditions. Precision is quantitative and most often expressed in terms of relative percent difference (RPD). Precision of the laboratory analyses will be assessed by comparing original and duplicate results, where applicable.

Precision of reported results is a function of inherent field-related variability plus laboratory analytical variability depending on the type of QC sample. Data will be evaluated for precision using field duplicates. The acceptable RPD limits for field duplicates are less than or equal to± 35% for biota tissue samples. Laboratory measures of precision will be evaluated with appropriate CLP SOW.

Accuracy. Accuracy is the degree of agreement of a measurement with an accepted reference or true value and is a measure of the bias in a system. Accuracy is quantitative and usually expressed as the percent recovery (%R) of a sample result. Percent Recovery results generated by the laboratory will be evaluated in accordance with the appropriate SOW.

Representativeness. Representativeness expresses the degree to which sample data accurately and precisely represent:

- The characteristic being measured
- Parameter variations at a sampling point; and/or
- An environmental condition.

Representativeness is a qualitative and quantitative parameter that is most concerned with the proper sampling design and the absence of cross-contamination of samples. Acceptable representativeness will be achieved through (a) careful, informed selection of sampling sites, (b) selection of testing parameters and methods that adequately define and characterize the extent of possible contamination and meet the required parameter reporting limits, c) proper gathering and handling of samples to avoid interferences and prevent contamination and loss, and (d) collection of a sufficient number of samples to allow characterization. The representativeness will be assessed qualitatively by reviewing the sampling and analytical procedures and quantitatively by reviewing the blank samples. If an analyte is detected in a method, preparation, or rinsate blank, any associated positive result less than five times (10 times for common laboratory contaminants) the concentration found in the associated blank should be qualified with a “B".

Completeness. Completeness is a measure of the amount of usable data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Usability will be determined by evaluation of the PARCC parameters excluding completeness. Those data that are validated or evaluated and are not considered estimated or are qualified as estimated or non-detect are considered usable. Rejected data are not considered usable. A completeness goal of 90% is projected. If this goal is not met, the effect of not meeting this goal will be discussed by the Trustee Council.

Comparability. Comparability is a qualitative parameter. Consistency in the acquisition, handling, and analysis of samples is necessary for comparing results. Data developed under this investigation will be collected and analyzed using standard EPA analytical methods and QC to ensure comparability of results with other analyses performed in a similar manner.

5.2 Field Measurements

Field measurements include surface water temperature, pH, turbidity, and salinity at native mussel sampling locations. These measurements will be made with a water quality meter that is calibrated according to the manufacturer's instructions. The size of the native mussels will also be measured. Only native mussels of 3 inches or larger will be kept for analysis.

5.2.1 Field Sample Custody and Documentation

The purpose and description of the sample label and the chain-of-custody record are detailed in the following sections.

5.2.1.1 Sample Labeling and Identification

Native mussels samples are identified by collection location. A simple alphanumeric coding system will identify native mussel tissue homogenate samples prepared by FWS. These numbers will serve to group samples by their sample location, homogenate type, and replicate. A unique sample identification number must be assigned to each native mussel tissue composite or QC sample.

A template for the native mussel homogenate sample number is as follows: KR-BB-CC-P where KR indicates Kanawha River, BB indicates the location, CC indicates the mussel survey transect number, and P will be used, if appropriate to designate that the sample is a duplicate.

Location codes that will be used include:

- MC – River Main Channel
- BC – River Back Channel
- R1 – Reference at upstream end of Blaine Island

Thus, a sample labeled KR-MC-35 indicates that the sample was collected in the Main Channel at Transect #35.

5.2.1.2 Paperwork Requirements

Paperwork requirements for shipping environmental samples to FWS-contract laboratories are provided below.

Chain-of-Custody Form

Completed form will be in sealed bag within the cooler holding the samples.

