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Tennessee Valley Authority Kingston Fossil Plant Coal Ash Release Natural Resource Damage Assessment

Restoration and Compensation Determination Plan

Final | 26 May 2015

prepared by:

Natural Resource Trustees of the Tennessee Valley Authority Kingston Fossil Plant Coal Ash Release Natural Resource Damage Assessment:

State of Tennessee Department of Environment and Conservation

Tennessee Valley Authority

United States Fish and Wildlife Service

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INDUSTRIAL ECONOMICS, INCORPORATED

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LIST OF EXHIBITS

LIST OF ACRONYMS

%EPT	Percent Ephemeroptera, Plecoptera, and Trichoptera
assessment area	Clinch, Emory, and Tennessee Rivers and Watts Bar Reservoir
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CoC	Contaminant of Concern
cy	Cubic Yards
DOI	United States Department of the Interior
DSAY	Discount Service Acre Year
EPA	United States Environmental Protection Agency
ERM	Emory River Mile
FWS	United States Department of the Interior Fish and Wildlife Service
HEA	Habitat Equivalency Analysis
KG	Kilograms
KIF	Kingston Fossil Plant
mg	Milligram
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment

PAH	Polycyclic Aromatic Hydrocarbon
RCDP	Restoration and Compensation Determination Plan
RP	Responsible Party
Site	TVA Kingston Fossil Plant
Swan Pond	Swan Pond Embayment Restoration and Recreation Park
TDEC	Tennessee Department of Environment and Conservation
TRM	Tennessee River Mile
Trustees	Tennessee Department of Environment and Conservation, Tennessee Valley Authority and United States Fish and Wildlife Service
TVA	Tennessee Valley Authority

EXECUTIVE SUMMARY

The Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) is located at the confluence of the Emory and Clinch Rivers and upstream of the confluence of the Clinch and Tennessee Rivers on Watts Bar Reservoir in Roane County, Tennessee. On Monday, December 22, 2008, a coal ash spill occurred at TVA-KIF, releasing approximately 5.4 million cubic yards (cy) of coal ash to adjacent waterways and wetland/riparian habitats. Coal ash smothered natural resources, and was then transported downstream via surface water flow through the Emory River to the Clinch River and into Watts Bar Reservoir. Following the spill, TVA completed dredging and excavation remedial actions to remove coal ash. A by-product of burning coal to produce electricity, coal ash is primarily composed of fine silica particles similar to sand, but also contains trace amounts of arsenic, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, zinc, and other elements that occur naturally in the coal (TVA 2010). The release and subsequent remedial activities injured natural resources that utilize aquatic habitat in the area.

Under Federal law, Federal and state agencies are authorized to act as trustees of natural resources on behalf of the public. In this role, trustees can assess and recover monetary and other damages for injuries to natural resources, and use these recovered damages to plan and implement actions that will compensate the public for the loss of services that natural resources would have provided had the injury not occurred. The Trustees for the TVA-KIF site are the United States Fish and Wildlife Service (FWS), Tennessee Department of Environment and Conservation (TDEC), and the TVA; TVA is also the party responsible for the release.

Following the 2008 spill, the Trustees initiated natural resource damage assessment (NRDA) activities. NRDA is a process that occurs *in addition* to the remedial process conducted by regulatory agencies like the U.S. Environmental Protection Agency (EPA). The Trustees are considering a settlement comprised of: 1) the implementation and long-term monitoring of the Swan Pond Embayment Restoration and Recreation Park, an approximately $10 million project paid for by TVA, and 2) a cash payment to the Trustees of $750,000 for additional restoration projects. Together, these projects are expected to compensate the public for natural resource injuries and associated ecological and recreational losses. Settlement at this time is reasonable because: 1) the Trustees believe that they have sufficient information to understand the type and magnitude of injuries to trust natural resources affected by the TVA-KIF spill, and 2) a restoration alternative (i.e., Swan Pond) is available that is a priority project for the Trustees and of sufficient scope to provide a substantial portion of the required compensation.

As part of this NRDA, the Trustees drafted this Restoration and Compensation Determination Plan (RCDP) for public review. The purpose of an RCDP is to list a reasonable number of possible alternatives that are expected to restore, replace, or acquire the equivalent of lost resource services (43 C.F.R. §11.81 (a)). Therefore, this RCDP: 1) summarizes natural resource injuries and associated losses in resource services due to the TVA-KIF coal ash release, 2) outlines the expected ecological and recreational benefits of the Swan Pond Embayment Restoration and Recreation Park (Swan Pond), and 3) evaluates restoration alternatives that could be implemented with the $750,000 cash payment to provide the additional resource benefits needed to fully compensate the public for TVA-KIF spill-related losses.

NATURAL RESOURCE INJURY AND SERVICE LOSSES

For purposes of this NRDA, the assessment area includes portions of the Emory, Clinch, and Tennessee Rivers and Watts Bar Reservoir downstream to the Watts Bar Dam. Within that area, the Trustees identified three categories of potential natural resource injury: contaminant-related injury, injury resulting from ash smothering and dredging, and injury related to lost recreational use.

Contaminant-Related Injury

There is little evidence of substantial toxicity-derived service loss in the vicinity of the Kingston facility. There were no exceedences of sediment toxicity guidelines, and exceedences of adverse effects thresholds for fish and birds were extremely limited.

Ash Smothering and Dredging Injury

Injury to the benthic invertebrate community resulting from ash smothering and subsequent dredging activities was quantified using Habitat Equivalency Analysis (HEA). A complete loss of ecological services was assumed for areas that were smothered and dredged. Following dredging, and for areas that were not dredged but were impacted by ash, service loss was estimated based on metrics of benthic community health and projected recovery. Losses are approximately 1,224 discount service acre years (DSAYs).

Recreational Losses

Sections of the Emory River were closed as a result of the TVA-KIF spill, precluding recreational fishing and boating in those areas. To estimate fishing losses, the Trustees combined data on the number of potentially affected fishing trips, as reported in relevant creel studies, with lost trip value reported in the peer-reviewed literature. This application of benefit transfer resulted in approximately $167,000 in damages. Boating-related losses were estimated based on the number of boat launches closed due to the release, and the added cost of launching a boat at the nearest open downstream launch. Based on the number of registered boats in the vicinity of the impacted area and available literature, damages were approximately $29,000.

BENEFITS OF SWAN POND

As designed, Swan Pond is expected to provide both ecological and recreational benefits similar to the ecological and recreational services lost as a result of the TVA-KIF spill.

To quantify the potential ecological benefits of aquatic habitat restoration in Swan Pond, the Trustees used both project-specific information (e.g., location, size, type) and generic unit-based information (e.g., level of ecological benefit gained). Relevant restoration activities include wetland creation, wetland enhancement, and riparian/shoreline restoration. Using HEA, estimated benefits are approximately 1,040 DSAYs. TVA will also conduct monitoring and adaptive management for 30 years to ensure the successful long-term provision of natural resource services. This provides partial compensation for ecological losses.

Swan Pond recreation restoration activities include the creation of a boat ramp and dock, canoe/kayak access points, and fishing piers/areas. These installations will provide recreational boating and fishing opportunities similar in kind to those lost due to the release *in addition* to what was available prior to the ash spill, thereby providing increased value to the boaters and anglers participating in these activities. This increased value provides partial compensation for the lost value associated with diminished or forgone fishing and boating trips.

ADDITIONAL RESTORATION ALTERNATIVES

To provide remaining ecological and recreational compensation for TVA-KIF spill-related losses, the Trustees evaluated three restoration alternatives, including: A: No Action, B: Habitat Restoration within the Emory, Clinch and Watts Bar watersheds, and C: Restoration of Recreational Opportunities within the Emory, Clinch and Watts Bar watersheds. Based on review of expected resource service benefits, environmental consequences, and comparison of project characteristics to site-specific and regulatory restoration criteria, the Trustees identified Alternatives B and C as appropriate and sufficient to provide the necessary remaining compensation to the public. These Alternatives will be funded by the $750,000 cash payment portion of the settlement.

As this RCDP is finalized, the Trustees will begin to identify and evaluate specific project options based on the preferred alternatives. Each project will be evaluated against the same restoration criteria described above, and, if needed, a further review of environmental consequences will be conducted. The Trustees will continue to inform the public of restoration project plans and progress.

CHAPTER 1 | INTRODUCTION

1.1 PURPOSE OF RCDP

The purpose of a Restoration and Compensation Determination Plan (RCDP) is to inform the public as to the type and scale of preferred restoration alternatives that are expected to compensate for injuries to natural resources. In this case, coal ash, containing measurable levels of hazardous substances such as arsenic, mercury, selenium, and zinc, has been released into the Emory, Clinch, and Tennessee Rivers as a result of a dike failure at the Tennessee Valley Authority (TVA) Kingston Fossil Plant (KIF) in Harriman, TN. Natural resources (e.g., surface water, sediments, invertebrates, fish, amphibians, reptiles, birds, and mammals) have been exposed to and adversely affected by the coal ash, resulting in a loss in ecological and recreational services. The restoration plan must include a reasonable number of alternative restoration actions and must identify a preferred alternative (which may include one or more of the possible actions).

1.2 ORGANIZATION OF THIS CHAPTER

This chapter discusses the following:

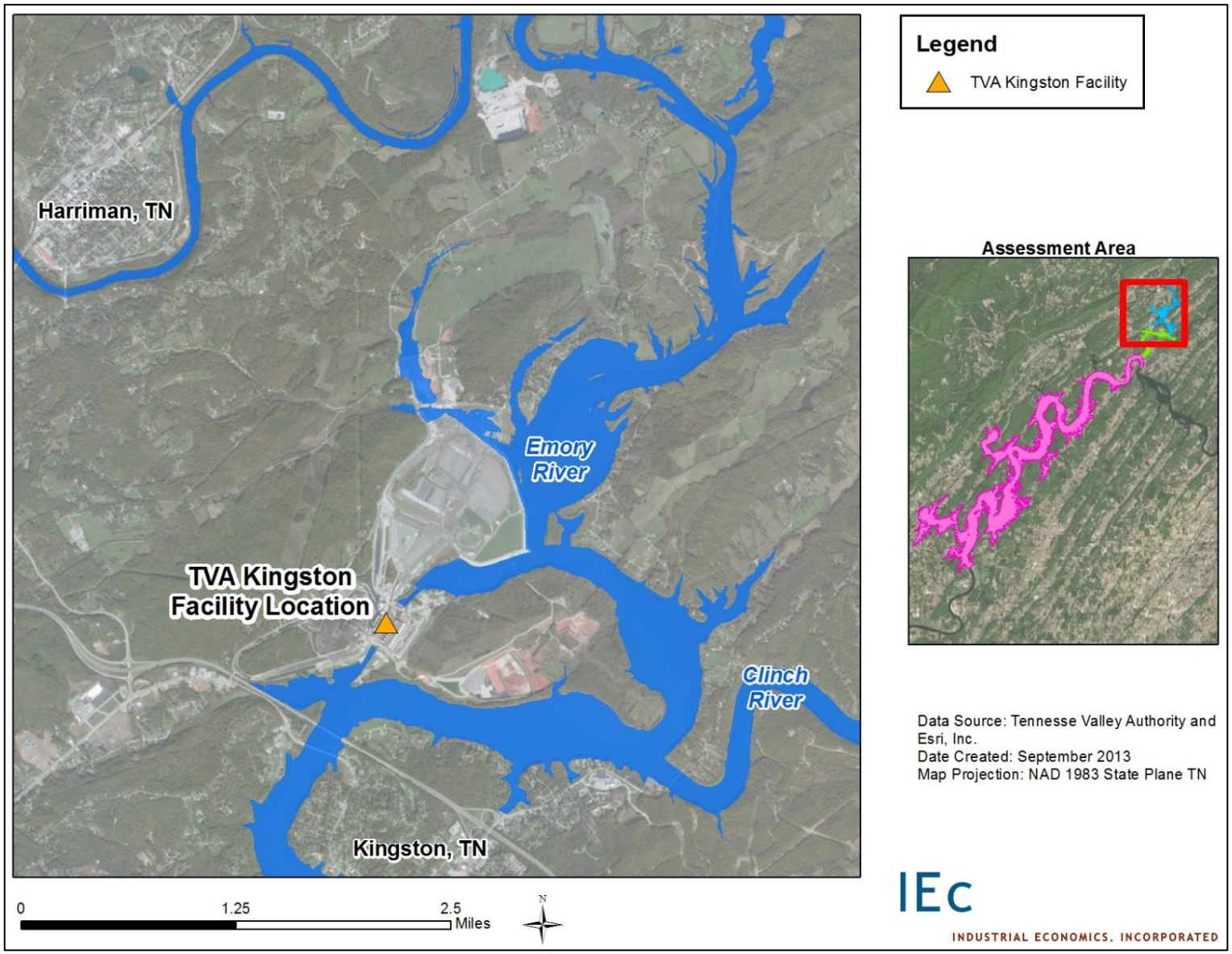
- An overview of the TVA-KIF ash spill,
- Trusteeship and coordination with the Responsible Party (RP),
- Compliance with other authorities,
- The relationship between natural resource damage assessment (NRDA) and remedial activities,
- Public participation, and
- An outline of the remainder of this RCDP.

1.3 OVERVIEW OF THE TVA KINGSTON ASH SPILL AND RELATED DREDGING[1]

The TVA-KIF is located at the confluence of the Emory and Clinch Rivers and near the confluence of the Clinch and Tennessee Rivers on Watts Bar Reservoir in Roane County, Tennessee (Exhibit 1-1). KIF is one of TVA's largest fossil fuel plants. Completed in 1955, today it generates 10 billion kilowatt-hours of electricity a year, enough to supply the needs of about 670,000 homes in the Tennessee Valley. TVA-KIF has nine coal-fired generating units, which consume approximately 14,000 tons of coal a day.

[1] Sources: Arcadis (2012), EPA (2012), Jacobs (2010), TVA (2010).

EXHIBIT 1-1 LOCATION OF TVA-KIF (TVA 2012)



Ash, a by-product of a coal-fired power plant, is stored in unlined containment areas at TVA-KIF, including the former Dredge Cell that failed on December 22, 2008. That dredge cell has been reinforced and capped since the spill. In addition, since the spill, TVA has constructed a new, lined landfill for the receipt of coal combustion residuals. While the released ash itself is primarily composed of fine silica particles similar to sand, it also contains trace amounts of arsenic, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, zinc, and other elements that occur naturally in the coal.

Approximately 5.4 million cy of wet fly ash and bottom ash were released during the ash release event and flowed into the surrounding area waters, including the Emory River, adjacent tributaries and sloughs and adjoining shorelines (Exhibit 1-2). Evaluation of the spatial extent of ash deposits indicates that ash initially traveled upriver as far as Emory River mile (ERM) 5.75, and eventually was transported into the Clinch River and as far downriver as Tennessee River mile (TRM) 564 by high river flow events.

Dredging in the Emory River began on March 20, 2009 with hydraulic dredging continuing until May 29, 2010, and mechanical dredging in pockets of ash upstream of ERM 1.75 continuing until August 2010. The initial dredging pilot program was performed until July 20, 2009. Phase I production dredging began in August 2009 and focused on removing the greatest volume of ash in the quickest time frame to reduce the potential for upstream flooding and downriver migration. A second period of "precision" dredging (Phase II dredging) began in February 2010 to further minimize potential future ash migration downriver. This dredging focused on returning the river channel to its original (pre-release) depths while minimizing disturbance of legacy (i.e., historic) sediment. Engineering controls (silt curtains) and operational controls (i.e., reduced cutter head speed, reduced rate of advance, and reversed cutter head rotation) were implemented to minimize suspending solids during the dredging operations.

Although dredging during the time-critical removal action removed approximately 3.5 million cy of released ash and sediment, no dredging was conducted downstream of ERM 1.75 due to the presence of legacy contaminants.

