

# **United States Nuclear Regulatory Commission (NRC) Environmental Assessment and Finding of No Significant Impact Paleoliquefaction Study**

## **Identification of the Proposed Action**

The U.S. Nuclear Regulatory Commission (NRC) proposes to initiate a paleoliquefaction study in portions of Kentucky, Missouri, Tennessee, Arkansas, Mississippi, and Virginia in areas containing significant paleoliquefaction features. Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4332) requires that Federal actions be reviewed for their effect on the quality of the human environment. The U.S. Nuclear Regulatory Commission (NRC) has implemented Section 102(2) of NEPA in 10 CFR Part 51. In accordance with 10 CFR Part 51, this Environmental Assessment (EA) provides the NRC staff's analyses of environmental impacts that could result from this proposed paleoliquefaction study.

## **The Purpose and Need for the Proposed Action**

Probabilistic seismic hazard analyses are used by the NRC to estimate earthquake-induced ground motions at sites of interest (e.g., potential sites for nuclear reactor power plants). Recurrence rates and seismologic source models for large earthquakes influence the results of these probabilistic seismic hazard analyses. The purpose and need of this paleoliquefaction study is to collect paleoliquefaction characterization data to reduce uncertainties in recurrence estimates and source models for large earthquakes in the Central and Eastern U.S. Seismic Zone.

The Central Eastern United States Seismic Source Characterization (CEUS-SSC) database includes readily available paleoliquefaction data collected from a variety of investigators and data from regional paleoliquefaction databases (Tuttle and Hartleb 2012). CEUS-SSC data are used to assess the seismic design basis for existing nuclear facilities.

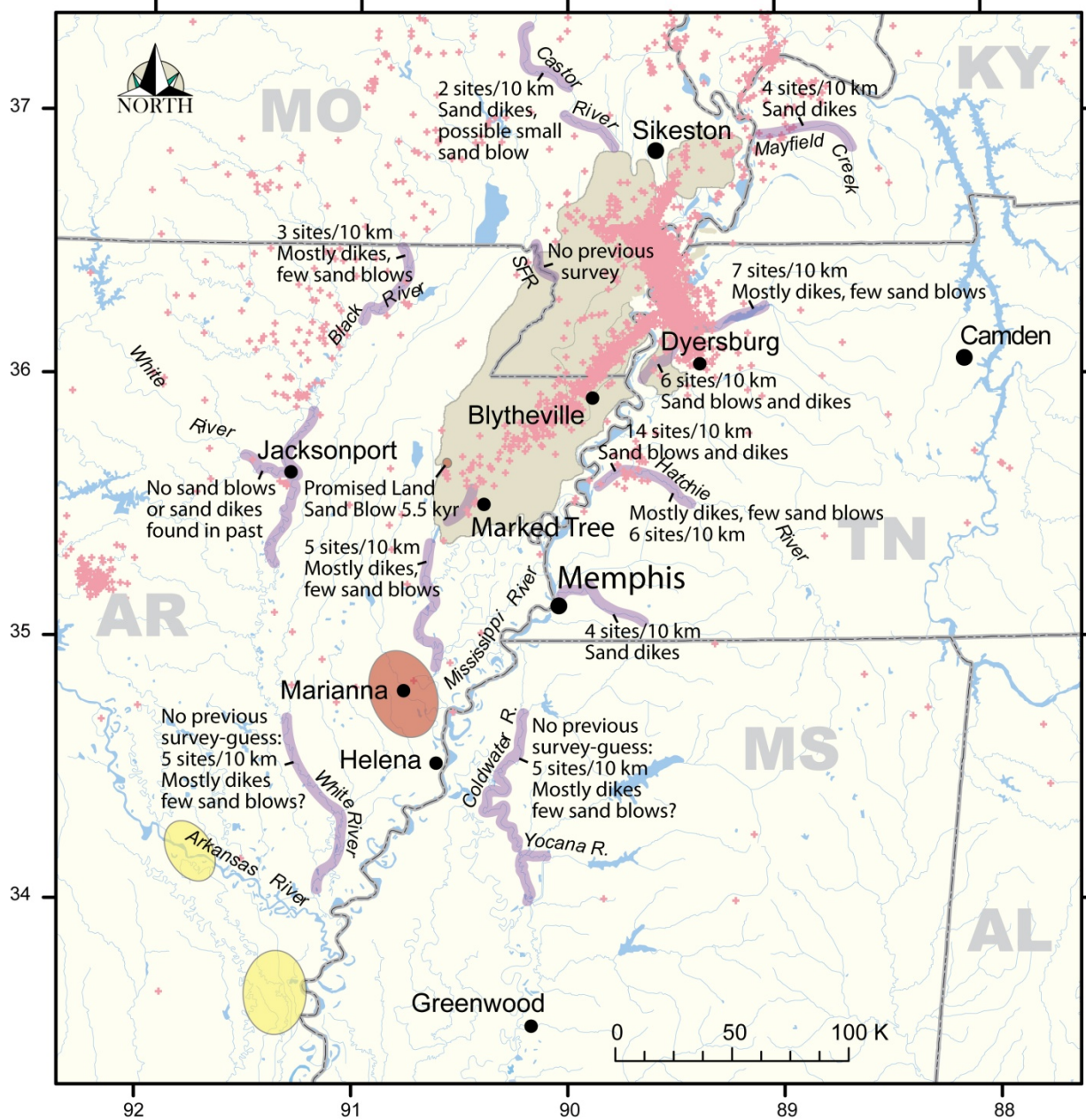
Paleoliquefaction is a term describing specific geologic features attributed to seismic events which occurred before ground motion measurements were taken or before detailed records were kept. Paleoliquefaction studies facilitate preparing and planning for future earthquakes by determining when past earthquakes occurred, along with their frequency and size. Liquefaction is the transformation of saturated granular material from a solid to a liquefied state as a result of increased pore-water pressure; thus, it leaves evidence behind in the geologic record. A paleoliquefaction feature could be a sand dike or a sand blow (USGS 2001).