Custody Seals

At least two custody seals will be placed across cooler openings in such a way that the seals will be broken when the cooler is opened. The sampler will sign and date the custody seals. Custody seals are not required to be placed on the lids of sample containers.

Catalog Submission Forms

FWS personnel will enter all samples into the ECDMS catalog system. A hardcopy of the catalog submission forms will be included in the sample shipment.

Communicating Shipping Information

FWS personnel will ship frozen native mussel soft tissue and fluid samples on dry ice directly to the laboratory. The FWS Case Manager is responsible for coordinating with the laboratory contact on the shipment and custody transfer of the samples.

5.2.1.3 Sample Packaging and Shipping

Native mussel samples are to be packaged in accordance with instructions received from the FWS-contract laboratory.

5.2.1.4 Field Logbook(s) and Records

Field logbook(s) will be maintained by the field team. FWS personnel are responsible for maintenance and document control of all field logbooks.

For the logbooks, a single strikeout initialed and dated is required for documentation changes. The correct information will be entered in close proximity to the erroneous entry. All deviations from the guiding documents will be recorded in the logbook(s).

5.2.1.5.1 Photographs

Field teams will photograph appropriate field work activities for documentation purposes.

5.3 Laboratory Analysis

Analytical methods, container requirements, and holding times are discussed below for the native mussel tissue samples. Table 3 provides a summary of this information.

Analytical Methods

PAH concentrations will be determined using EPA Methods 1625 and 8270. Tissues will be analyzed for chlorobenzenes using EPA Method 1699. Percent moisture and percent lipid will also be determined for each composite.

Quantitation limits

Table 3 summarizes the contract-required quantitation limits for the analytical methods referenced above which are considered acceptable to meet the intended purpose of this investigation.

Laboratories

Processing and compositing of samples will be conducted at a FWS facility by FWS personnel. All off-site analytical work will be contracted through FWS ACF.

Holding Times

Holding times are storage times allowed between sample collection and sample extraction or analysis (depending on whether the holding time is an extraction or analytical holding time) when the storage techniques are employed. The holding time for the various analytical methods listed for this investigation are presented in Table 3. Composites of mussel tissues and fluids will be frozen in the field and transported to the FWS-designated laboratory in coolers with dry ice.

5.4 Quality Control Samples

FWS personnel will prepare the native mussel tissue and fluid composites to obtain 100 g of soft tissue. FWS personnel will create a field duplicate by randomly assigning similarly sized mussels from the same location to two different composites.

Any tools used during shucking, homogenization and weighing parts of the native mussel will be decontaminated between each replicate sample. FWS will collect an equipment rinsate blank for shucking equipment to demonstrate effectiveness of decontamination.

FWS-contract laboratory will homogenize the samples for extraction and analysis. A duplicate will be collected from parent homogenate sample for each type of analysis to

measure laboratory variability. The laboratory will create the MS/MSD sample on a random composite sample.

5.5 Data Validation and Usability

Laboratory analytical results will be reviewed for compliance with project objectives. The laboratories will submit analytical data reports to FWS Analytical Control Facility (ACF) electronically. Data validation and evaluation will be performed by the FWS ACF following standard procedures.

Table 3. ANALYTICAL SAMPLING PROGRAM SUMMARY: Mussel Samples from Kanawha River

Analytical Parameter	Sample Matrix	Number of Samples	Analytical Method	Detection Limit	Sample Preservation	Holding Time	Containers
PAHs (Percent lipid & percent moisture must also be analyzed under this method)	Mussel soft tissue and fluids	12 composites	EPA-1625 and EPA-8270	0.1 ng/g	Freeze upon collection and ship on dry ice	< 1 year	Tissue: Glass jars Jars: plastic bag in cooler
Chlorobenzenes (Percent lipid & percent moisture must also be analyzed under this method)	Mussel soft tissue and fluids	12 composites	EPA 1699	0.05 ng/g	Freeze upon collection and ship on dry ice	<1 year	Tissue: Glass jars Jars: plastic bag in cooler

6 Data Management Plan

This Data Management Plan (DMP) has been prepared to describe how FWS will manage, manipulate, and present data collected during the NRDAR.