Approximately 532,000 cy of ash was estimated to remain in the river system, as described in the USEPA-approved Kingston Ash Recovery Project On-Scene Coordinator Report for the Time-Critical Removal Action at the TVA Kingston Fossil Fuel Plant Release Site, Roane County, Tennessee (TVA 2011). Residual ash estimates were based on interpretations of data from multiple sources, including pre-release and post-dredging bathymetric data, dredging logs, visual surveys, and VibeCore™ data.

EXHIBIT 1-2 AERIAL IMAGERY OF ASH RELEASE EXTENT IMMEDIATELY AFTER THE SPILL (TVA 2009)

Figure 1.1. Kingston Fossil Plant Prior to the Ash Spill

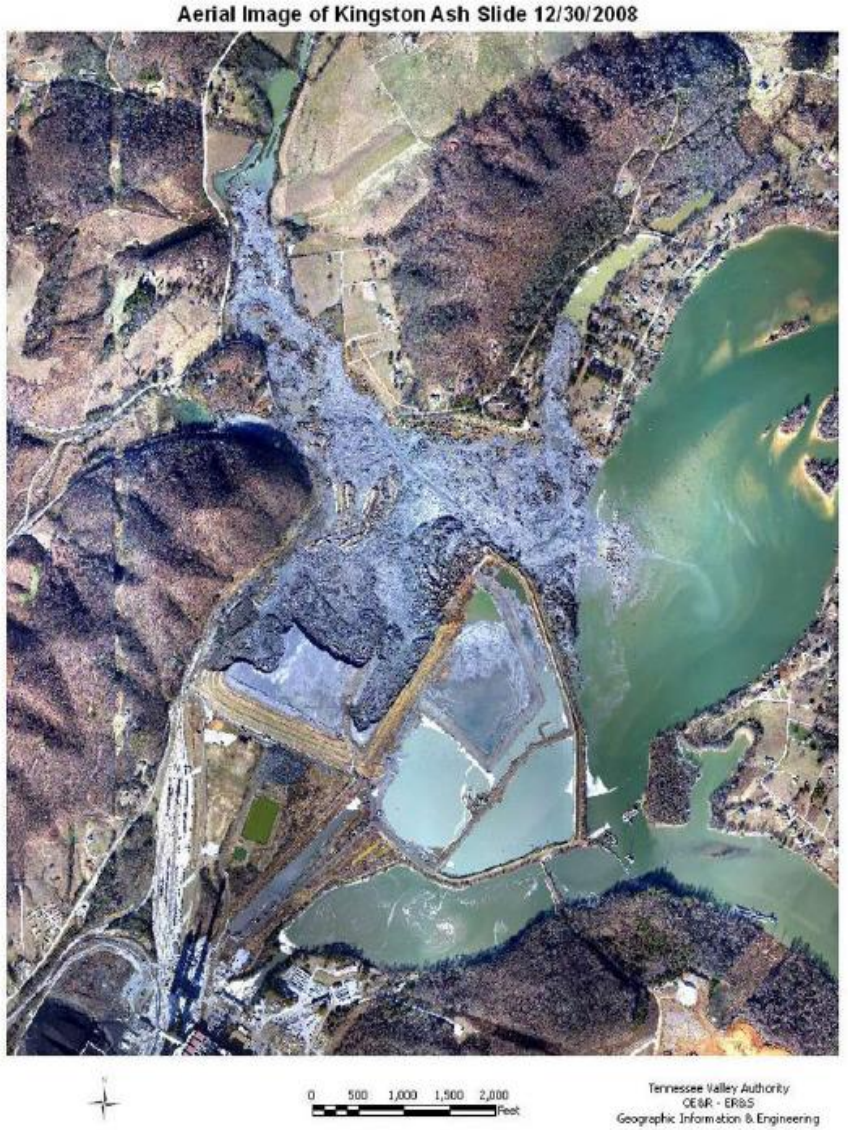


Figure 1.2. Kingston Fossil Plant After the December 22, 2008 Ash Spill

1.4 TRUSTEESHIP AND COORDINATION WITH THE RESPONSIBLE PARTY

This RCDP has been prepared by the TVA-KIF Trustees. Under Federal law, the Trustees are authorized to act on behalf of the public to assess and recover natural resource damages, and to plan and implement actions to restore, replace, or rehabilitate natural resources injured or lost as a result of the release of a hazardous substance, or to acquire the equivalent resources or the services they provide (42 U.S.C. §9601 *et seq*.; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); 43 C.F.R. §11). In addition, pursuant to Tenn. Code Ann. § 69-3-116, the Commissioner may assess damages to the state resulting from any person's pollution or violation, failure, or neglect in complying with any rules, regulations, or standards of water quality promulgated by the board or permits or orders issued pursuant to the Tennessee Water Quality Control Act, T.C.A. §§ 69-3-101, *et seq*.

In this case, the State of Tennessee Department of Environment and Conservation (TDEC) and the United States Department of the Interior (DOI) Fish and Wildlife Service (FWS) are designated as trustees for natural resources actually or potentially affected by the TVA-KIF ash spill under state and Federal authorities, including, but not limited to, CERCLA; the Federal Water Pollution Control Act (33 U.S.C. §§ 1251 *et seq*.); and the CERCLA Damage Assessment Regulations (43 C.F.R. Part 11), as well as Subpart G of the National Contingency Plan (40 C.F.R. §§ 300.600 *et seq*.); and Executive Order 12580 (52 Fed. Reg. 2923 (January 23, 1987)), as amended by Executive Order 12777 (56 Fed. Reg. 54757 (October 19, 1991).

As encouraged under 43 C.F.R. Part 11, TDEC and FWS invited TVA, as the party responsible for the coal ash spill, to participate in the development and implementation of assessment and restoration activities. TDEC and FWS noted that TVA may also be a co-trustee for some potentially injured resources and that it was appropriate, under 40 C.F.R. § 300.600(a)(4), for TVA to participate as a trustee in the NRDA process. Therefore, on January 12, 2011, TVA signed a Memorandum of Agreement (MOA) with TDEC and FWS to cooperatively resolve natural resource damages resulting from the TVA-KIF ash spill (TDEC et al. 2011). To-date, TVA's active involvement in the damage assessment and restoration planning process includes the following:

- Providing funding and assistance for assessment activities,
- Providing data and developing a database of contaminant concentration data,
- Participating in the development of injury assessments of ecological and recreational services, and
- Assisting with the identification and benefits assessment of restoration alternatives.

In addition, the MOA explicitly states:

> *"the parties agree to…develop a Natural Resource Restoration Plan to be funded by TVA for the restoration, replacement, and/or acquisition of the equivalent resources for those natural resources and/or services provided by those resources, that have been or may be injured, destroyed, or lost as a result of the*

events of December 22, 2008 at the Kingston Fossil Plant." (Trustees 2010, p. 4 Section 3).

1.5 COMPLIANCE WITH OTHER AUTHORITIES

Restoration alternatives described in this document will be conducted in compliance with all applicable Federal, state, and local regulations.

The Trustees prepared this RCDP to fulfill requirements under CERCLA. Authority to seek natural resource damages is also provided by the Federal Water Pollution Control Act of 1972, as amended, commonly referred to as the Clean Water Act.

Other Federal natural resource and environmental laws and regulations considered during the development of this RCDP include but are not limited to: the Endangered Species Act of 1973; the Migratory Bird Treaty Act; the National Historic Preservation Act; the Archaeological Resources Protection Act; the Wilderness Act of 1964; the Fish and Wildlife Coordination Act of 1934; the Refuge Recreation Act of 1962; the U.S. Fish and Wildlife Mitigation Policy of 1981; Executive Order 11990 on Wetlands; Executive Order 11988 on Floodplains; Executive Order 12580 on Superfund; and the Information Quality Act of 2001.

The major state environmental statutes and programs considered during the development of this RCDP include: the Water Quality Control Act and the Tennessee Solid Waste Disposal Act.

1.6 NRDA RELATIONSHIP TO REMEDIAL ACTIVITIES

NRDA is a process that occurs *in addition* to the remedial process conducted by regulatory agencies like the EPA. These two processes have different goals. Remedial action objectives are risk-based, and are developed to protect human health and the environment from further unacceptable harm. Remedies are selected based on evaluation criteria that are used to compare remedial alternatives and may result in contamination remaining in the environment above levels that existed prior to their release. Alternatively, the goal of NRDA is the restoration of resources to their baseline condition (i.e., what their condition would be absent the release). Losses resulting from natural resource exposure to released materials and/or hazardous substances are estimated over time until the resource is restored (i.e., interim losses). These losses can therefore extend beyond the date of remedy completion due to material and/or contaminants being left in the environment at levels injurious to natural resources.

There are components of NRDA and remedy however that overlap. For example, remedial decisions can include consideration of NRDA restoration objectives. Work to remedy a site may partially or completely restore injured natural resources, and NRDA estimates take this into account. In addition, remedial actions may cause "collateral injury" to habitat, and quantification and restoration of this remedy-induced injury is also evaluated within NRDA.

For the TVA-KIF NRDA, the Trustees have interacted with EPA and TVA as EPA and TVA evaluated the degree and extent of contamination; conducted human health and ecological risk assessments; and evaluated, selected, designed, and implemented

remedies. This coordination provided an understanding of the remedial process and helped the Trustees evaluate how each remedial decision affected estimates of natural resource damages. The Trustees also worked with EPA and TVA to integrate remediation and restoration and coordinate remedial activities with some of the Trustees' restoration priorities.

1.7 PUBLIC PARTICIPATION

Public participation and review is an integral part of the restoration planning process, and is specifically mentioned in the DOI NRDA regulations (e.g., 43 C.F.R. §11.81(d)(2)). Therefore, the Trustees made the draft RCDP available for review for a period of 30 days in accordance with 43 C.F.R. § 11.32(c)(1).

A copy of the final RCDP is available online at the following websites:

http://www.tva.com/kingston/

www.tn.gov/environment/kingston

Interested parties can obtain a hard copy of this RCDP from the Trustees by submitting a written request to the following address:

Debbie Duren
Natural Resource Trustee Program Manager
Tennessee Department of Environment and Conservation
761 Emory Valley Road
Oak Ridge, TN 37830
Debbie.Duren@tn.gov

The Trustees addressed public comments and documented responses to those comments in Appendix D.

As the restoration process progresses, the Trustees may amend this RCDP, and will subsequently notify the public. These amendments, if any, will be made available on the website mentioned above. In the event of a significant change to the RCDP, the Trustees will provide the public with an opportunity to comment on that particular amendment.

1.8 ORGANIZATION OF THIS RCDP

The remainder of this document is organized as follows:

- Chapter 2 describes the natural resources and contaminants of concern (CoCs) and the determination and quantification of natural resource injuries and associated service losses.
- Chapter 3 provides descriptions of the proposed restoration alternatives and how these projects are evaluated to compensate for the injuries described in Chapter 2.
- Chapter 4 presents the Trustees' restoration evaluation criteria and the selection of their preferred alternatives.
- Chapter 5 provides a summary of the preferred restoration alternatives.

CHAPTER 2 | SUMMARY OF NATURAL RESOURCE INJURIES AND SERVICE LOSSES

This Chapter provides an overview of the natural resource injuries and corresponding service losses incurred by Trust resources as a result of the TVA-KIF ash spill. This includes a description of the assessment area, the CoCs, the ecological and recreational services provided by Trust resources within the assessment area, and a summary of injury determination and quantification.

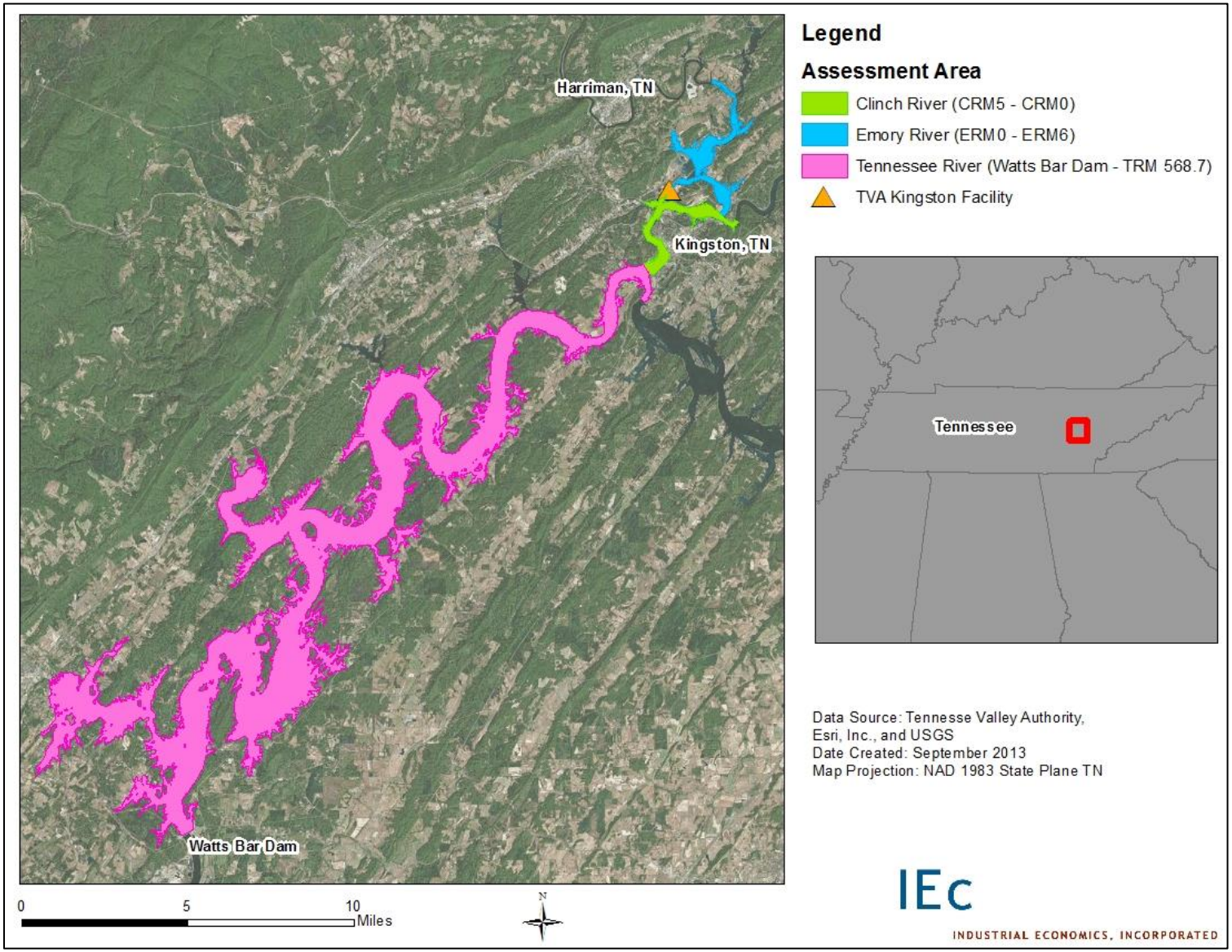
2.1 ASSESSMENT AREA

The TVA-KIF ash spill affected a broad area of complex hydrology and diverse habitats. The Emory River flows unregulated from its headwaters in the Catoosa Wildlife Management Area to its confluence with the Clinch River. Near its headwaters, the Emory River is joined by the larger Obed River, though it maintains its name as it continues downstream from its confluence with the Obed to its confluence with the Clinch River. The Clinch River flows approximately 300 miles from Virginia to its confluence with the Tennessee River a few miles downstream from the KIF. The Tennessee River flows from the confluence of the French Broad and Holston Rivers in Knoxville Tennessee to where it meets the Ohio River along the Kentucky and Illinois border. These rivers all flow into the Watts Bar Reservoir, which was formed when TVA constructed Watts Bar Dam in 1942 at TRM 529.9. These waterways are adjacent to upland, wetland, and riparian habitat included in the assessment area. The assessment area is based on the geographic scope within which trust resources have been directly or indirectly affected by the TVA-KIF ash spill. For purposes of this NRDA, these areas include the aquatic (i.e., riverine) habitat in:

- The Emory River from mile 6.0 downstream to mile 0.0;
- The Clinch River from mile 5.0 downstream to its confluence with the Tennessee River;
- The Tennessee River from mile 568.7 downstream to Watts Bar Dam; and
- The wetland and riparian areas located adjacent to the West Embayment, North Embayment, Swan Pond, and East Embayment.