## **Alternatives to the Proposed Action**

As an alternative to the proposed action, the NRC staff considered a "no-action alternative." Under the no-action alternative, the paleoliquefaction field study would not be conducted and important paleoliquefaction characterization data would not be collected.

## Description of the Proposed Action

The paleoliquefaction study region is shown in Figure 1 and Figure 2 and encompasses portions of Kentucky, Missouri, Tennessee, Arkansas, Mississippi, and Virginia. Highlighted areas in Figure 1 and Figure 2 show sections of rivers that will be searched for paleoliquefaction features. Table 1 provides a list of rivers and creeks included in the paleoliquefaction study.



**Figure 1.** Project Location Map for Paleoliquefaction Research Work in the Central United States

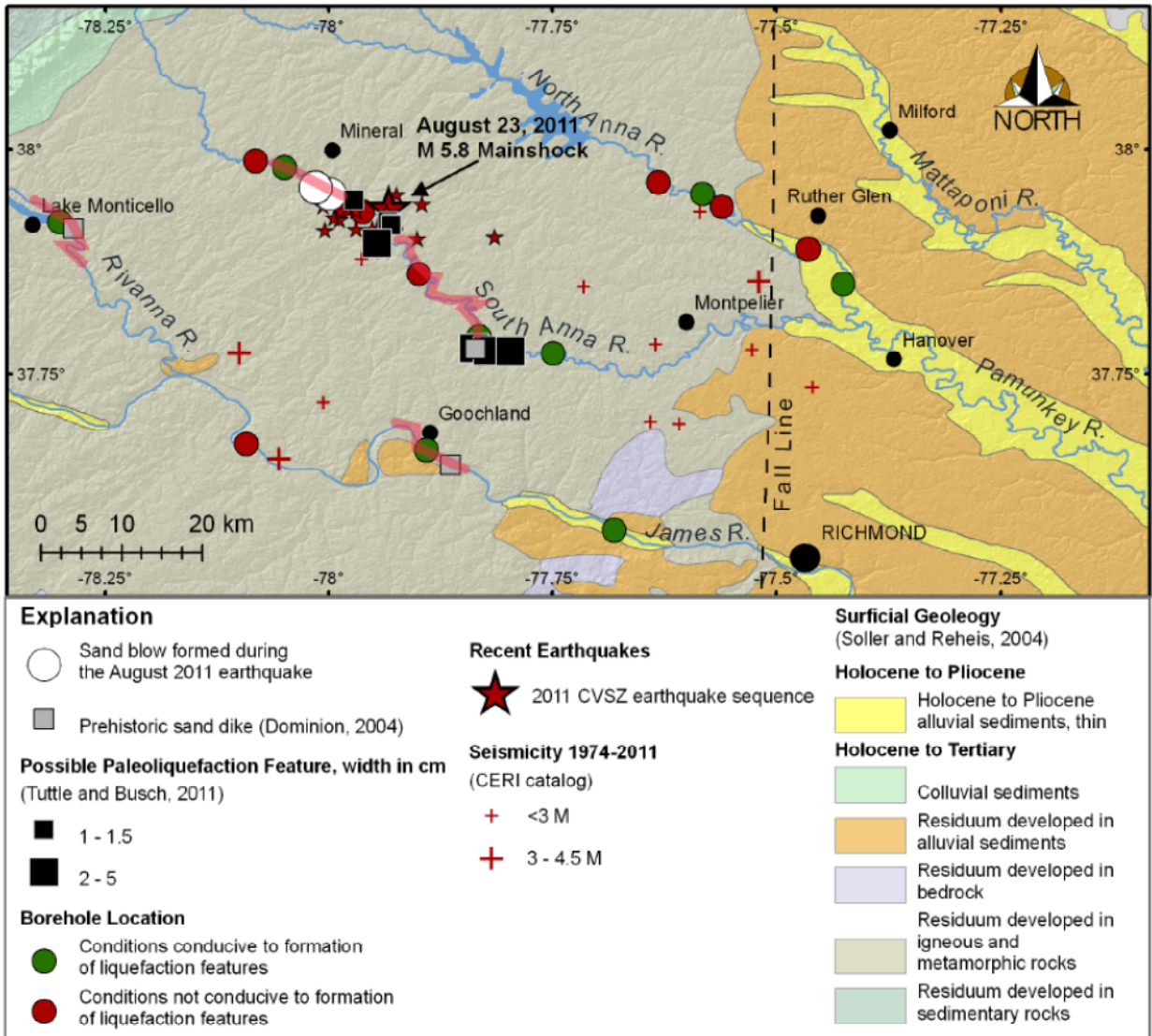


Figure 2. Project Location Map for Paleoliquefaction Research Work in Virginia (Tuttle et al. 2011)

**Table 1.** List of Waterbodies Included in the Paleoliquefaction Study

<b>Location (State)</b>	<b>River Name</b>
Missouri	Castor River <sup>(a)</sup> St. Francis River <sup>(b)</sup>
Kentucky	Clarks River Mayfield Creek Tennessee River
Arkansas	Black River Cache River L'Anguille River St. Francis River <sup>(c)</sup> White River
Tennessee	Hatchie River Obion River Wolf River
Mississippi	Coldwater River Yocona River
Virginia	South Anna River Rivanna River James River