6.1 Data Assembly

Data collected during the field investigation will be organized, formatted, and inputted into the project database for use in the data evaluation phase. A ll laboratory data will be validated by the FWS Analytical Control Facility. FWS will use Microsoft's Excel spreadsheet software for managing all data collected during the sampling program.

6.2 Data Entry and Format

Data may include laboratory results, water quality and other field parameters, and field screening data. It is assumed all laboratory analytical data will be provided to FWS as an electronic data deliverable.

6.3 Data Useability Evaluation

FWS ACF will review the data and the data validation report to determine if the data are of sufficient quality to be relied upon in performing an injury determination. The review will include an evaluation of field quality assurance/ quality control (QA/ QC) requirements to determine whether the samples were collected at the frequency specified in the Quality Assurance Project Plan (QAPP) and whether the results of the QA/QC samples are within specific guidelines. The review will also include an evaluation of the data validation report conclusions concerning whether the data meets the established quality goals.

6.4 Electronic Media Handling

The database will be maintained at FWS ACF and FWS PAFO. Archives will be created on an alternate hard drive. The label on archival media will include the following: client, work assignment number, disc number, date of origin, and format of data files. FWS will maintain a log of all the database files and discs that will track information and the status of each disc.

6.5 Quality Assurance and Quality Control

The electronically available data will be transferred into the FWS ACF system and a 10% QA/QC check will be performed by the FWS data management staff.

References

U.S. Environmental Protection Agency (EPA). 2000. Guidance for the Data Quality Objectives Process. EPA QA/G-4. September.

U.S. EPA. 2001. EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations. QA/R-5. Draft Final, March.

APPENDIX D

SOUTH CHARLESTON FACILITY KANAWHA RIVER NRDA: BENTHIC MACROINVERTEBRATE SURVEY STUDY PLAN

BACKGROUND

Benthic invertebrates are a natural resource over which the State and FWS exercise trusteeship. In addition, benthic macroinvertebrates (BMI) form the base of the aquatic food chain and emergent invertebrates are prey for birds and mammals. Contaminants present in porewater and sediment within the Kanawha River NRDA assessment area are documented to cause lethal and sublethal effects to BMI in both laboratory and field testing. As these invertebrates inhabit the substrate on the river bottom, they are directly exposed to contaminants in porewater and sediment. This study will generate data to evaluate if BMI abundance and diversity have been altered by exposure to site-related contaminants. These data will inform the injury determination and quantification phases of the assessment as well as provide some information about the pathway(s) and extent of contamination.

SAMPLING METHODS

BMI sampling in large rivers is best accomplished using artificial substrate devices. We will use Hester-Dendy plate samplers (HDs) with graduated spacing attached to a concrete block on the river bottom and cabled to the riverbank. We will retrieve the HDs into submerged 5- gallon buckets after a 6-week exposure period. In the laboratory, the organisms on each HD will be removed from the plates, sieved with #30, and rinsed into a container of 70% ethanol for preservation. The organisms will be identified and quantified by an aquatic entomologist certified with Society for Freshwater Science. The data will be used to derive the Ohio River Macroinvertebrate Index (ORMIn) score used by the Ohio River Sanitation Commission (ORSANCO 2020) to evaluate benthic invertebrate community health in this basin (Table D1). Scores for each location will be compared to the reference locations using one-way ANOVA, Kruskal-Wallis, or other suitable test based on data distribution and substrate-matched reference.