Exhibit 2-1 provides an overview of the assessment area as described above.

EXHIBIT 2-1 MAP OF ASSESSMENT AREA



2.2 NATURAL RESOURCES

According to the DOI NRDA regulations, natural resources are defined as:

> *Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the fishery conservation zone established by the Magnuson Fishery Conservation and Management Act of 1976), any State or local government, any foreign government, any Indian tribe, or, if such resources are subject to a trust restriction on alienation, any member of an Indian tribe (42 USC § 9601 (16)). These natural resources have been categorized into the following five groups: Surface water resources, ground water resources, air resources, geologic resources, and biological resources (43 CFR § 11.14 (z)).*

As described above, the assessment area includes riverine, wetland, and riparian areas within the Emory, Clinch, and Tennessee Rivers and Watts Bar Reservoir. Natural resources of concern include all Trust resources that comprise or utilize these habitats within the assessment area, including, but not limited to, surface water, sediment, soil, plants, insects, fish, amphibians, reptiles, birds, and mammals. For example:

Mussels. Aquatic habitat in the vicinity of the Kingston facility supports six common mussel species including *Elliptio crassidens* (Elephant Ear), *Leptodea fragilis* (Fragile Papershell), *Obliquaria reflexa* (Threehorn Wartyback), *Potamilus alatus* (Pink Heelsplitter), *Pyganodon grandis* (Giant Floater), and *Quadrula pustulosa* (Pimpleback) (McKinney 2014).

Fish. TVA sampling efforts in 2009 indicated that 43 fish species are present in the area, with gizzard shad, bluegill sunfish, freshwater drum, largemouth bass, and redear sunfish being the predominant species. Federally-listed threatened snail darter and spotfin chub are known to occur in tributaries to the Watts Bar Reservoir and may occur in the reservoir itself, though they have not been reported in the vicinity of Kingston (Arcadis 2012).

Reptiles and Amphibians. Riparian, wetland, and aquatic habitats in the Watts Bar Reservoir watershed generally support amphibian and reptile species. Amphibian species include the bullfrog, green frog, Eastern narrow-mouth toad, and Fowler's toad. Reptiles such as the common snapping turtle and painted turtle are also present (Arcadis 2012).

Birds. Riparian and wetland habitats along the Watts Bar Reservoir support a range of bird species, including both residential and migratory populations. Representative species include killdeer, semipalmated plover, mallard, American black duck, hooded merganser, resident Canada goose, wood duck, and the Federally-listed bald eagle. Avian species specifically documented as nesting near TVA-KIF include piscivorous (i.e., fish-eating) birds such as the double-crested cormorant, various heron species, and osprey (Arcadis 2012).

Mammals. Mammalian species are found in riparian and wetland habitat in the area, including white-tailed deer, raccoon, eastern mole, eastern cottontail rabbit,

groundhog, gray fox, and the coyote. The Watts Bar Reservoir watershed is also home to the Federally-listed endangered gray bat, but there are no known maternity colonies or hibernacula in the vicinity of Kingston (Arcadis 2012).

2.3 NATURAL RESOURCE INJURY

Available data indicate that resources within the assessment area have been injured due to smothering by coal ash and dredging activities, and may be injured in the future due to long-term exposure to bioaccumulative contaminants.[2] That is, exposure to coal ash, including bioaccumulative CoCs, and corresponding dredging has resulted (or may result) in a measurable adverse change in the quality and viability of natural resources. As a result, the public has experienced and continues to experience a reduction (i.e., an interim loss) of both ecological and human use services provided by these natural resources relative to the services that the resources would have provided had the spill not occurred (i.e., their baseline condition). Through the proposed restoration activities described later in this RCDP, the Trustees seek to ensure that natural resource services are provided, in the future, of a type and scale sufficient to compensate for this interim loss.

Natural resources provide a variety of services. Services are, "the physical and biological functions performed by the resource, including the human uses of those functions, [that result from the resource's] physical, chemical, or biological quality" (43 CFR § 11.14 (nn)). For example, ecological services provided by streams include the provision of habitat for fish (including stocked and migratory species), amphibians, and other aquatic organisms; and foraging opportunities for animals that eat fish, macroinvertebrates, and aquatic plants. Similarly, riparian and wetland soils provide services by supporting healthy vegetation and diverse plant communities that in turn provide animals with foraging opportunities, nesting or denning areas, and protective cover. Examples of human use services provided by natural resources include opportunities for fishing, boating, and wildlife viewing and appreciation.

There are three potential categories of natural resource injury related to the release: contaminant-related injury, injury from dredging and smothering, and injury related to recreational use.

2.3.1 CONTAMINANT-RELATED INJURY

Toxic constituents of coal ash vary depending on the source of coal burned in the power plant. CoCs for this site include arsenic, cadmium, chromium, copper, lead, mercury, nickel, polycyclic aromatic hydrocarbons (PAHs), selenium, vanadium, and zinc. Building on information presented in the Baseline Ecological Risk Assessment (BERA; Arcadis 2012) for this site, and critical review of the corresponding toxicological profiles (Industrial Economics, Inc 2012) and other literature, the Trustees developed a suite of screening criteria against which to compare observed CoC concentrations. The criteria

[2] Site-specific studies to-date report CoCs in ash at levels not expected to cause substantial injury. Bioaccumulative CoCs include mercury, selenium, and zinc.

represent CoC concentrations above which adverse effects on endpoints such as reproduction, growth, and/or survival may occur (Appendix A). The Trustees concluded that for all CoCs, the majority of site-specific tissue and sediment concentrations measured to-date were below corresponding thresholds.

Observed contaminant concentrations in the vicinity of TVA-KIF were compared to the screening criteria described above to determine whether an injury (as defined by the DOI NRDA regulations at 43 CFR Part 11) has occurred, or is likely to have occurred. The Trustees assume that site-specific contaminant concentrations below their corresponding screening criteria do not cause injury to natural resources, whereas any observed concentration in exceedence of a criterion may cause a loss in ecological service.

As indicated by the exhibits in Appendix A, there is little evidence of substantial toxicity-derived service loss in the vicinity of the Kingston facility. There were no exceedences of sediment toxicity criteria, while exceedences in fish and birds were limited to arsenic and zinc, respectively. In addition, evidence that these exceedences were caused by the coal ash spill is limited. For example, zinc concentrations in reference areas (i.e., upstream of the spill) are comparable to those measured within the assessment area. The Trustees also note that arsenic results in Clinch River fish from one lab exceeded the screening criterion; however, given the existence of samples from other labs that are well below the screening criterion, evidence of service loss is not compelling.

Although site-specific toxicity and community structure field studies currently available on mussels, fish, reptiles, and birds did not identify adverse effects related to the TVA-KIF ash spill, it is possible that some service loss to trust resources may have occurred or may occur in the future. For example, mercury, selenium, and zinc are known to biomagnify and may cause injury in the future, potentially affecting sensitive biological endpoints/life stages (e.g., larval fish).

Given this information, the Trustees' preferred restoration alternatives (Chapters 4 and 5) are expected to provide sufficient ecological benefits to assessment area resources to account for any of these potential injuries.

2.3.2 ASH-SMOTHERING AND DREDGING

Natural resources experienced a loss in ecological function as a result of both ash smothering and dredging. Smothering occurred when the amount of ash in the waterway was sufficient to eliminate the benthic community. Dredging in this case is the physical removal of ash and ash-sediment mixtures from the bed and banks of aquatic habitat within the assessment area.

To quantify the ecological losses incurred as a result of smothering and dredging, the Trustees used habitat equivalency analysis (HEA), a method commonly applied in NRDA that accounts for the spatial and temporal scope of injuries in units of discount service acre-years of habitat (See Text Box "What is Habitat Equivalency Analysis?" on page 15).

Because of its large spatial extent, the Trustees divided the assessment area into sub-sections based on environmental parameters (e.g., hydrology, topography). The spatial

extent of dredging (Exhibit 2-2) and dredge completion date were identified for each sub-section.[3]

For purposes of this analysis, dredged areas are analogous to areas smothered by ash. The smothering of the river bottom and subsequent removal of substrate that occurred during dredging activities resulted in substantial disturbance to the benthic invertebrate community, which is a reasonable indicator of overall aquatic community health. As a result, the Trustees assumed a 100 percent service loss prior to dredge-completion. For non-dredged areas and post-dredge recovery within dredged areas, the Trustees chose the benthic invertebrate community as a representative resource for injury quantification. The benthic invertebrate community encompasses the invertebrate organisms that live on (epifauna) or within (infauna) sediment substrate. Among other functions, benthic invertebrate communities are integral to maintaining the structure and function of the aquatic ecosystem (e.g., the base of the aquatic food web), and play an important role in ecosystem energy and nutrient cycling.

Researchers repeatedly surveyed the benthic community from 2009 through 2013 at multiple locations within the assessment area, as well as reference locations (i.e., upstream of the spill area) on the Emory, Clinch, and Tennessee Rivers. These researchers then counted and identified the benthic invertebrates found within each sample collected during the surveys. Using these data, the Trustees calculated the number of individuals (density), number of different taxonomic groups (richness), and the percent of pollution sensitive individuals (%EPT) first within each sample, then across samples in each sub-section by year.[4] Taken together, these three metrics inform the health of the benthic community within each sub-section.

To determine service loss by assessment area sub-section on a yearly basis, reductions in density, richness, and %EPT, as compared to reference locations were quantified. Review of site-specific data indicated that all dredged sub-sections recovered within two years following dredging. Therefore, if site-specific benthic community metrics indicated losses continuing through 2013, future losses were assumed to decline to zero over two years (i.e., full recovery is predicted in 2015).[5] Details are provided in Appendix B.

[3] If site-specific data were not available for a sub-section for a given year, ecological losses and recovery were based on the site-specific data in either previous and subsequent years or at adjacent sub-sections. If both data sources were available, previous and subsequent years took precedence over adjacent sub-sections.

[4] %EPT refers to the percentage of invertebrate samples in the three invertebrate orders considered to be especially sensitive to pollution: Ephemeroptera, Plecoptera, and Trichoptera.

[5] Benthic community data were not available for all years and assessment area sections. The Trustees applied calculated benthic service loss percentages from neighboring assessment area sections with available data to extrapolate service loss in areas with no data.

What is Habitat Equivalency Analysis?

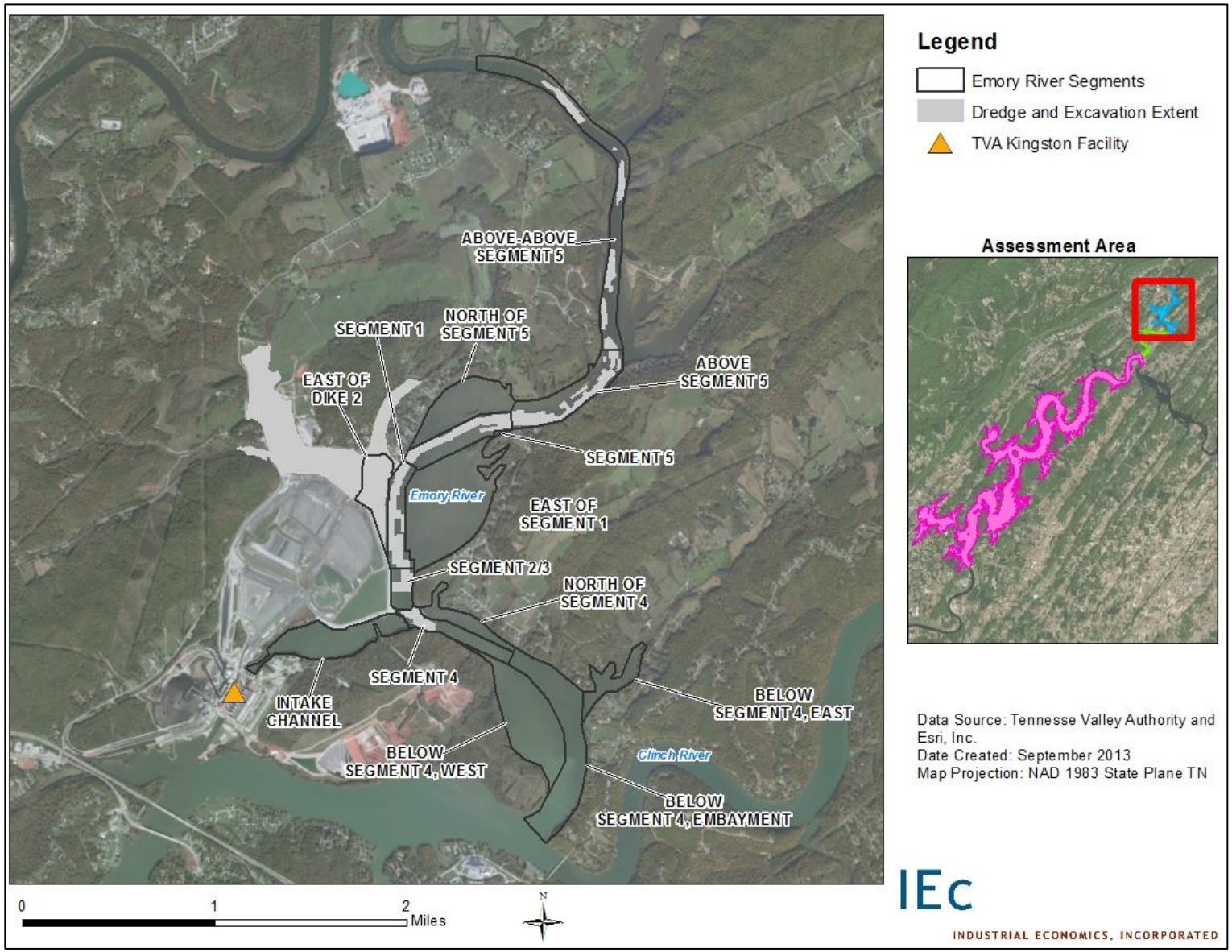
The basic premise of habitat equivalency analysis is that the public can be compensated for past and expected future losses in ecological services through the provision of additional ecological services in the future. Compensable losses are "interim" losses – the loss in ecological services incurred from the time the resource is injured* until the services provided by the injured resource return to their baseline level. Baseline is defined as the level of services that would have been provided in the absence of the pollution. Recovery to baseline for each resource service may be achieved through remediation, restoration, and/or natural recovery. Compensatory restoration actions for these interim lost services are *in addition* to those actions required to restore injured resources to baseline conditions (i.e., primary restoration).

Within equivalency analyses, both service losses and compensatory service gains are typically measured in terms of "unit-time" (e.g., acre-years), which incorporates both the geographic and temporal nature of the analysis. Each acre-year represents the existence of one acre of a particular habitat for one year. The concept of an acre-year allows the analysis to consider not only the *number* of acres lost as a result of the adverse effects, but also the fact that these acres have not provided the baseline level of services *each year* for some period of time. For example, if an acre of aquatic habitat is injured (e.g., provides zero percent of baseline services due to ash smothering) in 2009, and remains injured until 2015, losses are accrued for the acre of injured habitat for each of the six years of loss (e.g., six acre-years, not accounting for the present value of these services). Use of the acre-year metric also allows losses to be scaled with gains in ecological services from restoration (i.e., the services provided by an acre of restored habitat over a period of time). For example, if one acre of fully-functional riparian habitat is expected to provide 100 percent of baseline services each year for the next ten years, it will provide ten acre-years** (again, not accounting for the present value of these services). Equivalency between losses and gains is then established by determining the present value of each (i.e., compounding past losses and discounting future losses and gains). Losses and gains are expressed in terms of units of the diminished resource itself (e.g., discount service acre-years; DSAYs) rather than economic value (Unsworth and Bishop 1994). Dollar damages are calculated as the cost of compensatory restoration projects.

* Damages are calculated from the start of injury or 1981, whichever is later, in accordance with the promulgation of CERCLA.