(a) including Castor River Diversion Channel southwest of Whitewater, Missouri

(b) including Wilhelmina Cutoff, and lower portions of Dudley Main Ditch and Mingo Ditch

(c) including Central Ditch, Cross County Ditch, and St. Francis Ditch between Marked Tree and Marianna, Arkansas

This table does not include drainage ditches that the U.S. Army Corps of Engineers might excavate or clean over the next few years, providing opportunity for exposure of paleoliquefaction features.

A professional geologist, assisted by one to two researchers, will conduct the paleoliquefaction study by floating down the rivers and looking for evidence of paleoliquefaction features. A small motorboat will be used when possible; however, a canoe will be used in locations inaccessible to the motorboat. Based on prior experience in the study regions, the NRC estimates between 2 and 14 paleoliquefaction features will be identified for each 10 km of river within the study region.

At locations where liquefaction features are observed, the boat will be anchored and research will be conducted on the shore. While onshore, researchers will characterize the feature dimensions and obtain a small soil sample (~5 cm in diameter by 15 cm in depth) and a leaf or twig for carbon dating. Up to four samples could be collected at each location. The majority of samples will be obtained from scraped areas (17 cm x 17 cm x 2 cm). A few samples will be taken from slightly larger scraped areas (1.3 m x 1.3 m x 5 cm).