Table D1. ORMIn METRICS

Metrics	**Metric Definition**
Taxa	Number of unique macroinvertebrate taxa
EPT Taxa	No. of taxa that belong to Ephemeroptera, Plecoptera, or Trichoptera orders
Predator Taxa	No. of taxa that are predators
% Collector	% of taxa that feed on fine particulate organic matter
% Caenids	% of individuals that belong to the pollution tolerant Ephemeropterans
% Odonates	% of individuals that belong to the Odonata order
% Intolerants	% of individuals intolerant to pollution and habitat degradation
% Clingers	% of individuals that cling to instream habitat

LOCATIONS

Sampling within the Kanawha River NRDA assessment area is based on the Revised Conceptual Site Model (Figure 2.1) and targets porewater contamination or a combination of porewater and sediment contamination at ten areas (Table D2). The Middle Island DNAPL area will not be sampled as these sediments were already demonstrated to be toxic to invertebrates in the USGS amphipod laboratory test (USGS 2023). In larger areas where a substantial gradient or shift in contaminants occurs, paired sampling locations will capture potential differences. Two reference locations were selected based on substrate within the industrial area, boat traffic, and known presence of a federally listed mussel. The gravel-cobble reference location will be in the Back Channel near the head of Blaine Island and the second reference location will be on the right descending river bank of the Main Channel where a federally listed mussel was documented. At each location, five HDs will be placed in close proximity to three mussel silos, but sufficiently separated to enable ample flow through both. GPS coordinates will be recorded for each trap cluster.

Table D2. Target Locations within each area of the river.

Target Location	Name	Hester Dendy Lat	Hester Dendy Long
REFERENCE			
Island Head of Back Channel	Ref 001	38.367185	-81.674872
RDB of Main Channel	Ref 002	38.372044	-81.679256
BACK CHANNEL			
Island - Lower/Middle	SD001	38.372742	-81.696971
	SD010	38.3716099	-81.691833
Island – Middle	SD017	38.369807	-81.686903
Island - Upper	SD024	38.368501	-81.682591
Mainland - Upper	SD028	38.36664	-81.677971
Mainland - Middle	SD018	38.369425	-81.686635
	SD023	38.368282	-81.683307
Mainland (Chlorohydrin)	SD014	38.370453	-81.688994
Mainland Lower (Chlorobenzene)	SD011	38.371087	-81.692049
	SD012	38.370851	-81.690581
MAIN CHANNEL			
Northern Middle Island	SD007	38.371357	-81.681399
Middle Island	SD005	38.371654	-81.684892
	PW146	38.371917	-81.686574
Lower Middle Island	SD002	38.372621	-81.693196

Figure D1. Hester-Dendy Target Locations within the Main and Back Channels of the Kanawha River.

APPENDIX E

SOUTH CHARLESTON FACILITY KANAWHA RIVER NRDA: CAGED MUSSEL TOXICITY STUDY PLAN

BACKGROUND

Freshwater mussels are a natural resource over which the State and FWS exercise trusteeship. In addition, recent surveys have documented the presence of two state and federally listed mussels (snuffbox; *Epioblasma triquetra* and round hickorynut; *Obovaria subrotunda*) in the Kanawha River NRDA assessment area. As freshwater mussels inhabit the substrate on the river bottom, they are directly exposed to contaminants in porewater and sediment. The contaminant mixture present in sediment within the DNAPL area of the Back Channel was documented to cause lethal and sublethal effects to a freshwater mussel in laboratory testing (USGS 2023). However, toxicity data are not available for the other contaminant mixtures in sediment and porewater in the Back and Main Channels of the river. This study will generate data with which to evaluate if juvenile mussels placed in cages experience lethal or sublethal effects when exposed to site-related contaminant mixtures at other locations within the assessment area. The Trustee Council (TC) will use these data to inform the injury determination and quantification phases of the assessment as well as provide some information about the pathway(s) and extent of contamination.