** Assuming the habitat selected for restoration previously provided no ecological services (i.e., the *gain* in services is 100 percent).

EXHIBIT 2-2 MAP OF DREDGING AND EXCAVATION EXTENT



The percentage service loss per year (2009-2015) for each assessment area sub-section was multiplied by the acreage of that sub-section, and the present value (in 2013) of these lost acres is calculated using a discount rate of three percent.[6] Results indicate a loss of 1,091 DSAYs in dredged areas and 133 DSAYs in additional ash-impacted areas (Exhibit 2-3).

EXHIBIT 2-3 ECOLOGICAL LOSSES BY SUB-SECTION RESULTING FROM ASH SMOTHERING AND DREDGING (DSAYS)

SUB-SECTION	PRESENT VALUE LOSSES (DSAYS)		
	DREDGED AREA	ADDITIONAL IMPACTED AREA	TOTAL
Segment 1	59	0	59
Segment 2/3	17	0	17
Segment 4	19	4	22
Segment 5	58	4	62
Above Segment 5	84	0	84
Above-Above Segment 5	66	24	89
Below Segment 4, West	NA	45	45
Below Segment 4, East	NA	0	0
Below Segment 4, Embayment	NA	0	0
North of Segment 4	NA	4	4
Intake Channel	NA	16	16
East of Segment 1	NA	0	0
North of Segment 5	NA	36	36
Dike 2	189	NA	189
Church Slough	5	NA	5
East Embayment-South End	57	NA	57
East Embayment-North End	25	NA	25
Middle Embayment	289	NA	289
North Embayment-South End	135	NA	135
North Embayment-North End	89	NA	89
Total	**1,091**	**133**	**1,224**

Notes:
1. Additional Impacted Areas are areas within the study area that were not dredged, but that sustained some loss based on benthic community data.
2. Totals may not sum due to rounding.
3. NA in the Dredged Area column indicates that within a sub-section, no dredging occurred. NA in the Additional Impacted Areas column indicates that the entire area of a sub-section was dredged. 0 indicates that the calculated present value losses were zero.

[6] Because the spill occurred at the very end of 2008, we begin annual calculation of damages in 2009.

2.3.3 RECREATIONAL LOSSES

The release of coal ash from TVA's KIF impaired recreational services within the assessment area. In particular, the closure of a section of the Emory River and Swan Pond during dredging impacted fishing and boating activities. Fishing and boating losses were quantified using site-specific estimates of fishing and boating effort in conjunction with valuation information from the economics literature in a standard application of the benefit transfer methodology. Total present value losses associated with lost recreational opportunities are approximately $200,000.

Fishing

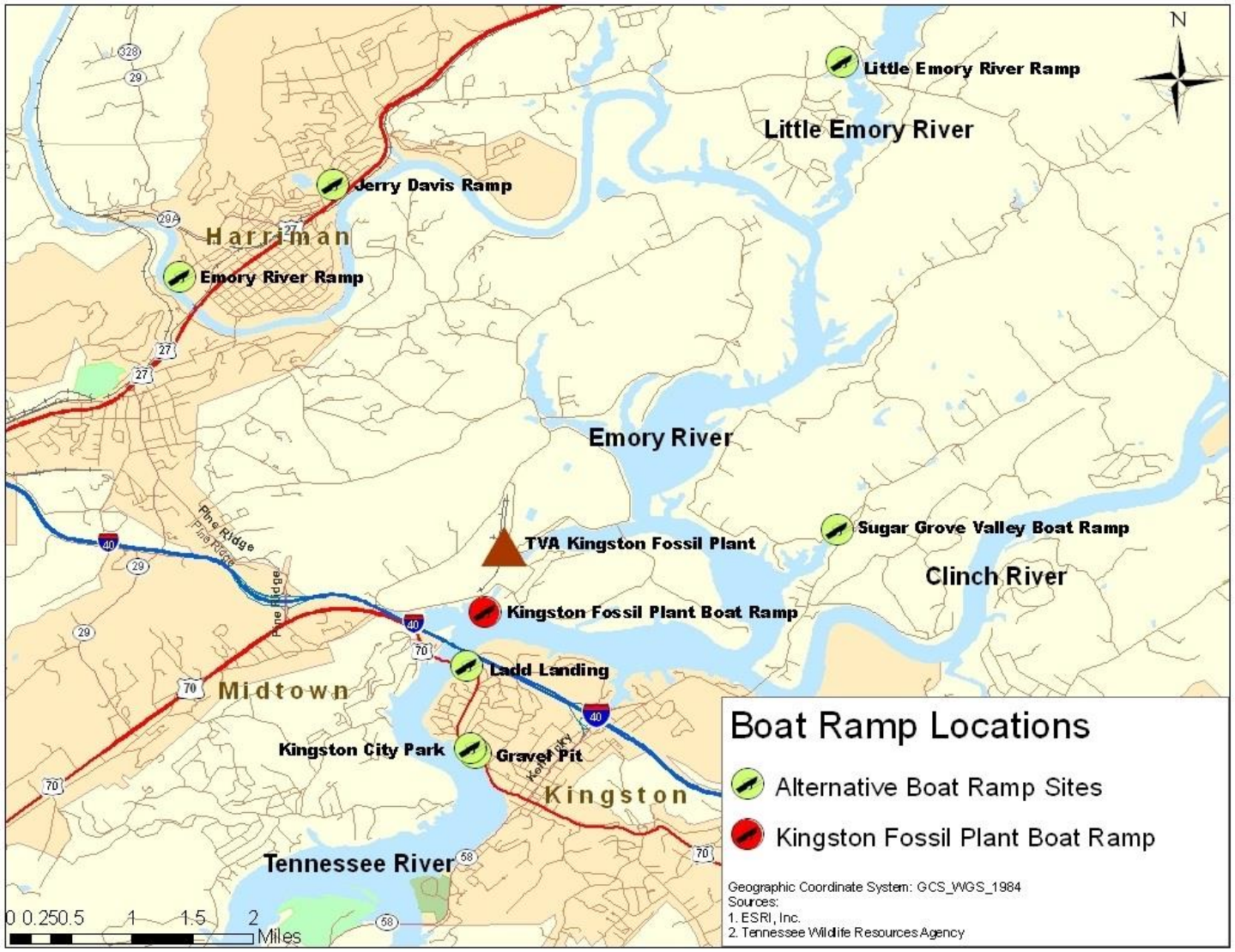
The Trustees estimated losses associated with compromised fishing opportunities for the Emory River beginning in 2009 due the closure of the Emory River and Swan Pond and continuing through the projected re-opening of each area and/or expected cessation of major remedial/restoration activities: Emory River in 2010, West of Dike #2 in 2012, and East of Dike #2 in 2015. Based on available creel surveys conducted by TVA in the vicinity of the assessment area, the Trustees assumed approximately 2.1 trips per acre at a value of $32.44 per trip were completely lost during that timeframe (i.e., there were no substitutes; Jakus et al. 1997). Using a three percent discount rate, present value recreational fishing losses were estimated to be approximately $167,000.

Boating

Boating-related losses were estimated based on the number of boat launches closed due to the release, and the added cost of launching a boat at the nearest open downstream launch (Exhibit 2-4). That is, the Trustees assumed individual trips were not lost but occurred at a different location at an added cost to the angler. Based on the number of registered boats in the vicinity of the impacted area and available literature, approximately 1,650 trips per year (2009-2010) were adversely impacted (TVA 2009). The additional cost per trip was estimated to be approximately $8.50[7], which, using a three percent discount rate, results in approximately $29,000 in present value damages.

[7] Additional cost per trip is calculated as the added out-of-pocket cost for operating a car ($0.33 per mile * average distance from closed boat ramps to next closest downstream of closure area), plus the opportunity cost of having to drive farther (1/3 wage rate).

EXHIBIT 2-4 MAP OF BOAT RAMP LOCATIONS AT THE TIME OF THE TVA-KIF SPILL



CHAPTER 3 | RESTORATION OBJECTIVES AND PROPOSED RESTORATION ALTERNATIVES

To compensate the public for injuries (i.e., service losses) to natural resources resulting from the TVA-KIF spill, the Trustees are required to develop alternatives for the "restoration, rehabilitation, replacement, and/or acquisition of the equivalent of the natural resources and the services those resources provide" (42 C.F.R. §11.82 (a)). At this time, the Trustees are considering a settlement comprised of:

1. The complete implementation and subsequent monitoring of the Swan Pond Embayment Restoration and Recreation Park (Swan Pond) developed by TVA, which is expected to provide approximately 1,040 DSAYs and new recreational fishing and boating opportunities for area anglers.
2. A cash payment of $750,000 to fund additional restoration projects that will compensate for the remaining 184 DSAYs and additional recreational losses .

Together, these projects are expected to compensate the public for natural resource injuries and associated ecological and recreational losses. Settlement at this time is reasonable because: 1) the Trustees believe that they have sufficient information to understand the type and magnitude of injuries to trust natural resources affected by the TVA-KIF spill, and 2) a restoration alternative (i.e., Swan Pond) is available that is a priority project for the Trustees and of sufficient scope to provide a substantial portion of the required compensation.

This chapter summarizes the natural resource service benefits expected from completion of Swan Pond, and describes the Trustees' proposed plans and priorities with respect to identification and implementation of additional restoration projects that together will compensate for the natural resource injuries and service reductions described in Chapter 2.

3.1 SWAN POND EMBAYMENT RESTORATION AND RECREATION PARK

Following the release of ash from the KIF in 2008, TVA acquired the majority of property either directly affected by the TVA-KIF ash spill or adjacent to areas smothered in ash. Subsequently, TVA designed and is currently engaged in habitat preservation and enhancement and creation of new recreational opportunities as described in the following restoration plans:

- Kingston Ash Recovery Project Non-Time Critical Removal Action Swan Pond Embayment Ecosystem Restoration Technical Specifications – 100% Design
- Kingston Ash Recovery Project Non-Time Critical Removal Action Swan Pond Recreation Area: Phase I Lakeshore Area Technical Specifications – 100% Design plans (together, Swan Pond Plans; Exhibit 3-1).

Once completed, Swan Pond will provide both natural resource services similar to the assessment area's baseline services (i.e., the natural resource services the area provided prior to the spill) and resource services similar to those lost due to the TVA-KIF spill. The project, funded by TVA, costs approximately $10 million. The following sections describe in further detail Swan Pond's ecological and recreation restoration activities and their related benefits.

3.1.1 ECOLOGICAL SERVICES: HABITAT RESTORATION, CREATION AND PRESERVATION

The Swan Pond Plans include a suite of ecological restoration activities that benefit a variety of habitat types. These include, but are not limited to, re-vegetation of shoreline habitats, installation of water control structures, removal of invasive species, creation of riparian buffers and wetland preservation (TVA and Jacobs Engineering 2011). Ecological components of the master plan fall into one of five categories: 1) restoration of habitat to its pre-spill (i.e., baseline condition), 2) enhancement of upland habitat, 3) preservation of existing wetland habitat, 4) enhancement of aquatic habitat, or 5) creation of new aquatic habitat.

To assess the ecological benefits provided by Swan Pond as compensation for natural resource services lost due to the TVA-KIF spill, the Trustees focused on components that provide ecological services of the same type and quality as those lost *and* that are above and beyond the baseline level of services. These components include enhancement of existing and creation of new aquatic habitat. Aquatic habitat, including in-stream, shoreline/riparian, and wetland habitat, provides relevant ecological services. For example, wetland and shoreline/riparian areas provide habitat for breeding and migratory fish and birds, improve water quality by filtering sediments and other pollutants from the water column, reduce erosion, and export detritus (energy source for the aquatic food web). Further, these activities help increase the production of forage fish, which provide prey for piscivorous fish, birds, reptiles, and mammals. Habitat creation and enhancement will increase the quality and quantity of these types of ecological services in Swan Pond. For example, areas dominated by invasive species have limited habitat value to native species due to invasive-related changes in characteristics such as species composition, nutrient cycling, and hydrology, which correspondingly alter the overall structure and function of the habitat. Removal of invasive species and re-establishment of the native vegetative community would reverse that degradation.

EXHIBIT 3-1 SWAN POND EMBAYMENT RESTORATION AND RECREATION AREA DESIGN

The aquatic habitat creation and enhancement activities in Swan Pond will occur on approximately 90 acres of inter-connected habitat (Exhibit 3-2). Using methods commonly applied in NRDA (e.g., HEA) and information from the literature (e.g., Harper and Peckarsky 2005, Muotka et al. 2001, National Oceanic and Atmospheric Administration (NOAA) 1999), the Trustees applied the following information and assumptions to quantify the expected natural resource benefits resulting from Swan Pond aquatic habitat restoration:

- Construction began in 2013 and is expected to end in 2014 (i.e., ecological service gains will begin to accrue in 2015).
- 90 acres of aquatic habitat will be created or enhanced.
- Pre-restoration ecological services are assumed to be zero percent due to ash smothering and corresponding dredging activities.
- There is no additional loss in these areas due to restoration-related construction activities because the baseline level of ecological services is zero percent.
- Maximum service levels of the restored habitat are estimated to be 85 percent because anthropogenically-restored habitats generally do not reach productivity levels associated with natural, fully functional habitats.
- Ecological benefits accrue for 30 years.
- The annual discount rate of ecological services through time is three percent, consistent with economic theory and typical NRDA practice (NOAA 1999, Freeman 1993).

Based on these assumptions, creation and enhancement of aquatic habitat in Swan Pond is expected to provide approximately 1,040 DSAYs, which will partially compensate the public for lost ecological services. Appendix C presents details on the inputs used to quantify the benefits of the proposed activities and the corresponding results.

3.1.2 RECREATION SERVICES: BOAT RAMP, FISHING AND CANOE/KAYAK ACCESS

Swan Pond recreation activities include the creation of a boat ramp and dock, four canoe/kayak access points and five fishing piers/areas (Exhibit 3-3). These installations will provide recreational boating and fishing opportunities similar in kind to those lost due to the release *in addition* to what was available prior to the ash spill, thereby providing increased value to the boaters and anglers participating in these activities. This increased value provides partial compensation for the lost value associated with fishing and boating trips diminished or forgone as a result of the TVA-KIF spill.