### **Impacts to Historical and Cultural Resources**

In accordance with Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), and the implementing regulations of the Advisory Council on Historic Preservation (ACHP) at 36 CFR Part 800, the NRC initiated consultation with the State Historic Preservation

Officers (SHPOs) of Arkansas and Missouri by letters dated August 23, 2012 (NRC 2012a,b) In addition, the NRC initiated Section 106 consultation with the Quapaw Tribe of Oklahoma and the Osage Nation by letters dated August 23, 2012 (NRC 2012c,d).

On September 4, 2012, the Missouri SHPO responded by letter to the NRC and concurred with the staff's determination that "the proposed paleoliquefaction research project will have no adverse effect on any properties listed in or determined eligible for inclusion in the National Register of Historic Places" (Missouri DNR 2012). On September 6, 2012, the Arkansas SHPO responded by letter to the NRC and concurred that this undertaking will have no adverse effect on historic properties (Arkansas SHPO 2012). No responses were received to the August 23, 2012 letters from the NRC to American Indian Tribes. Table 2 provides a listing of consultation correspondence completed to date.

Consultation will be initiated with SHPO's in the states of Kentucky, Mississippi, Tennessee, and Virginia and the Section 106 process will be completed (in accordance with 36 CFR Part 800) prior to commencing any ground disturbing activities in those states.

The NRC has determined that the area of potential effects (APE) for this paleoliquefaction study are the areas where paleoliquefaction features are observed and sampled. These areas may occur at any of the highlighted river sections shown in Figures 1 and 2.

During this study, researchers will be sensitive to cultural resources and minimize disturbance. In the event that cultural materials are encountered during project activities, sampling will stop and the appropriate SHPO will be notified to determine the appropriate course of action.

Due to the limited scope and minimal disturbance caused by the paleoliquefaction study and, based on the correspondence identified in Table 2, the NRC staff finds, in accordance with 36 CFR 800.5(b) and (c)(1) of the ACHP regulations, that this project would have "no adverse effect" on historic properties within the APE.

## **Ecology and Threatened, Endangered, Protected Species & Essential Fish Habitat Impacts**

In accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), the NRC staff had a phone conference on June 28, 2012 with staff from Region 4, Southeast Field Office of the USFWS to discuss the paleoliquefaction study (NRC 2012e). By e-mail dated July 13, 2012, NRC requested informal consultation with the USFWS (PNNL 2012).

Staff from the Region 4 Southeastern Field Office of the USFWS distributed the proposed project description to all USFWS Field Offices with jurisdiction over waterbodies included in the proposed study. On August 13, 2012 USFWS responded, via e-mail, that no concerns were identified for Federally listed species or designated critical habitat (USFWS 2012).

This project is temporary, minimally invasive, and will occur outside the critical nesting times for migratory birds. Further, researchers will avoid mussel beds and active nests, and will minimize disturbance to vegetation.

Due to the limited scope and minor disturbance caused by this survey and based on the discussions and consultation with the USFWS, the NRC staff concludes that under Section 7 of the ESA this project would have “no effect” on Federally threatened or endangered species. On October 10, 2012, NRC prepared a determination letter for the project file (NRC 2012e).

The NRC staff concludes that fish and wildlife species and habitat (i.e., migratory birds, threatened and endangered species, designated critical habitat, and essential fish habitat) will not be impacted by the proposed action.

### **Other Resource Area Impacts Considered**

Due to the nature of the proposed action, no environmental resources associated with the following resource areas will be affected: radiological and human health; land use; surface water, groundwater, and air quality; and socioeconomics and environmental justice.

### **Environmental Impacts of the Alternatives to the Proposed Action**

As an alternative to the proposed action, the NRC staff considered the “no-action” alternative. No environmental impacts are associated with the “no-action” alternative.

### **Finding of No Significant Impact**

The NRC staff prepared this EA in support of its review of the proposed action and to meet NRC’s statutory obligations under NEPA. The scope of the paleoliquefaction study is limited to minor field disturbance and the applicable impacts were determined by this review to be undetectable or so minor that they would neither destabilize nor noticeably alter any important attribute of the relevant resources. The NRC staff concludes that there will be no significant environmental impacts associated with this paleoliquefaction research project.