SAMPLING METHODS

Mussel toxicity testing in rivers is best accomplished using flow-through cages within concrete silos. In Spring 2023, 20 juvenile *Lampsilis cardium* mussels (~60d), reared at the USFWS White Sulphur Springs National Fish Hatchery, will be randomly placed in each mussel silo cabled to the riverbank or a concrete weight. We will document mussel survival after 6 weeks and retrieve the silos after a 12-week exposure period. The mussels will be evaluated by two TC biologists to determine survival at 6 and 12 weeks, digitally photographed to verify survival and facilitate growth measurements, and weighed to the nearest 0.1mg at deployment and retrieval following USGS procedures. The TC will compare survival, growth, and biomass for each location (i.e., known contaminant mixture and concentration) to the reference location using one-way ANOVA, Kruskal-Wallis, or other suitable test based on data distribution and habitat-matched reference.

LOCATIONS

Sampling within the Kanawha River NRDA assessment area is based on the Revised Conceptual Site Model (Figure 2.1) and targets ten areas with documented porewater or a combination of porewater and sediment contamination (Table E1). In larger areas where a substantial gradient or shift in contaminants occurs, paired sampling locations will capture potential differences. Two reference locations were selected based on substrate within the industrial area, boat traffic, and known presence of a federally listed mussel. The gravel-cobble reference location will be in the Back Channel at the head of Blaine Island and the second reference location will be on the right descending river bank of the Main Channel where a federally listed mussel was documented. At each location, three mussel cages will be placed in close proximity to five Hester- Dendy samplers, but sufficiently separated to enable ample flow through both. GPS coordinates will be recorded for each mussel silo cluster.

Table E1. Target Locations within each area of the river.

Target Location	Name	Cage Lat	Cage Long
REFERENCE			
Island Head in Back Channel	Ref 001	38.367185	-81.674872
RDB of Main Channel	Ref 002	38.372044	-81.679256
BACK CHANNEL			
Island - Lower/Middle	SD001	38.372742	-81.696971
	SD010	38.3716099	-81.691833
Island – Middle	SD017	38.369807	-81.686903
Island - Upper	SD024	38.368501	-81.682591
Mainland - Upper	SD028	38.36664	-81.677971
Mainland - Middle	SD018	38.369425	-81.686635
	SD023	38.368282	-81.683307
Mainland (Chlorohydrin)	SD014	38.370453	-81.688994
Mainland Lower (Chlorobenzene)	SD011	38.371087	-81.692049
	SD012	38.370851	-81.690581
MAIN CHANNEL			
Northern Middle Island	SD007	38.371357	-81.681399
Middle Island	SD005	38.371654	-81.684892
	PW146	38.371917	-81.686574
Lower Middle Island	SD002	38.372621	-81.693196

Figure E1. Mussel Cage Target Locations within the Main and Back Channels of the Kanawha River.

APPENDIX F

SOUTH CHARLESTON FACILITY KANAWHA RIVER NRDA: COMMENT SUMMARY AND RESPONSES

The Trustees received two sets of comments (see attached) on the draft Assessment Plan for the South Charleston Facility Kanawha River NRDAR. The Trustees have paraphrased the comments and provided responses below and incorporated any changes to the Final Assessment Plan. Copies of the original comments may be found following this Response.

Comment 1: Due to the complexities involved in the laboratory analysis of tissue samples for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), please provide the field and laboratory standard operating procedures that will be used.

Response: SOPs will be made available to the public prior to study initiation. Based on the COPC, the Trustees will not be collecting or analyzing fish tissue at this time and this change has been made in the Final Assessment Plan. Rather, the Trustees will only be analyzing the mussel tissue for SVOCs. Mussel tissue sampling for SVOCs will follow approved analytical methods.

Comment 2: Please describe how the Trustees will relate fish tissue concentrations to COPC concentrations in the porewater and sediment within the Assessment Area given that the fish are moving around and occupying both contaminated and noncontaminated areas, even if their home range is fully within the Assessment Area.

Response: Trustees do not plan to collect fish tissue at this time and this reference was removed from the Final Assessment Plan.

Comment 3: Tissue COPC data may be useful to document exposure, but UCC does not believe they are useful inputs to quantify injury.