EXHIBIT 3-2 MAP OF SWAN POND AQUATIC RESTORATION AREAS EXPECTED TO PROVIDE NRDA-RELATED ECOLOGICAL SERVICES

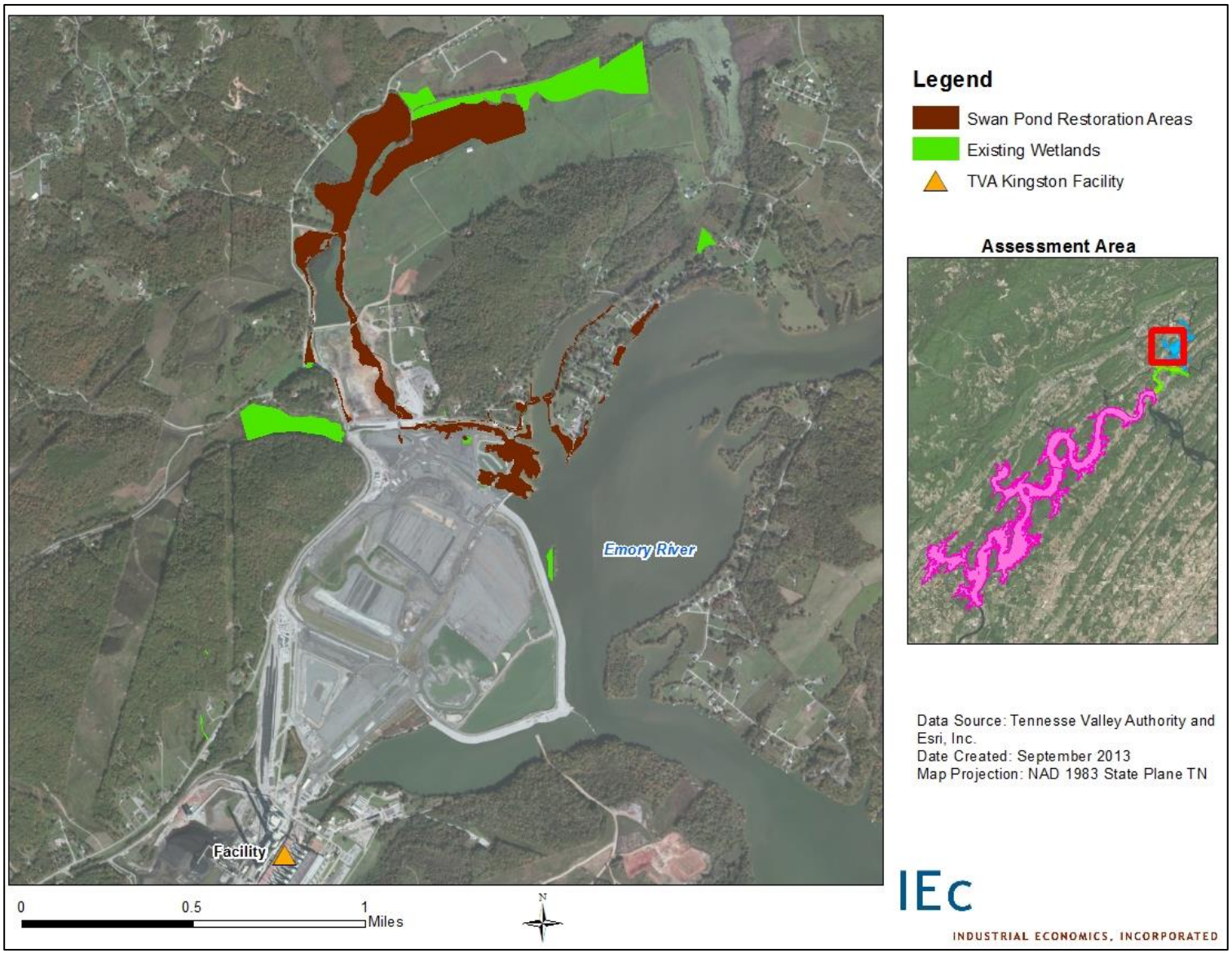


EXHIBIT 3-3 PROPOSED SWAN POND NEW RECREATIONAL FISHING/BOATING ACCESS POINTS

3.1.3 MONITORING AND ADAPTIVE MANAGEMENT OF ECOLOGICAL RESTORATION AT SWAN POND

Following the completion of Swan Pond, monitoring and adaptive management are required to ensure that restoration actions are successful in the long-term. TDEC and FWS require all ecological and recreational fishing/boating activities proposed by TVA in the Swan Pond Restoration master plan are completed, and that sufficient monitoring and management occur (either directly or funded by TVA) for a minimum of 30 years.

A critical component of any restoration project, monitoring provides a mechanism to determine whether the project has met its goals or performance criteria and helps to guide adaptive management actions and site maintenance. The Trustees, including TVA, are designing a monitoring plan that is tailored to the specific characteristics of the Swan Pond restoration. The plan includes performance criteria: the measures that will assess the progress of the restoration sites toward project goals. In this case, performance criteria include both the performance anticipated as well as the time that is predicted for the restored habitat to reach intermediate milestones and overall project goals. Because planting success criteria are expected to be met in year 15, intermediate milestones are necessary to determine whether a project is on an acceptable trajectory toward full recovery.

To ensure the success of a restoration site it is important to have an adaptive management strategy that will allow Trustees to determine what attributes are not on target for project success and what actions, including overall course corrections due to site conditions, need to be taken to achieve project success. Examples of adaptive management actions include replanting species, changing plant species or densities, re-grading banks, adjusting hydrological connections, and/or installing irrigation. Monitoring parameters, described below, are designed to collect data that will inform whether adaptive management may be needed. If an attribute is not performing as expected, TVA will critically evaluate the issue and if needed will develop an adaptive management plan that will be reviewed and approved by all the Trustees prior to implementation.

The specific parameters being monitored reflect both the physical structure and biological components of the restored habitat. More importantly, the selected parameters and plan assess how the system and its ecological processes are functioning. In this case, the Trustees are focusing on the plant community as a proxy for overall ecosystem health. For example, monitoring will assess plant survival, percent cover, and percent native species.

As noted above, the ecological services provided by restored habitats take time to fully develop. Typically, sites develop more rapidly at first as plants become established and animal species return, and then have a slower recovery rate in later years. To account for this temporal variability, monitoring will be completed every year for the first few years after project implementation, and then will be spaced more infrequently in subsequent years: Therefore monitoring and reporting will be performed in years 1, 2, 3, 5, 7, 10, 15, 20, 25, and 30. All monitoring will occur during the early part of the growing season, between mid-April and late May, and monitoring reports will be submitted to the Trustees each monitoring year.

If upon review of the monitoring reports it is shown that success criteria are not on track to be met at the anticipated date, then changes will be made to the plan. These changes may include selection of different species to be planted, alternative settings at the weirs to control water levels, new drainage patterns that affect the wetlands, or changes in methods used to manage invasive species. Should such changes be necessary, the revised plan will be submitted to Trustee agencies for review and approval prior to changes being implemented.

3.2 $750,000 CASH PAYMENT FOR RESTORATION

In addition to implementation of the Swan Pond master plan, TVA's NRDA settlement includes a $750,000 cash payment for additional restoration outside the Swan Pond area. Restoration activities could include projects such as conservation easements, land acquisition, stream-bank restoration or the creation of new recreational fishing/boating access. The broader geographic scope of these projects would enable the Trustees to conduct restoration in other areas that support relevant aquatic habitat and associated natural resources, and would provide the remaining ecological benefits required for compensation, and/or additional fishing, boating, and other recreational opportunities for the public. Identification and selection of specific projects will also include opportunities for public outreach and comment as required under the DOI NRDA regulations (43 CFR 11.81).

3.3 PROPOSED RESTORATION ALTERNATIVES

As described above, in addition to the implementation of Swan Pond, TVA provided a cash payment of $750,000 to the Trustees to implement additional restoration projects. The remainder of this chapter describes restoration alternatives the Trustees deemed potentially appropriate for funding, as well as several alternatives the Trustees evaluated but eliminated from further consideration. Further details of the Trustees' evaluation of the restoration alternatives are presented below and in Chapter 4.

3.3.1 ALTERNATIVE A: NO ACTION / NATURAL RECOVERY

The No Action/Natural Recovery alternative includes any continuing or further remedial activities and associated adaptive management, but would not include additional activities to restore injured natural resources or compensate for the interim loss of natural resource services.

The National Environmental Policy Act (NEPA) requires the Trustees to consider no action/natural recovery as an option for restoring injured natural resources and services. The No Action alternative thus serves as a point of comparison to determine the context, duration, and magnitude of any environmental effects that might result from the implementation of other restoration actions.

3.3.2 ALTERNATIVE B: HABITAT RESTORATION WITHIN THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

Habitat restoration within the Emory, Clinch and Watts Bar watersheds is expected to provide natural resource services similar to the services that the injured habitat would have provided but for the TVA-KIF spill. This alternative would increase habitat quality and quantity, promote habitat connectivity, and benefit Trust natural resources specifically within the injured ecosystem.

There are a variety of habitat restoration options within the Emory, Clinch and Watts Bar watersheds that would provide relevant ecological services. Trust resources potentially benefited by these habitat restoration alternatives include surface water, sediments, aquatic invertebrates, fish, birds, turtles, amphibians and mammals. For example:

- *Habitat Creation*. This involves converting one type of habitat to another. Typically this is undertaken when:
    1. A disturbed/non-habitat area can be converted to habitat. Example: An abandoned parking lot could be cleared, debris removed, graded, and planted as native grassland (e.g., to support migratory songbirds).
    2. An area is restored to a historic habitat type. Example: A wetland, previously filled, could be excavated, re-graded, hydrologically reconnected to surface water or other wetland, and replanted with native wetland vegetation (e.g., to support waterfowl, amphibians, etc.).
    3. There is a specific need for a particular habitat type in an area. Example: An endangered plant requires vernal pools for survival. Protection and restoration for that species is a resource management priority. In the area of concern, vernal pools are sufficiently rare such that conversion of other habitat (e.g., upland) to vernal pool is appropriate.
- *Habitat Restoration*. This includes improvement of degraded habitat, ideally returning the area to conditions that better approximate "natural" conditions. Example: The hydrologic connectivity of an existing wetland is restricted by an undersized culvert. The existing culvert could be replaced with a larger, more wildlife-friendly culvert. Other examples of habitat restoration activities include invasive species removal, planting of native species, stocking native bivalves, dam removal, or the addition of soil amendments to promote natural vegetation growth.
- *Habitat Enhancement.* This involves increasing one or more of the services provided by an existing habitat. Example: There are sufficient feeding opportunities for osprey in area streams and rivers, but nesting habitat is scarce and is limiting the local population. Osprey nesting platforms could be installed in strategic locations throughout relevant habitat.
- *Habitat Preservation*: This involves preservation of habitat that would otherwise be developed or degraded. Example: A developer is planning to purchase land to construct a shopping center. The land is adjacent to a stream that supports

threatened mussel species, and is visible from nearby hiking trails. Purchase and preservation of the property would prevent the degradation of the area within the shopping center footprint, the stream, and the viewshed. Habitat preservation activities could also include the acquisition of ecologically valuable habitat or establishment of conservation easements on riparian habitat along ecologically valuable waterways.

3.3.3 ALTERNATIVE C: PROVISION OF NEW/IMPROVED RECREATIONAL OPPORTUNITIES WITHIN THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

New/improved recreational opportunities within the Emory, Clinch and Watts Bar watersheds are expected to provide natural resource services similar to the services lost due to the TVA-KIF spill. This alternative includes new or improved opportunities for recreational fishing and/or boating within the Emory, Clinch and Watts Bar watersheds, as well as other aquatic habitat-related recreational activities (e.g., swimming, hiking, and bird-watching). For example, the Trustees could acquire property and develop a fishing/boating pier and ramp in a section of river previously inaccessible to the public. The Trustees are also considering improving existing access areas, such as through additional parking, improved amenities, and/or shoreline stabilization to improve bank fishing. These types of opportunities within the watersheds would enable the Trustees to conduct restoration in areas where formal closures were not implemented, but where public use of resources may have been affected by the spill. For example, members of the public may have forgone fishing trips or enjoyed a lesser quality of fishing trip in areas downstream of the closures.

3.4 ALTERNATIVES CONSIDERED BUT NOT PURSUED

The Trustees identified, but eliminated from further evaluation, two additional restoration alternatives: habitat restoration outside the Emory, Clinch and Watts Bar watersheds and provision of new/improved recreation opportunities outside of the Emory, Clinch and Watts Bar watersheds.

3.4.1 HABITAT RESTORATION OUTSIDE THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

The Trustees considered the potential benefits of restoration projects intended to restore aquatic habitat outside the Emory, Clinch and Watts Bar watersheds, but chose not to evaluate this alternative. Habitat restoration outside the Emory, Clinch and Watts Bar watersheds is not as likely to provide the same type of ecological services as those injured due to the TVA-KIF spill, and would not provide a similar level of habitat connectivity as projects within the affected watersheds.

3.4.2 PROVISION OF NEW/IMPROVED RECREATION OPPORTUNITIES OUTSIDE THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

The Trustees considered the potential benefits of restoration projects intended to create and/or improve recreation opportunities outside the Emory, Clinch and Watts Bar watersheds, but chose not to evaluate this alternative. Because formal closures due to the TVA-KIF spill were not implemented outside the Emory, Clinch and Watts Bar

watersheds, it is likely these areas did not see the same reduction in diminished or foregone recreation trips as areas within the Emory, Clinch and Watts Bar watersheds. Therefore, implementation of projects outside the Emory, Clinch and Watts Bar watersheds is unlikely to provide benefits to the members of the public that did experience a loss in recreational services as a result of the TVA-KIF spill.

CHAPTER 4 | EVALUATION AND SELECTION OF THE PREFERRED ALTERNATIVES

This chapter presents an evaluation of the proposed restoration alternatives described in Chapter 3. The Trustees' primary goal is to select restoration alternatives that sufficiently compensate the public for natural resource injuries and associated service losses resulting from the TVA-KIF ash spill. As noted in Chapter 2, available information indicates that the most substantial injuries and service losses resulted from: 1) the ecological effects of ash smothering and corresponding dredging to remove the ash, and 2) reductions in the frequency and value of recreational activities such as fishing and boating. In order to ensure the appropriateness and acceptability of the proposed restoration alternatives in light of spill-related ecological and recreational losses, the Trustees evaluated each option against site-specific and DOI restoration criteria.

The criteria specific to compensatory restoration for the TVA-KIF spill include:

1. Location within the Emory, Clinch and Watts Bar watersheds; and
2. Habitat connectivity (e.g., larger/more connected parcels provide greater resource services than smaller disconnected parcels).

The DOI NRDA regulations at 43 C.F.R. §11.82(d) include the following restoration project criteria:

1. Technical feasibility (i.e., whether it is possible to implement the alternative);
2. The relative cost-effectiveness of different alternatives (i.e., if two alternatives are expected to produce similar benefits, the least costly one is preferred);
3. The probability of project success (i.e., the likelihood that implementing the alternative would produce the desired results);
4. Proximity and benefit to the affected natural resources and services;
5. Potential for multiple resource benefits;
6. The results of actual or currently-planned response actions;
7. The potential for collateral injury to the environment resulting from the proposed actions, including long-term and indirect impacts, to the injured resources or other resources if the alternative is implemented;
8. The ability of the natural resources to recover with or without each alternative, and the time required for such recovery;
9. Potential effects on public health and safety; and

10. Compliance with applicable Federal and state laws.

4.1 EVALUATION OF ALTERNATIVE A: NO ACTION/NATURAL RECOVERY

Under the No Action/Natural Recovery alternative, the public would not be fully compensated for injuries to trust resources or for associated reductions in ecological and recreational services.

Under the No Action scenario, natural resources in the TVA-KIF assessment area would continue to be influenced by a variety of ongoing ecological stressors (e.g., invasive species, shoreline erosion and instability). The absence of Trustee-funded restoration activity under the No Action alternative therefore results in lower environmental quality and reduced natural resource services within the region than if restoration projects were implemented.

The Trustees expect that many of the natural resources and services impacted by ash smothering and dredging will recover naturally. However, this recovery could be slow and may fall short of conditions achieved through active restoration efforts. Under the No Action Alternative, the public would not receive compensation for interim losses. Habitat quality would not be improved above baseline, recreational fishing and boating opportunities would not increase, and no additional options for swimming, wildlife viewing, or other aquatic-based recreational activities would be available to the public.

Although the No Action alternative provides a useful reference point for characterizing the impact of the other restoration alternatives as required by NEPA, it fails to fulfill the Trustees' mandate under CERCLA. The Trustees are required under CERCLA to use the settlement funds to restore, replace or acquire the equivalent of injured resources. Therefore, the Trustees do not consider No Action a viable alternative.

4.2 EVALUATION OF ALTERNATIVE B: HABITAT RESTORATION WITHIN THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

The habitat restoration options described in Chapter 3 have the potential to accomplish the primary goal of compensating the public for injuries to Trust resources and associated ecological service reductions. Habitat creation and restoration activities provide natural resource services similar to the assessment area's baseline services. For example, the restored wetlands and shoreline/riparian areas provide habitat for breeding and migratory fish and birds, improve water quality by filtering sediments and other pollutants from the water column, reduce erosion, and export detritus (energy source for the aquatic food web). Further, these activities influence increased production of forage fish which provide additional prey for piscivorous fish, birds, reptiles, and mammals. Preservation restoration activities such as land acquisition and conservation easements protect ecologically viable habitat from current and future development. Additionally, potential habitat restoration activities within the Emory, Clinch and Watts Bar watersheds would specifically promote habitat connectivity throughout the assessment area, which is critical for providing high quality aquatic ecological services similar to those lost.