Therefore, in accordance with 10 CFR 51.32(a)(2), the NRC has determined not to prepare an environmental impact statement for the proposed action. The above environmental assessment is hereby incorporated by reference in this Finding of No Significant Impact (FONSI). This FONSI, the environmental assessment, and the documents identified in the environmental assessment are available electronically, for public inspection, in the NRC’s Agencywide Document Access and Management System (ADAMS) on the internet at the following web address: <http://www.nrc.gov/reading-rm.html>. If persons do not have access to ADAMS or have problems accessing the documents located in ADAMS, contact the NRC Public Document Room Reference staff at 1-800-397-4209, or 301-415-4737, or via e-mail to [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov).

### **Agencies and Persons Consulted**

NRC staff consulted with a number of Federal, State, and Tribal organizations regarding the environmental impacts of this paleoliquefaction research project. In addition to consultation, NRC staff contacted these agencies throughout the planning stages of this project to gather information related to this paleoliquefaction study and no environmental concerns were raised. On September 17, 2012, NRC staff contacted the USACE (NRC 2012f) to inform the USACE of the paleoliquefaction study (specifically the locations and type of work to be performed) and to

address any USACE questions or concerns. The USACE responded on October 3, 2012 (USACE 2012) stating that no permit would be required.

NRC staff have incorporated suggestions from Federal, State, and Tribal organizations into the field study plan to minimize environmental impacts. Table 2 lists consultation correspondence sent and received during the evaluation process of this environmental assessment.

**Table 2.** Key Consultation Correspondence

<b>Source</b>	<b>Recipient</b>	<b>Date of Letter</b>
NRC (Mr. Michael J. Case)	The Department of Arkansas Heritage (Mr. George McCluskey)	August 23, 2012 ML12234A463
The Department of Arkansas Heritage (Mr. George McCluskey)	NRC (Mr. Michael J. Case)	September 6, 2012 ML12277A237 SHPO stamp on NRC Letter
NRC (Mr. Michael J. Case)	Missouri Department of Natural Resources (Ms. Judith Deel)	August 23, 2012 ML12234A511
Missouri Department of Natural Resources (Mr. Mark A. Miles)	NRC (Mr. Michael J. Case)	September 4, 2012 ML12277A236
NRC (Mr. Michael J. Case)	Osage Nation (Dr. Andrea Hunter)	August 23, 2012 ML12234A503
NRC (Mr. Michael J. Case)	Quapaw Tribe of Oklahoma (Ms. Jean Ann Lambert)	August 23, 2012 ML12234A507
Pacific Northwest National Laboratory (Ms. Tara O'Neil)	U.S. Fish & Wildlife Service (USFWS) (Mr. Kenneth Graham)	July 13, 2012 ML12278A341
USFWS (Mr. Kenneth Graham)	NRC (Mr. Thomas Weaver)	August 13, 2012 ML12278A343
NRC (Dr. Thomas J. Weaver)	U.S. Army Corps of Engineers (USACE) (Mr. Gregg Williams)	September 17, 2012 ML12278A340
USACE (Mr. Timothy Davis)	NRC (Mr. Thomas Weaver)	October 3, 2012 ML12278A340

## References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

Arkansas Historic Preservation Office (Arkansas SHPO). 2012. Response from George McCluskey (Arkansas SHPO) to NRC dated September 6, 2012, Stamped Reply “This undertaking will have no adverse effect on historic properties.” Accession No. ML12277A237.

Endangered Species Act of 1973, as amended (ESA). 16 U.S.C. 1531 et seq.

Missouri Department of Natural Resources (Missouri DNR). 2012. Letter from Mark Miles (Missouri SHPO) to Michael Case (NRC) dated September 4, 2012. “Earthquake Reconnaissance Along River Cutbanks (NRC) Missouri.” Accession No. ML12277A236.

National Environmental Policy Act of 1969, as amended (NEPA). 42 U.S.C. 4321 et seq.

National Historic Preservation Act of 1966, as amended (NHPA). 16 U.S.C. 470 et seq.