Response: Thank you for your comment. The Trustees will consider this once they are reviewing the data collected pursuant to the Assessment Plan.

Comment 4: UCC is seriously concerned that the existing pipes and infrastructure could be damaged by the benthic trawl. Given this concern, UCC suggests that the Trustees develop an alternative method for collecting data in this location to ensure existing piping and infrastructure are not impacted or damaged.

Response: It is important to collect fish with similar methods widely accepted by benthic fish experts and in the Kanawha River to ensure data collected can be integrated with previous data. The Trustees will continue to work with UCC to determine a safe method to collect fish in areas with active infrastructure.

Comment 5: Please note that reference data from Scotts Island will not be contemporaneous. Also, the reference location is not subject to the same suite of non-site-related anthropogenic stressors as Blaine's Island. Please address how these potentially confounding factors will be addressed in the injury analysis.

Response: The Trustees determined that existing data for Scotts Island was relevant and accurate and therefore did not propose to re-sample in an effort to reduce the costs of the assessment. Please provide any evidence that conditions have changed since the previous sampling event and the Trustees can re-consider if re-sampling is warranted. Scotts Island is an appropriate reference for Blaine Island because of similarities in habitat structure and proximate geographic location in the Kanawha River, and geological and hydrogeological settings that form the foundation for the ecological conditions. Several industries (e.g., oil refineries, power plants, coal distribution areas, and wastewater treatment plants) are located upstream of Scotts Island.

Figure 1.1 Map of Assessment Area (orange polygon) with UCC South Charleston Facility Identified (red polygons)

- *Comment 6: The red polygon shown on Blaine Island does not correctly represent the UCC South Charleston Facility. The entire island is part of the UCC South Charleston Facility.*

  Response: The figure has been corrected.

Figure 2.2 NRDAR Assessment Area (orange polygon) including reference locations (blue polygons)

- *Comment 7: The red polygon shown on Blaine Island does not correctly represent the UCC South Charleston Facility. The entire island is part of the UCC South Charleston Facility.*

  Response: The figure has been corrected.

- *Comment 8: The third reference area near the wastewater treatment plant along the left descending bank near the UCC boundary is missing from the figure.*

  Response: That proposed location has been dropped from the study plan.

Comment 9: Overall, the study seems thorough and uses standard methods.

Response: Thank you for your comment.

Comment 10: The color of the Groundwater Flow arrows in Figure 2.1 found on page 13 of the Draft Assessment Plan is difficult to see. Please change the color improve visibility.

Response: This Figure is taken from a UCC report (Jacobs 2020a) submitted to EPA and we are unable to alter the colors used.

Comment 11: Please clarify which groundwater plumes are to be sampled.

Response: Sampling locations have been selected based on previous sediment and porewater sample results for each generalized groundwater plume discharge area and sediment deposit. However, field conditions may necessitate adjustment of some samples. Thus, exact locations will be included in the final study report.

Comment 12: Benthic Macroinvertebrate sampling: Using the ORSANCO protocol with plate samplers allows comparison to other large deep-water streams, but sampling may be biased against burrowing mayfly species such as Hexagenia. (Kirk and Perry 1994 study). This genus has been used as a water quality indicator in some watersheds.

Response: It is true that we do not anticipate sampling burrowing species utilizing this method. However, we will not include their absence in our sampling as an indication of absence at the site to inform water quality. We will use the metrics specifically outlined by ORSANCO (ORMIn Metrics) used with the Hester-Dendy plate samplers and compare results to reference locations.

Comment 13: Caged Mussel study: Please indicate the species of mussels to be used in the study. Also, please describe the source of the juvenile mussels as there may be some pollution tolerance if these were pre-exposed to the chemicals or water quality was worse where they will be collected compared to the test site.

Response: The mussel species is *Lampsilis cardium.* The juvenile mussels used for this study will be propagated and cultured at the U.S. Fish and Wildlife Service White Sulphur Springs National Fish Hatchery and as such will not be previously exposed to any source of contamination or water quality issues.