As part of the Trustees' evaluation of this alternative, they considered the environmental consequences that could be caused by implementing the restoration options described above. Although most of the changes likely to occur to trust resources as a result of habitat restoration would be positive, some short-term negative impacts also may occur. For example, any aquatic restoration project requiring the use of mechanical equipment and/or soil or sediment disturbance has the potential for local, short-term adverse impacts. These potential impacts may include increased turbidity and sedimentation, dust, noise, and the potential for releases of oil products. Use of best management practices during construction would avoid or minimize any adverse impacts and ensure no significant adverse impacts. In addition, the Trustees expect any of these adverse effects to be temporary and minor, and would be outweighed by the potential long-term ecological benefits of the ecological projects.

4.3 EVALUATION OF ALTERNATIVE C: PROVISION OF NEW/IMPROVED RECREATIONAL OPPORTUNITIES WITHIN THE EMORY, CLINCH AND WATTS BAR WATERSHEDS

The recreation restoration options described in Chapter 3 have the potential to accomplish the primary goal of compensating the public for injuries to Trust resources and associated service reductions. This alternative could include new or improved opportunities for recreational fishing and/or boating, as well as other aquatic habitat-related recreational activities (e.g., swimming, hiking, bird-watching). Recreation-related restoration opportunities within the Emory, Clinch and Watts Bar watersheds would enable the Trustees to conduct restoration in areas where formal closures were not implemented, but where public use of resources may have been affected by the spill. For example, members of the public may have forgone fishing trips or enjoyed a lesser quality of fishing trip in areas downstream of the closures.

As part of the Trustees' evaluation of this alternative, they considered the environmental consequences that could be caused by implementing the options described above. Although most of the changes likely to occur to trust resources as a result of recreation-related restoration would be positive, some short-term negative impacts also may occur. For example, construction activities associated with the development of a new fishing pier could cause short-term habitat degradation effects, such as the displacement of river sediments, increased turbidity, and recreation use loss (e.g., if the construction occurs at an existing access point). However, the Trustees expect these adverse effects to be temporary and minor, and would be outweighed by the potential long-term recreational benefits of the recreation projects.

CHAPTER 5 | PREFERRED RESTORATION ALTERNATIVE SUMMARY

The Trustees evaluated three restoration alternatives that address natural resource injuries and service reductions resulting from the TVA-KIF spill. Based on the site-specific and regulatory criteria described in Chapter 4, the Trustees selected a combination of Alternatives B and C as the preferred restoration alternative (summarized in Exhibit 5-1). The Trustees believe these alternatives compensate the public for losses due to the TVA-KIF spill, and satisfy the site-specific and DOI NRDA regulations criteria described in Chapter 4.

As this RCDP is finalized, the Trustees will begin to identify and evaluate specific project options based on the preferred alternatives. Each project will be evaluated against the same restoration criteria described above, and, if needed, a further review of environmental consequences will be conducted. Any selected projects that are expected to have non-negligible impacts will be subject to a project-specific NEPA analysis prior to implementation. In addition, a Section 7 consultation (under the Endangered Species Act) will be completed for restoration projects that may affect threatened or endangered species and Section 106 of the National Historic Preservation Act will be followed for each restoration project that will be implemented.

The Trustees will continue to inform the public of restoration project plans and progress.

EXHIBIT 5-1 EXAMPLE EMORY, CLINCH AND WATTS BAR WATERSHED RESTORATION OPTIONS AND TRUST RESOURCES POTENTIALLY BENEFITED

ALTERNATIVE B AND C COMPONENTS[1]	GENERIC DESCRIPTION	TRUST RESOURCES/RESOURCE SERVICES POTENTIALLY BENEFITED
Habitat Creation	Converting one habitat type to another.	• Surface Water • Sediments • Aquatic Invertebrates • Fish • Birds • Turtles • Amphibians • Mammals
Habitat Restoration	Improving degraded habitat or returning former habitat to natural conditions.	
Habitat Enhancement	Increasing one or more of the services provided by an existing habitat.	
Land Acquisition and Easements	Preserving habitat that would otherwise be developed or degraded.	
Public Access	Providing new or enhancing existing access for recreational opportunities.	• Public recreation

Note:

1. Restoration alternatives must be within the Emory, Clinch and Watts Bar watersheds.

5.1 EVALUATION BASED ON CRITERIA

In order to determine the appropriateness and sufficiency of the preferred restoration alternatives, the components of the habitat restoration and new/improved recreation activities within the Emory, Clinch and Watts Bar watersheds were evaluated based on the criteria described in Chapter 4. Site-specific criteria and the criteria listed in the DOI regulation for damage assessment [43 CFR Section 11.82 (d)] were considered as follows:

Site-specific criteria:

- *Location within the Emory, Clinch and Watts Bar watersheds.* Habitat restoration and new/improved recreation projects chosen by the Trustees will be implemented completely within the Emory, Clinch and Watts Bar watersheds, which is where natural resources have been and continue to be injured as a result of the TVA-KIF ash spill and corresponding remedial actions.

- *Habitat connectivity (e.g., larger/more connected parcels provide greater resource services than smaller disconnected parcels).* The Trustees will focus on selecting and implementing projects that will maximize habitat connectivity. For example, they may prioritize projects that are: on land adjacent to property that is already preserved, on land adjacent to a water body, on a large parcel of land, and/or on land that has been identified as a part of a habitat corridor. Habitat restoration, creation, and enhancement are all project types that, if sited correctly, can improve habitat connectivity.

DOI NRDA regulations at 43 C.F.R. §11.82(d):

- *Technical feasibility (i.e., whether it is possible to implement the alternative).* Habitat restoration, recreation, and enhancement projects and the implementation of new/improved recreation activities within the Emory, Clinch and Watts Bar watersheds are technically feasible. The Trustees plan to apply methods that have been successful in other locations, and will work closely with project proponents to ensure that the design satisfies this criterion. When the Trustees review specific projects, they will evaluate the technical feasibility of implementing each project in further detail.
- *The relative cost-effectiveness of different alternatives (i.e., if two alternatives are expected to produce similar benefits, the least costly one is preferred).* Habitat restoration, creation, and enhancement projects and the implementation new/improved recreation activities within the Emory, Clinch and Watts Bar watersheds can all be cost effective when implemented in an appropriate location using technically feasible methods. The Trustees will focus on gaining the maximum ecological and/or recreational benefit per dollar spent. When the Trustees review specific projects, they will evaluate the cost-effectiveness of each project in further detail.
- *The probability of project success (i.e., the likelihood that implementing the alternative would produce the desired results).* Habitat restoration, creation, and enhancement as well as recreational enhancement projects similar to the preferred alternative have previously successfully been implemented within the Emory, Clinch and Watts Bar watersheds. When the Trustees review specific projects, they will evaluate each project's probability of success in further detail.
- *Proximity and benefit to the affected natural resources and services.* Habitat restoration, creation, and enhancement projects will be specifically targeted to benefit trust resources that utilize aquatic habitat. Example habitat types include open water, riparian/shoreline areas, and wetlands. This will directly benefit resources such as invertebrates, fish, birds, and mammals, all of which incurred some injury as a result of the TVA-KIF ash spill. Similarly, recreational-related projects will be designed to provide increased and/or improved opportunities for public recreational fishing and boating – activities which were lost or diminished in quality due to the spill. As noted under the

site-specific criteria, projects will be located within the Emory, Clinch and Watts Bar watersheds, maximizing proximity to injured resources.

- *Potential for multiple resource benefits.* The variety of potential habitat and recreation activities will allow for these projects to benefit multiple resources and resource services. Recreation projects such as the installation of a new boat ramp will enhance public access and both recreational boating and fishing activities injured by the spill. Habitat restoration such as in-stream alterations will improve ecological functions such as water flow and cover for fish and invertebrates, which will not only provide direct benefit to those resources, but benefits to the resources that rely on invertebrates and fish for food, and to anglers who would enjoy an increase catch rate as fish populations improve.
- *The results of actual or currently-planned response actions.* Remedial activities at the Site are complete.
- *The potential for collateral injury to the environment resulting from the proposed actions, including long-term and indirect impacts, to the injured resources or other resources if the alternative is implemented.* The Trustees will evaluate and implement habitat and recreation project options within the Emory, Clinch and Watts Bar watersheds that are specifically designed to improve the conditions of the associated resources. Designs will be evaluated to ensure that the potential for causing additional direct or indirect injury through the projects is minimal compared to the ecological and recreational benefit the project is expected to generate.
- *The ability of the natural resources to recover with or without each alternative, and the time required for such recovery.* The Trustees expect that many of the natural resources and services impacted by ash smothering and dredging will recover naturally. However, this recovery would be slow and may fall short of conditions achieved through the preferred alternative active restoration efforts.
- *Potential effects on public health and safety.* Habitat restoration and the implementation of new/improved recreation activities may result in potential exposure to contaminants and the risk of injury from heavy equipment (e.g., dredging and construction equipment). The Trustees, however, expect that public exposure to these areas during restoration will be minimized, thereby limiting or possibly eliminating any risk.
- *Compliance with applicable Federal and state laws.* The Trustees' consideration of this criterion is discussed in Chapter 1. In addition, the Trustees will review specific project proposals to ensure continued compliance.

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APPENDIX A SUMMARY OF CONTAMINANT CONCENTRATIONS COMPARED TO SCREENING CRITERIA/THRESHOLDS

EXHIBIT A-1 COMPARISON OF OBSERVED SEDIMENT CONCENTRATIONS (MG/KG) TO SCREENING CRITERIA (MG/KG)

CONTAMINANT	SCREENING CRITERIA		CLINCH (2010-2011)	DREDGE AREA (2009-2011)	EMORY ABOVE DREDGE (2011)	WATTS BAR (2010-2011)
	VALUE	SOURCE				
Arsenic	33	(2)	13.37	18.77	3.61	10.70
Arsenic (Speciation Lab)	33	(2)	16.19	19.33	5.78	19.59
Inorganic Arsenic	33	(2)	13.66	19.12	4.80	17.10
Organic Arsenic	33	(2)	3.67	2.67	1.32	3.65
Cadmium	4.98	(2)	0.09	0.09	0.08	0.14
Chromium	111	(2)	27.28	19.78	9.88	19.10
Copper	149	(2)	19.60	20.99	5.88	15.77
Lead	128	(2)	18.12	14.41	7.63	14.62
Mercury	1.06	(2)	0.22	0.13	0.03	0.27
Mercury (Speciation Lab)	1.06	(2)	0.45	0.08	0.08	0.47
Nickel	48.6	(2)	17.34	20.03	9.33	14.49
Selenium	4	(1)	0.98	1.51	0.86	1.19
Vanadium	50	(3)	38.87	34.44	13.53	30.19
Zinc	459	(2)	61.73	50.57	32.90	67.39
Total PAHs	22.8	(2)	0.30	0.23	0.46	0.64

Note: Any observed concentration in exceedence of a criterion may cause a loss in ecological services, and is highlighted in yellow. Green indicates that a geometric mean concentration did not exceed the criterion for that contaminant.

Data Source: Tennessee Valley Authority. 2012. Site-Specific Post Kingston Coal Ash Release Contaminant Concentration Data.

Screening Criteria Sources:

1. DOI 1998
2. MacDonald et al. 2000
3. NOAA 1999

EXHIBIT A-2 COMPARISON OF OBSERVED FISH CONCENTRATIONS (MG/KG) TO SCREENING CRITERIA (MG/KG)

CONTAMINANT	SCREENING CRITERIA		CLINCH (2009-2011)	DREDGE AREA (2009-2011)	EMORY ABOVE DREDGE (2010-2011)
	VALUE	SOURCE			
Arsenic	0.49	(12)	0.43	0.40	0.27
Arsenic (Speciation Lab)	0.49	(12)	0.79	0.31	0.24
Inorganic Arsenic	0.49	(12)	0.21	0.00	0.00
Organic Arsenic	0.49	(12)	0.41	0.31	0.24
Cadmium	0.17	(4),(7),(11),(1)	0.01	0.01	0.01
Chromium	0.8	(6)	0.43	0.22	0.14
Copper	1.6	(9),(8),(3)	1.31	0.84	0.83
Lead	0.4	(5)	0.26	0.12	0.08
Mercury	0.2	(13),(2),(10),(5)	0.02	0.01	0.01
Nickel	40	(12)	0.29	0.16	0.11
Selenium	4	(12)	0.59	0.69	0.46
Vanadium	Insufficient Information		0.45	0.26	0.09
Zinc	40	(5)	20.41	22.04	18.96

Note: Any observed concentration in exceedence of a criterion may cause a loss in ecological services, and is highlighted in yellow. Green indicates that a geometric mean concentration did not exceed the criterion for that contaminant.

Data Source: Tennessee Valley Authority. 2012. Site-Specific Post Kingston Coal Ash Release Contaminant Concentration Data.

Screening Criteria Sources:

1. Cope et al. 1994
2. Friedmann et al. 2002
3. Hansen et al. 2002
4. Hansen et al. 2004
5. Hinck et al. 2009
6. Irwin et al. 1997
7. Kumada et al. 1972
8. Lundebye et al. 1999
9. Marr et al. 1996
10. Matta et al. 2001
11. Spehar et al. 1978
12. Industrial Economics, Inc. 2012.
13. Weis and Weis 1978

EXHIBIT A-3 COMPARISON OF OBSERVED FISH CONCENTRATIONS (MG/KG – DIET) TO AVIAN DIETARY SCREENING CRITERIA (MG/KG - DIET)

CONTAMINANT	SCREENING CRITERIA		CLINCH (2009-2011)	DREDGE AREA (2009-2011)	EMORY ABOVE DREDGE (2010-2011)
	VALUE	SOURCE			
Arsenic	30	(8)	0.43	0.40	0.27
Arsenic (from speciation lab)	30	(8)	0.79	0.31	0.24
Inorganic Arsenic	30	(8)	0.21	0.00	0.00
Organic Arsenic	30	(8)	0.41	0.31	0.24
Cadmium	0.5	(1),(3)	0.01	0.01	0.01
Chromium	15.4	(6)	0.43	0.22	0.14
Copper	52	(7),(2)	1.31	0.84	0.83
Lead	16.3	(5)	0.26	0.12	0.08
Mercury	0.02	(6),(9)	0.02	0.01	0.01
Nickel	2.5	(8)	0.29	0.16	0.11
Selenium	1	(8)	0.59	0.69	0.46
Vanadium	5	(8)	0.45	0.26	0.09
Zinc	4	(4)	20.41	22.04	18.96

Note: Any observed concentration in exceedence of a criterion may cause a loss in ecological services, and is highlighted in yellow. Green indicates that a geometric mean concentration did not exceed the criterion for that contaminant.

Data Source: Tennessee Valley Authority. 2012. Site-Specific Post Kingston Coal Ash Release Contaminant Concentration Data.

Screening Criteria Sources:

1. Burger et al. 2005
2. Chiou et al. 1997
3. Eisler 2000
4. Hinck et al. 2006
5. Hinck et al. 2009
6. Irwin et al. 1997
7. Kassim and Suwanpradit 1996
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APPENDIX B SUMMARY OF HABITAT EQUIVALENCY ANALYSIS INJURY INPUTS AND RESULTS BY RIVER SECTION

EXHIBIT B-1 DREDGED AREA HEA INPUTS AND RESULTS

RIVER SEGMENT[1]	ACRES OF AQUATIC HABITAT	SERVICE LOSS[2]								RECOVERY BEGINS	DSAYS
		2009	2010	2011	2012	2013	2014	2015	2016		
Segment 1	22	100%	100%	41%	8%	0%	0%	0%	0%	2011	59
Segment 2/3	6	100%	100%	41%	8%	0%	0%	0%	0%	2011	17
Segment 4	7	100%	100%	41%	8%	0%	0%	0%	0%	2011	19
Segment 5	20	100%	100%	54%	8%	0%	0%	0%	0%	2011	58
Above Segment 5	24	100%	100%	74%	47%	0%	0%	0%	0%	2011	84
Above-Above Segment 5	23	100%	100%	54%	9%	0%	0%	0%	0%	2011	66
Dike 2	33	100%	100%	100%	100%	100%	41%	8%	0%	2014	189
Church Slough	5	100%	0%	0%	0%	0%	0%	0%	0%	2010	4
East Embayment-South End	10	100%	100%	100%	100%	100%	41%	8%	0%	2014	57
East Embayment-North End	9	100%	100%	41%	8%	0%	0%	0%	0%	2011	25
Middle Embayment	51	100%	100%	100%	100%	100%	41%	8%	0%	2014	289
North Embayment-South End	37	100%	100%	100%	41%	8%	0%	0%	0%	2012	135
North Embayment-North End	24	100%	100%	100%	41%	8%	0%	0%	0%	2012	89
Sub-Total[4]											1,091

Notes:

1. Service loss is based on the comparison of several metrics evaluating benthic community health (abundance, richness, and percent sensitive species) for each segment to values for reference areas.
2. For areas that have not returned to baseline conditions, recovery is expected to take two years.
3. Benthic community data were not available for all segments. Information on how data gaps were filled is provided earlier in this memo.
4. Total includes this dredged area sub-total plus the sub-total for ash-affected areas (Exhibit B-2).