Pacific Northwest National Laboratory (PNNL). 2012. E-mail from Tara O’Neil (PNNL) to Kenneth Graham (USFWS) dated July 13, 2012, “NRC paleoliquefaction research project – Environmental Assessment”. Accession No. ML12278A341.

Tuttle, M., T. Busch, and K. Tucker. 2011. *Reconnaissance for liquefaction features in the meizoseismal area of the 23 August 2011 M 5.8 Virginia earthquake*, Technical report to the U.S. Nuclear Regulatory Commission, contract NRC-HQ-11-C-04-0041, unpublished.

Tuttle, M.P. and R.D. Hartleb. 2012. “CEUS Paleoliquefaction Database, Uncertainties Associated with Paleoliquefaction Data, and Guidance for Seismic Source Characterization.” *Central and Eastern United States Seismic Source Characterization for Nuclear Facilities, Appendix E*. NUREG-2115, Volume 5: Appendices C to F. U.S. Department of Energy (DOE), U.S. Nuclear Regulatory Commission (NRC), and Electric Power Research Institute (EPRI), Palo Alto, California. Accession No. ML12048A859.

U.S. Army Corps of Engineers (USACE). 2012. E-mail from Timothy Davis (USACE) to Thomas Weaver (NRC) dated October 3, 2012, “NRC Earthquake Reconnaissance Along River Cut Banks”. Accession No. ML12278A340.

U.S. Fish & Wildlife Service (USFWS). 2012. E-mail from Kenneth Graham (FWS) to Thomas Weaver (NRC) dated August 13, 2012, “NRC paleoliquefaction research project – Environmental Assessment”. Accession No. ML12278A343.

U.S. Geological Survey (USGS). 2001. Paleoliquefaction Studies in Continental Settings: Geological and Geotechnical Factors in Interpretations and Back-Analysis. United States Geological Survey Open-File Report 01-029. Accessed September 24, 2012 at <http://pubs.usgs.gov/of/2001/of01-029/of01-029.pdf>

U.S. Nuclear Regulatory Commission (NRC). 2012a. Letter from Michael Case (NRC) to George McCluskey (Arkansas Historic Preservation Program) dated August 23, 2012, “106 Review for NRC Earthquake Reconnaissance Along River Cutbanks”. Accession No. ML12234A463.



U.S. Nuclear Regulatory Commission (NRC). 2012b. Letter from Michael Case (NRC) to Judith Deel (Missouri State Historic Preservation Office) dated August 23, 2012, "106 Review for NRC Earthquake Reconnaissance Along River Cutbanks". Accession No. ML12234A511.

U.S. Nuclear Regulatory Commission (NRC). 2012c. Letter from Michael Case (NRC) to Jean Ann Lambert (Quapaw Tribe of Oklahoma) dated August 23, 2012, "106 Review for NRC Earthquake Reconnaissance Along River Cutbanks". Accession No. ML12234A507.

U.S. Nuclear Regulatory Commission (NRC). 2012d. Letter from Michael Case (NRC) to Dr. Andrea Hunter (Osage Nation) dated August 23, 2012, "106 Review for NRC Earthquake Reconnaissance Along River Cutbanks". Accession No. ML12234A503.

U.S. Nuclear Regulatory Commission (NRC). 2012e. Letter from NRC to project file, Subject: Endangered Species Act Consultation Determination Letter to file on October 10, 2012. Accession No. ML12297A304.

U.S. Nuclear Regulatory Commission (NRC). 2012f. E-mail from Thomas Weaver (NRC) to Gregg Williams (USACE) dated September 17, 2012, "NRC Earthquake Reconnaissance Along River Cut Banks". Accession No. ML12278A340.

## Appendix A

### Contributors to the Environmental Assessment

<b>Name</b>	<b>Affiliation</b>	<b>Function or Expertise</b>
Thomas Weaver	U.S. Nuclear Regulatory Commission Office of Research	Project Manager Engineer
Tara O'Neil	Pacific Northwest National Laboratory	Task Leader Cultural Resources
Amanda Stegen	Pacific Northwest National Laboratory	Ecology
Robert Bryce	Pacific Northwest National Laboratory	Peer Review
Eva Eckert Hickey	Pacific Northwest National Laboratory	Peer Review
Terri Miley	Pacific Northwest National Laboratory	References
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