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

April 6, 2023

Kathleen Patnode
U.S. Fish and Wildlife Service
110 Radnor Road, Suite 101
State College, Pennsylvania 16801
Via Email: Kathleen_Patnode@fws.gov

Re: South Charleston Facility Kanawha River Natural Resource Damage Assessment Plan, Draft for Public Review and Comment

Dear Ms. Patnode,

This letter is submitted on behalf of Union Carbide Corporation (UCC) and provides comments on the South Charleston Facility Kanawha River Natural Resource Damage Assessment Plan, Draft for Public Review and Comment (Draft AP). The Draft AP is one of the documents identified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Natural Resource Damage Assessment (NRDA) regulations; its purpose is "to ensure that the assessment is performed in a planned and systematic manner and that methodologies selected [...] can be conducted at a reasonable cost" (43 *Code of Federal Regulations* 11.30(b)). UCC appreciates the opportunity to present these comments to the Trustees and looks forward to working collaboratively with the Trustees on the assessment.

UCC's comments focus on Section 5 and Appendices B through E; these are important sections that describe the studies the Trustees plan to undertake in the Assessment Area and reference areas and how these data will be used in the injury assessment. UCC reserves the right to comment on any future or modified plans for additional assessment activities or studies before they are finalized by the Trustees.

UCC Comments

Section 5.1.1 Aquatic Resources Evaluation

- The third bullet under *A. Screening of chemical contaminants in surface waters, porewater, sediment, mussels, and fish* states the following:
  - "Collect fish and mussel samples for chemicals of potential concern (COPC) analysis, respectively across a gradient of COPC concentrations in the assessment area and reference areas."
    - **Comment 1**: The primary COPCs at the Facility are volatile organic compounds (VOCs). Other COPCs include semivolatile organic compounds (SVOCs) and

metals. Processing tissue samples immediately after collection to ensure that these volatile and semivolatile compounds are preserved in tissue for subsequent laboratory analysis is a complex undertaking. To avoid questions regarding the validity of the chemical data for use in the injury assessment, the Trustees must provide for review the field and laboratory standard operating procedures that will be used. See also comments 2 and 3 for questions regarding the relevance of these data for the injury assessment.

- **Comment 2**: With respect to collection of fish tissue for chemical analysis, UCC notes that the activities identified in Appendix B do not provide for the collection of fish tissue for chemical analysis, which is consistent with UCC's understanding of the Trustees' proposed activities per the parties' discussions at the December 13, 2022, meeting among technical personnel in Farmington, West Virginia. If, however, the Trustees are proposing to collect fish for chemical analysis, language needs to be added to the Study Plan in Appendix B to reflect this component of the study. More importantly, UCC has significant concerns regarding how these data will be used in the injury assessment. Specifically, because fish will be collected along trawl lines, the precise area along a trawl line where the fish were collected relative to known gradients of COPC concentrations along these trawl lines makes the interpretation of tissue COPC concentrations very uncertain. Stated another way, how will the Trustees relate fish tissue concentrations to COPC concentrations in the porewater and sediment within the Assessment Area given that the fish are moving around and occupying both contaminated and noncontaminated areas, even if their home range is fully within the Assessment Area?

- The fourth bullet under *A. Screening of chemical contaminants in surface waters, porewater, sediment, mussels, and fish* states the following:
  - "Compare the highest tissue concentrations to the lowest and most conservative applicable ecological benchmark or injury thresholds."
    - **Comment 3**: Notwithstanding the issues raised in the preceding comments, UCC has concerns regarding how any mussel or fish tissue COPC concentration data will be used in the injury assessment. VOCs and SVOCs are transitory in nature in media such as tissue. Thus, it will be difficult, if not impossible, to determine whether tissue concentrations reflect long-term exposure that is important with respect to quantifying injury or whether the exposure is short-lived. The transitory nature of VOCs and SVOCs in tissue is also relevant to comparing tissue concentrations to ecological benchmarks or injury thresholds, of which there are few. For these reasons, tissue COPC data may be useful to document exposure, but UCC does not believe they are useful inputs to quantify injury.