EXHIBIT B-2 ADDITIONAL ASH AFFECTED AREAS HEA INPUTS AND RESULTS

RIVER SEGMENT[1]	ACRES OF AQUATIC HABITAT	SERVICE LOSS[2]								DSAYs
		2009	2010	2011	2012	2013	2014	2015	2016	
Segment 1	14	0%	0%	0%	0%	0%	0%	0%	0%	0
Segment 2/3	10	0%	0%	0%	0%	0%	0%	0%	0%	0
Segment 4	22	0%	11%	5%	0%	0%	0%	0%	0%	4
Segment 5	22	6%	6%	3%	0%	0%	0%	0%	0%	4
Above Segment 5	32	0%	0%	0%	0%	0%	0%	0%	0%	0
Above Above Segment 5	69	30%	0%	0%	0%	0%	0%	0%	0%	24
Below Segment 4, West	88	0%	32%	16%	0%	0%	0%	0%	0%	45
Below Segment 4, East	96	0%	0%	0%	0%	0%	0%	0%	0%	0
Below Segment 4, Embayment	25	0%	0%	0%	0%	0%	0%	0%	0%	0
North of Segment 4	23	0%	11%	5%	0%	0%	0%	0%	0%	4
Intake Channel	62	0%	16%	8%	0%	0%	0%	0%	0%	16
East of Segment 1	139	0%	0%	0%	0%	0%	0%	0%	0%	0
North of Segment 5	57	23%	23%	12%	0%	0%	0%	0%	0%	36
Sub-Total[4]										133

Notes:
1. Service loss is based on the comparison of several metrics evaluating benthic community health (abundance, richness, and percent sensitive species) for each segment to values for reference areas.
2. For areas that have not returned to baseline conditions, recovery is expected to take two years.
3. Benthic community data were not available for all segments. Information on how data gaps were filled is provided earlier in this memo.
4. Total includes the dredged area sub-total (Exhibit B-1) plus this sub-total for ash-affected areas.

APPENDIX C SWAN POND HABITAT EQUIVALENCY ANALYSIS

EXHIBIT C-1 SWAN POND AQUATIC HABITAT RESTORATION INPUTS AND RESULTS[8,9]

ECOLOGICAL HEA INPUTS	WETLANDS AND RIPARIAN / SHORELINE RESTORATION BENEFITS
Final Level of Services	85%
Acres	90.05
Restoration start	2014
Restoration Complete	2014
Present Year	2013
Discount Rate	3%
Recovery Years	15
Recovery Begins	2015
Recovery Shape	Linear
Time Frame	30 Years
Starting Level of Services	0%

TIMEFRAME OF BENEFITS[10]	TOTAL ECOLOGICAL BENEFITS (DISCOUNT SERVICE ACRE-YEARS GAINED)
2013-2045	1,040

[8] Includes wetland and riparian/shoreline restoration.

[9] In addition to the 90 acres of wetland/shoreline restoration, the Swan Pond Master Plan includes 38 acres of wetland preservation activities (as described in the ecological restoration section above). Because wetlands already receive some protection under Federal law, and because the wetlands identified for preservation in the Master Plan are not known to be under threat of development, the magnitude of ecological benefits gained through preservation is uncertain. Therefore, the ecological service gains potentially associated with wetland preservation are not quantified.

[10] Although restoration gains do not begin until 2015 (the year after construction ends), benefits are discounted to their value in 2013 to be consistent with the calculation of losses in 2013.

APPENDIX D RESPONSE TO PUBLIC COMMENTS

The Trustees released the RCDP for public review in March 2015, and held a public meeting to discuss the RCDP on April 9, 2015. Two individuals and two groups submitted written comments during the review period. Responses to these comments are provided below, organized by general topic. Note that comments are not presented verbatim. To request a copy of the original comments, please contact:

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TRUSTEE ROLES

Comment 1: It is not appropriate for TVA to participate in the NRDA and RCDP process as both a Trustee and a responsible party; it is a clear conflict of interest.

Response 1: As described in Section 1.4 of the RCDP, Federal, State, and Tribal entities are authorized to act as Trustees pursuant to Section 307(f) of CERCLA. Several Federal agencies, including TVA, are designated to act on behalf of the public as Trustees for natural resources under Federal jurisdiction. TVA has trust responsibilities for the natural resources they manage or control. For example, TVA is responsible for the management of 293,000 acres of public land and 11,000 miles of public shoreline in the TVA region, including a significant portion of the land that was impacted by the 2008 KIF ash spill.

In this case, TVA is also the party responsible for the releases from the ash spill and therefore also a potentially responsible party. Federal regulations require that the Trustees invite the responsible party to participate in the damage assessment, whether the responsible party is a private entity, a public agency, or a Trustee. The Trustees shall, "invite the participation of the potentially responsible party…in the development of the type and scope of the assessment and in the performance of the assessment." (43 C.F.R. § 11.32(a)(2)(iii)(A). This type of coordination also assists the Trustees in meeting the regulatory requirement of reasonable cost (i.e., the anticipated cost of the assessment is expected to be less than the anticipated damage amount (43 C.F.R. § 11.14(ee))) by increasing the efficiency of the NRDA process. TVA and the other Trustees signed a Memorandum of Agreement in January 2011 regarding the conduct of the damage assessment and have agreed to work cooperatively to resolve natural resource damages resulting from the KIF coal ash release. While TVA has input into the damage assessment and restoration planning process (examples provided in Section 1.4 of the RCDP),

decisions regarding final analytical parameters, methods, restoration priorities, and sufficiency of proposed compensation are made by the Trustees as a whole.

PUBLIC PROCESS

Comment 2: The current public comment period is somewhat meaningless given that the Swan Pond project is nearly complete. Obviously, the Trustees were committed to that project, and to the $750,000, long before the draft RCDP was presented to the public, and nothing the public could say at this point could affect this predetermined outcome.

Response 2: As stated in Chapter 3, the Trustees are *considering* a settlement with TVA that is comprised of implementation and monitoring of the Swan Pond Embayment Restoration and Recreation Park and a cash payment of $750,000 to fund additional restoration projects. The Trustees evaluated this combination of projects and funding and determined that it provides sufficient and appropriate compensation for ecological and recreational losses. Considerations include:

- Swan Pond satisfies both the site-specific and the DOI restoration criteria (43 C.F.R. § 11.82(d)) that are set out in Chapter 4 of the RCDP against which other restoration projects are evaluated.
- The DOI regulations state that Trustees should coordinate assessment and restoration activities with remedial activities where feasible (43 C.F.R. § 11.23(f)) and 43 C.F.R. § 11.82(b)(ii)).
- As part of public outreach and involvement efforts, TVA released the plan for the Swan Pond Embayment Restoration and Recreation Park for Swan Pond for public review and comment prior to the release of the RCDP. The final Swan Pond plan, which is the one accounted for in the RCDP, was finalized after consideration of the public comments TVA received during the comment period.
- The Trustees will assess the ecological and recreational benefits of projects proposed to be funded with the $750,000 against the site-specific and regulatory criteria listed in Chapter 4 of the RCDP to ensure that full compensation is achieved under the Preferred Alternative.

This public comment period requested public feedback on the RCDP *prior to* any settlement agreement, specifically to understand the public's opinion on the proposed restoration package, and to determine whether any modifications were warranted. The stage of completion of Swan Pond is not relevant to a settlement.

ASSESSMENT AREA

Comment 3: Did this NRDA and RCDP review and consider damage/negative impact to private/public parties across the Emory River and downstream entities on the Clinch and Watts Bar?

Response 3: In NRDA, Trustees are authorized to claim damages for losses resulting from injuries to natural resources (43 C.F.R. § 11.14(aa)). Natural resources are described

in Section 2.2 of the RCDP and are defined by the DOI NRDA regulations at 43 C.F.R. § § 11.14 (z) as "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled…*for the public*" (emphasis added). This definition and explicit direction to focus on public resources signifies that private party interests are not claimable in this context.

This case specifically addresses natural resources within the assessment area, which includes aquatic habitat (Emory River mile 6.0-0.0, Clinch River mile 5.0 to its confluence with the Tennessee River, Tennessee River mile 568.7 downstream to Watts Bar Dam), and wetland and riparian areas adjacent to the West, North, and East Embayments and Swan Pond (Section 2.1).

BIOTA

Comment 4: Selenium is identified as a contaminant of concern by the EPA in sediments used by certain insect larvae (e.g., midges), which are shown to be adversely impacted. These insect larvae are a major food source for swallows. Swallows were shown to be adversely impacted and are being further monitored. Why are only fish considered in these exhibits and report?

Response 4: The commenter does not identify what data support the assertion that midges and tree swallows were impacted. However, as described in Section 2.2 of the RCDP, the Trustees' analysis considered the following natural resources: sediment, surface water, soil, plants, invertebrates, mussels, fish, reptiles, amphibians, birds and mammals. Using available information, the Trustees evaluated injury to these resources using three lines of evidence:

1. *Contaminant concentrations to which natural resources have been exposed*. This includes sediment/benthic invertebrates, fish, and birds (Section 2.3.1 and Appendix A).
2. *Effects of dredging*. The Trustees assign 100 percent initial service loss to dredged areas to account for the fact that *all* resources within the dredged area were adversely impacted (i.e., invertebrates, fish, birds, etc.). Recovery within the dredged footprints is evaluated based on benthic community metrics. Of all the affected resources, the benthic community is the least mobile and therefore is expected to take the longest to return to pre-release/pre-dredge conditions within the dredge footprint. In addition, sufficient data are available to inform benthic recovery (Section 2.3.2). This is consistent with the DOI NRDA regulations, which state that injury can be quantified based on, "Species or habitats that can represent broad components of the ecosystem, either as representatives of a particular ecological type, of a particular food chain, or of a particular service" (43 C.F.R. § 11.71(l)(2)(i)).
3. *Effects of ash in non-dredged areas*. Among other functions, benthic invertebrate communities are integral to maintaining the structure and function of the aquatic ecosystem (e.g., the base of the aquatic food web), and play an important role in

ecosystem energy and nutrient cycling. In addition, available data on the impacts of ash on the benthic community, as compared to data for other resources, were the most comprehensive and relevant to the NRDA process. Therefore, the Trustees chose the benthic invertebrate community as representative of the overall aquatic community. That is, although injury is quantified based on changes in benthic community metrics, those changes are expected to reflect impacts to *all* aquatic-associated resources, including fish and birds (Section 2.3.2 and, as noted in number 2 above, in 43 C.F.R. § 11.71(l)(2)(i)).

Comment 5: Most fish species were shown to not be impacted; however, there is some evidence "shell crackers" like sunfish may be exhibiting some stress and warrant further monitoring. What fish species were considered for these exhibits? Were all fish lumped into one set of numbers? Why?

Response 5: Fish species specifically considered in our analysis include those for which data are readily available: black crappie, blue catfish, bluegill, channel catfish, gizzard shad, largemouth bass, red ear sunfish, spotted bass, thread fin shad, and white crappie. To assess injury to fish, the Trustees combined all fish species for two main reasons:

1) The Trustees' goal is to evaluate injury to the fish community as a whole, which is consistent both with the manner in which adverse effects information is compiled (i.e., aggregated across a variety of species) and with the DOI NRDA regulations, "The extent to which the injured biological resource differs from baseline should be determined by analysis of the population or the habitat or ecosystem levels. (43 C.F.R. § 11.71(l)(1)).

2) Data for any one individual species is insufficient in terms of number of samples or geographic distribution to be able to meaningfully interpret results.

CONTAMINANTS

Comment 6: Selenium is identified as a contaminant of concern by the EPA and exceeded threshold criteria for some biota sampling. How is selenium not considered in the sediment concentrations in Exhibit A-1?

Response 6: Selenium concentrations are included in Exhibit A-1 of the RCDP, and were found to not exceed the screening threshold criteria for sediment, fish, or birds.

Comment 7: The naturally-occurring metals are hazardous substances as defined by CERCLA Section 101(14). Ash material also contains naturally-occurring radionuclides, which are also hazardous substances as defined by CERCLA Section 101(14), (EPA-AO-054). Has there been any consideration given and accounted for naturally-occurring radionuclides in this NRDA and RCDP?

Response 7: Radionuclides are not addressed in this RCDP. The Trustees focused NRDA efforts on contaminants that were detected at levels sufficient to trigger additional

evaluation. Radionuclides were evaluated as part of the initial screening in the BERA (Arcadis 2012). Results indicated that radionuclide concentrations in the ash released from the TVA Kingston Facility are so low as to not trigger a full risk evaluation (Arcadis 2012). The Trustees reviewed this conclusion and determined that radionuclide levels were also too low to be assessed in the NRDA.

DATA SOURCES

Comment 8: Other than the EPA 2012 Non-Time Critical Removal Action River System EE/CA Fact sheet, what other EPA related documents were used as sources of data and information for this NRDA and RCDP? If none, why not?

Response 8: There are a suite of site-specific documents, many conducted under EPA oversight, which the Trustees relied upon in conducting this NRDA. See Administrative Record.

Comment 9: How were the sources of data and information selected and how was their credibility determined? How were the sources used deemed credible? These appear somewhat outdated against the recent EPA science performed specifically as a result of the ash spill. For example, were the results from the BERA (Arcadis 2012) used?

Response 9: Data sources were selected based on relevance to contaminants of concern/ash, consistency with the biological community in the assessment area, and adverse effects resulting from exposure of biota to contaminants/ash. The credibility of data sources was assessed by first evaluating the context for publication. For example, peer-reviewed literature, studies conducted as part of remedial activities for the Kingston ash release (including the BERA; Arcadis 2012), government agency policy documents, and studies undertaken for a government agency are considered appropriate for use in this NRDA (See Administrative Record). Second, where applicable, the Trustees assessed the design, methods, and results (e.g., did the study have appropriate controls) of each study to ensure that only studies of sufficient quality were included in the analysis.

SCREENING CRITERIA

Comment 10: Are the Screening Criteria sources endorsed by the EPA?

Response 10: As described in Section 2.3 of the RCDP and defined in the DOI NRDA regulations at 43 C.F.R. § § 11.70, the screening criteria for the RCDP were developed by the Trustees as part of the NRDA process. Screening criteria were developed to determine the point at which natural resource exposure to concentrations of COCs are sufficient to cause injury. Injury is defined as, "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 C.F.R. § 11.14(v)). This is separate from the remedial process directed by EPA (Section 1.6 of the RCDP), and therefore not specifically endorsed by EPA.

Comment 11: Even though it is said that the "majority of site-specific tissue and sediment concentrations measured to-date where below corresponding thresholds," what about the minority exceeding thresholds; i.e., arsenic and selenium? The arsenic results for one lab exceeding the screening criteria should not be discounted.

Response 11: While these exceedences indicate that injury may have occurred, the evidence of service loss associated with these possible injuries is not compelling. As identified in Appendix A of the RCDP, data indicate no exceedences of screening criteria for sediment, an exceedence of one arsenic criterion in the Clinch River for fish, and an exceedence of the zinc criterion in all areas for birds. No exceedences of selenium criteria were identified. Because the screening criteria represent concentrations above which an adverse effect may occur, it is possible that fish and/or birds within the assessment area may have been injured (43 C.F.R. § 11.14(v)).

Once injury is determined, the Trustees then quantify that injury as a loss in resource services. Services are defined in the DOI NRDA regulations as, "the physical and biological functions performed by the resource, including the human uses of those functions, [that result from the resource's] physical, chemical, or biological quality" (43 C.F.R. § § 11.14 (nn)). However, it is unlikely that a measurable loss in services resulting from ash-related contamination has occurred. For example, in the Clinch River, sediment arsenic concentrations reported by other laboratories were below the screening criteria, and verification that any effects of zinc on birds were caused by the coal ash spill is limited, as zinc concentrations in reference areas are comparable to those within the assessment area.

Given this information, the Trustees' preferred restoration alternatives (described in Chapters 4 and 5 of the RCDP) are expected to provide sufficient ecological benefits to assessment area resources to account for any potential, minimal loss in ecological services resulting from ash-related contamination.

Comment 12: Commenters question the selected screening criteria values as presented in Exhibits A-1, A-2, and A-3. According to the commenters, the process for determining criteria is unclear and the commenter is concerned that criteria were derived by Industrial Economics. One commenter cites an alternative selenium sediment concentration screening criterion of 2 mg/kg.

Response 12: The screening criteria presented in Appendix A of the RCDP were identified through review of: 1) the Toxicological Profiles that support the Baseline Ecological Risk Assessment (Arcadis 2012 Appendix D), 2) peer-reviewed and other published literature, and 3) data on background concentrations. These criteria reflect thresholds relevant to injury determination (as opposed to remedial risk determination; Response 10 and Section 1.6 of the RCDP), that is, the lowest concentration at or above which an adverse effect resulting in a loss of ecological services may occur. IEc did not derive the criteria mathematically; rather, each criterion reflects the result of one or more studies (Appendix A, "Source" column in Exhibits A-1 through A-3).

Although the commenter did not provide sufficient information regarding the source or derivation of the 2 mg/kg they cite for selenium in sediment, average selenium concentrations in the assessment area range between 0.86 mg/kg and 1.51 mg/kg (Appendix A, Exhibit A-1), all of which are below 2 mg/kg.

DATA ANALYSIS

Comment 13: Why was the geometric mean chosen versus the arithmetic mean? Some concentrations likely did exceed the criteria. Where were these located? How much did they exceed the criteria?

Response 13: In this case, the geometric mean is the most appropriate measure of the midpoint of the distribution of contaminant data. As stated in EPA (2000), "Due to the skewed nature of many exposure distributions, the arithmetic mean may not be a good indicator of the midpoint of a distribution (e.g., the 50th percentile). Under these circumstances, a median value (e.g., the geometric mean) may provide more appropriate information (Habicht 1992)." (p.2-36) This is further supported by other studies (e.g., Leith et al. 2010). In this case, observed contaminant concentrations are not normally distributed. They are right-skewed, that is, many observed values are low, while a smaller number of observed values are in the high end (or right hand tail) of the distribution. These high concentrations introduce bias into the arithmetic mean, such that it overestimates the true mean. Therefore, the Trustees utilize the geometric mean to assess contaminant exposure within each sub-section of the assessment area.

The Trustees evaluate injury based on mean exposure concentrations, rather than for each individual sample. Most organisms are mobile, and are therefore exposed to contaminant concentrations (e.g., in sediment) over some area; they are not exposed solely to one sample location. In addition, the Trustees are evaluating injury and corresponding service losses to the overall biological community, which is appropriately reflected by the average. While it is possible that an individual organism may have a contaminant body burden that exceeds a screening criterion, it is unlikely that injury to one organism would cause a measurable loss in ecological services.

Comment 14: The Trustees used half the detection limit. There are other options to address non-detect results that would be more conservative and more accurately reflect the environmental impact of the Kingston spill.

Response 14: The Trustees agree that other options for addressing non-detects are available (e.g., assume non-detects equal zero or the full detection limit). However, we disagree that an alternative option would more accurately reflect environmental conditions. The fundamental nature of a detection limit implies that the true concentration of a contaminant is unknown, and ranges between zero and the detection limit. Using half the detection limit evenly distributes this uncertainty. Any alternative interpretation would simply shift, not reduce, that uncertainty. As it is the Trustees' goal to develop the most reasonable, technically defensible estimate of damages, rather than the highest (or lowest) value, an even distribution of uncertainty is appropriate.

Comment 15: Commenters have the following contaminant data requests: 1) detection limits for each contaminant and method , and 2) a table of all data points used in the analysis of contaminant-related injury, as well as a calculation of the mean, median, and modified delta-lognormal values for each set of data. Commenters also request that these results be evaluated before making a final determination of the natural resource damage resulting from contaminant-related injury.

Response 15: All of the contaminant concentration data used in the analyses presented in the RCDP can be found in the site-specific documents listed in the Administrative Record. These sources provide a suite of data parameters including, but not limited to, location, date of collection, analytical method, detection limit, contaminant concentration, and qualifiers. Most of these documents are available on-line or are included in the accompanying CD. In addition, TVA maintains a database of all contaminant data collected as part of remedial efforts. This database includes most, if not all, data presented in Administrative Record documents. For assistance with this database, please contact TVA at tvainfo@tva.gov.

Per the Commenter's request, the Trustees re-evaluated contaminant data (concentrations and distribution), treatment of detection limits, and use of the geometric mean (more detail in Responses to Comments 13 and 14). After this review, the Trustees' conclusions regarding injury and service losses to natural resources resulting from contaminants associated with the TVA-KIF ash release are consistent with the draft RCDP.

ECOLOGICAL SERVICE LOSSES

Comment 16: EPA results included much data regarding the benthic community. Were these results considered in the service losses?

Response 16: The commenter does not cite specific data sources, so we are not sure to which data the commenter is referring. However, the Trustees' analysis of benthic community data, outlined in Appendix B of the RCDP, relies on data described in Chapter 3 of Arcadis and TVA's report "Updated Data Analysis and Temporal Trend Evaluations in Biota: 2009-2013" published in October 2014 and available online at http://www.tva.gov/kingston/pdf/Updated%20Biota%20Report%202009-2013.pdf. This study was conducted as part of remedial efforts with EPA oversight.

Comment 17: Several commenters asked how service loss was determined for non-dredged areas outlined in Exhibit B-1 including: Has the service loss been analyzed for non-dredged areas for which ash deposits are known to exist? What is the recovery time for non-dredged areas? How is it assumed that areas where no dredging occurred can result in little to no present value losses? What is the basis for a recovery period of two years to return to baseline conditions?

Response 17: For this NRDA, the Trustees use site-specific benthic community metrics to measure recovery of the aquatic community (Response to Comment 4 explains

rationale for use of benthic community). Data were collected from 2009 through 2013 at multiple locations within the assessment area, as well as reference locations (i.e., upstream of the spill area) on the Emory, Clinch, and Tennessee Rivers. For almost all sections (dredged and non-dredged), benthic community data indicate that recovery was complete in two years (Section 2.3.2 and Appendix B of the RCDP).

HUMAN USE LOSSES

Comment 18: Where is the detail of the site-specific estimates of fishing and boating losses that led to the present value loss of $200,000? What is the source of these site-specific estimates and how were these calculated? The footnote indicates a 1/3 wage rate - is this assumed to be only 1 angler per trip? Often there is more than one person in the boat.

Response 18: Section 2.3.3 of the RCDP discusses recreational losses related to impacted fishing and boating activities. For fishing activities, the Trustees estimated damages using the standard benefit transfer method. Commonly applied in NRDA, benefit transfer applies per trip changes in value from a relevant literature study to the site-specific estimates of affected trips. In this case, data from creel surveys conducted by TVA in the vicinity of the assessment area were used to estimate the number of angling trips affected by the ash release

For boating activities, the Trustees estimated the added cost incurred per trip to the nearest open boat launch to be approximately $8.50. This is based on the additional out-of-pocket cost of operating a vehicle and the per person opportunity cost of having to drive farther (estimated as one-third the wage rate). The number of boats affected by the ash release was estimated using boat registration information from the vicinity of the assessment area. The Trustees agree that insofar as multiple people use a boat, the lost opportunity cost is understated.

Comment 19: What about the loss of water sports, like swimming, paddle boarding, wading. Why are boating trips for anglers only? What about boating trips for skiers, swimmers, wake boarders, canoes, kayaks, etc.?

Response 19: The Trustees agree that other water sports such as swimming, wake boarding, water skiing, canoeing, and kayaking are relevant to the area affected by the spill. In this case, data are insufficient to quantify losses related to these activities, and information on the number of participants and the lost value per trip/participant resulting from closure of a section of the river are lacking. For example, boaters and anglers can be tracked through license and/or permit sales, but that type of registration is not required for other types of water-related recreation. However, because restoration activities within Swan Pond and the Preferred Alternative will benefit recreators directly (e.g., via increased access to the Emory River) and indirectly (e.g., via improved water quality), the Trustees expect that participants in other water sports will be sufficiently compensated.

Comment 20: How was the value of $32.44 per trip value determined? Is there any consideration as to trip lengths (e.g., 2 hours vs. 6 hours)?

Response 20: As stated in Section 2.3.3 of the RCDP, the $32.44 per trip value is derived from the peer-reviewed literature (i.e., Jakus et al. 1997) and data collected from several reservoirs in Middle and East Tennessee. Jakus et al. (1997) employ a random utility model (RUM), which assumes that on any given trip occasion an individual will choose the site that yields that highest level of expected utility. The study estimates values per trip, accounting for a variety of trip lengths.

Comment 21: The residents of Roane County request TVA approve the TWRA request to build a fishing pier at the new Wildlife Management Area on the Tennessee River just a few miles downstream from the coal ash spill.

Response 21: The Trustees appreciate the public's concern in this matter, but it is outside the scope of this NRDA.

REMEDY

Comment 22: Why were private citizen settlement amounts based on being downriver from the I-40 bridge rather than the amount of ash in a given area?

Response 22: As noted in the response to Comment 1, NRDA focuses on damages to natural resources and losses in the services these resources provide to the public. Private claims are outside the scope of the NRDA.

Comment 23: Is there anything in the plans to address the ash between the park and my property (at Clinch River Mile 1.6)?

Response 23: Remedial issues are outside the scope of the NRDA.

RESTORATION

Comment 24: The losses are quantified into "discount service acre years (DSAYs)." There is no calculation shown to indicate how the DSAYs were converted to $750,000. How was the $750,000 value determined? Based on what?

Response 24: The Trustees are confident the $750,000 will fund sufficient projects such that compensation for the remaining 184 DSAYs and additional recreational benefits will be provided to the public. As specific projects are identified, the Trustees will assess the ecological and recreational benefits of each project to ensure that full compensation is achieved. Until specific projects are identified, however, the exact amount of funding that will generate a specific number of DSAYs cannot be determined.

Comment 25: Why are pre-restoration services assumed to be zero percent due to ash smothering and corresponding dredging activities? What were the ecological services prior to the ash spill and what was their value lost?

Response 25: Section 3.1 of the RCDP describes the Trustees' approach to quantifying ecological benefits resulting from Swan Pond restoration. Due to the substantial disturbance to the benthic invertebrate community, the Trustees assume that areas smothered by ash and then subsequently dredged do not provide ecological services until dredging is complete. This assumption is consistent with the injury quantification approach described in Section 2.3.2.

In terms of ecological services provided by Swan Pond prior to the ash spill, we assume:

- Areas that were occupied by yards, homes, or agricultural land were not habitat and did not provide ecological services pre-spill. These areas are the focus of restoration activities for which ecological service gains are estimated.
- Existing wetlands provide ecological services, but preservation of these areas as part of Swan Pond restoration activities did not increase the level of services. That is, services provided prior to the spill and at the conclusion of restoration activities are equal.

Comment 26: The alternatives analysis in the RCDP was constrained by the minimal number of options considered. In essence, the RCDP listed two alternatives: do nothing, or do the selected option. In particular, no alternatives to the Swan Pond restoration were considered. Moreover, the RCDP did not meaningfully assess the no-action alternative, which would have provided a baseline to which multiple action alternatives could have been compared.

Response 26: First, the DOI NRDA regulations state that the Trustees "shall develop a Restoration and Compensation Determination Plan that will list a reasonable number of possible alternatives" (43 C.F.R. § 11.81(a)(1)). The Trustees contend that three alternatives are reasonable. Second, the No Action Alternative in the context of the RCDP is not the same as the No Action Alternative in the remedial process. In the RCDP, the No Action Alternative accounts for completed, on-going, and planned remedial actions consistent with whatever remedial alternative EPA identified as preferred, and evaluates what no further *restoration* action would mean in terms of sufficiently compensating the public for losses of natural resources and resource services. For the TVA-KIF ash spill, a No Action Restoration Alternative would not initiate any restoration action outside of currently funded programs, and therefore the public would be under-compensated for both ecological and recreational losses [this is the "baseline" to which the commenter refers]. Finally, because Swan Pond is a specific component of the proposed settlement for natural resource damages, an alternatives assessment for this project is not appropriate.

Comment 27: The RCDP does not define the selection process or criteria to allocate the cash payment for additional habitat and recreation projects. These omissions make it difficult to comment on the effectiveness of this element of the proposed cash payment for restoration to offset damages to public trust resources.

Response 27: The Trustees agree that a defined, transparent process for selecting projects to fund with the $750,000 cash payment is essential. At this time, the Trustees are working on establishing that process. At a minimum, the process will assess the cost effectiveness of projects to ensure that the funding is used to achieve the greatest possible quantity of relevant natural resource benefits. The Trustees aim to achieve a balance between recreation and habitat restoration projects. Projects that effectively improve recreation opportunities and restore habitat, such as the Swan Pond restoration effort, are a high priority because they accomplish multiple objectives.

RESTORATION MONITORING PLAN

Comment 28: When will the monitoring plan tailored to the specific characteristics of the Swan Pond restoration be available for review? Will there be public participation? Will monitoring reports be available for public review? How will these be made available?

Response 28: The Trustees are in the process of finalizing the monitoring plan; it will be completed after the RCDP is finalized. Swan Pond monitoring reports will be made available by TDEC through the public record

Comment 29: What is the adaptive management strategy? What are its goals and what are the attributes and metrics for determining strategy success? Should this strategy be part of the monitoring plan?

Response 29: The adaptive management strategy allows the Trustees to ensure the success of a restoration project in light of Trustee-approved project goals in the event that circumstances require alternations of one or more project components. The monitoring plan is designed to collect data that will inform whether adaptive management may be needed. If an attribute is not performing as expected, TVA will critically evaluate the issue and if needed will develop an adaptive management plan that will be reviewed and approved by all Trustees prior to implementation. Examples of adaptive management actions may include replanting species, changing plant species or densities, re-grading banks, adjusting hydrological connections, and/or installing irrigation (Section 3.1.3).

Comment 30: There is a 30-year Monitoring Plan in place already via the EPA clean-up and recovery efforts. It appears the one in this RCDP is a different one designed to evaluate the Swan Pond Restoration project. Is this correct? And how does this RCDP Plan consider or link to the EPA plan?

Response 30: The 30 year monitoring plan for Swan Pond is designed specifically to ensure the long-term success of the project in the context of NRDA-related goals (e.g., habitat quality over time). It is not connected to the EPA monitoring plan, which is focused on the success of remedial actions.

GENERAL

Comment 31: In addition to the TVA ash spill, there are many other factors that adversely affect the assessment area, such as fish consumption advisories, a ban on commercial fishing, and bioaccumulation of contaminants in the food web from residual coal ash (e.g., selenium). I trust this will be thoroughly addressed sometime in the foreseeable future.

Response 31: The Trustees acknowledge that there are considerations in the assessment area other than impacts from the TVA-KIF ash spill, but these issues are outside the scope of the NRDA.

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