- The third bullet under *B. Assessing trends in benthic fish communities, mussel, and benthic macroinvertebrates (Appendices B, C, and D)* states the following:
  - "The benthic fish survey, conducted following the protocol outlined in Owens (2019),[1] will target Back and Main Channel areas not previously surveyed focusing on areas with sediment and porewater contamination."
    - **Comment 4**: UCC has serious concerns regarding implementation of the benthic fish survey methods (i.e., benthic trawl survey) in the Back Channel. Specifically, UCC is concerned that the existing pipes and infrastructure could be damaged by the benthic trawl. Given this concern, UCC suggests that the Trustees develop an alternative method for collecting data in this location to ensure existing piping and infrastructure are not impacted or damaged.
- The Sampling Methods Section indicates that Scotts Island will be the reference island and that only Blaine Island—and not Scotts Island—will be sampled.
  - **Comment 5**: Please note that reference data will not be contemporaneous and that the reference location is not subject to the same suite of non-site-related anthropogenic stressors. Please address how these potentially confounding factors will be addressed in the injury analysis.

Figure 1.1 Map of Assessment Area (orange polygon) with UCC South Charleston Facility Identified (red polygons)

- **Comment 6:** The red polygon shown on Blaine Island does not correctly represent the UCC South Charleston Facility. The entire island is part of the UCC South Charleston Facility.

Figure 2.2 NRDAR Assessment Area (orange polygon) including reference locations (blue polygons)

- **Comment 7:** The red polygon shown on Blaine Island does not correctly represent the UCC South Charleston Facility. The entire island is part of the UCC South Charleston Facility.

- **Comment 8:** The third reference area near the wastewater treatment plant along the left descending bank near the UCC boundary is missing from the figure.

[1] Owens, N., 2019. *Distribution and Habitat Use of Benthic Fishes in the Lower Kanawha River, West Virginia.* Master's Thesis. Morgantown, West Virginia. West Virginia University; Davis College of Agriculture, Natural Resources, and Design.

UCC appreciates the opportunity to review and comment on the AP. If you have any questions about the comments, please feel free to contact me at (267) 751-4121 or dhaury@anchorqea.com.

Sincerely,

David Haury
Principal

cc: Jim Sprague, UCC
Ryan Weiss, UCC
Nicole Moshang, Manko, Gold, Katcher, and Fox

Public Comment: South Charleston Facility Kanawha River Natural Resource Damage Assessment Plan, Draft for public review and Comment.

To: Kathleen Patnode
U.S. Fish and Wildlife Service
110 Radnor Road, Suite 101
State College, PA 16801

From: University of Charleston, WV, undergraduate STEM Scholar Program students.

General opinion:

Overall, the study seems thorough and uses standard methods.

I feel like the color of the Groundwater Flow arrows in figure 2.1 found on page 13 needs to be changed. I feel like the blue is hard to see, especially because the majority of them fall within the Generalized Plume Locations and they are marked with a purple color. Due to this I feel like changing the color of the Groundwater Flow would allow readers to see these Groundwater Flow patterns much easier.

Other areas of concern voiced by students:

It was hard to determine which plumes were to be sampled from the figures provided.

Benthic Macroinvertebrate sampling

Using the ORSANCO protocol with plate samplers allows comparison to other large deep-water streams, but sampling may be biased against burrowing mayfly species such as *Hexagenia*. (Kirk and Perry 1994 study). This genus has been used as a water quality indicator in some watersheds.

Caged Mussel study

The species of mussels to be used in the study was not indicated. Depending on the source of the juvenile muscles there may be some pollution tolerance if these were pre-exposed to the chemicals or water quality was worse where they will be collected compared to the test site.