TENNESSEE DEPARTMENT
OF
ENVIRONMENT AND CONSERVATION

DIVISION OF REMEDIATION
OAK RIDGE OFFICE

ENVIRONMENTAL MONITORING PLAN

July 2018 – June 2019

Tennessee Department of
Environment and Conservation,
Authorization No. 327023
June 29, 2018

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Executive Summary

The Tennessee Department of Environment and Conservation (TDEC), Division of Remediation (DoR), Oak Ridge Office (ORO), submits its FY 2019 Environmental Monitoring Plan (EMP) in accordance with the Environmental Surveillance and Oversight Agreement (ESOA) between the United States Department of Energy (DOE) and the State of Tennessee; and where applicable, the Federal Facilities Agreement (FFA) between the DOE, the Environmental Protection Agency (EPA), and the State of Tennessee.

In accordance with the ESOA Agreement and TDEC's mission, execution of this EMP serves to provide assurance to the citizens of Tennessee that the DOE's activities on and around the Oak Ridge Reservation (ORR), Oak Ridge, Tennessee, are being performed in a manner protective of human health and the environment.

Section 5 of the ESOA, *State Commitments*, charters the State to:

> (1) Oversee the DOE ORR Environmental Surveillance Program
> (2) Publish reports of State oversight activities and the associated results to local governments and to the public.

The State's oversight activities will be conducted in accordance with approved environmental standards, many of which are used by DOE to perform routine environmental surveillance as described by DoE in its Environmental Monitoring Plan for the Oak Ridge Reservation CY 2018 (DOE/ORO-2227).

DOE publishes its Environmental Monitoring and Surveillance Program results to the public via the:

1. Annual Site Environmental Report for the Oak Ridge Reservation, and the
2. ORR Remediation Effectiveness Report.

The ESOA supports the DOE ORR Environmental Surveillance Program's ability to independently oversee, monitor, and evaluate associated activities and results.

The State will fulfill these commitments through a program of independent environmental surveillance, oversight, and monitoring projects as presented in its FY 2019 EMP. This EMP defines 21 independent project charters (scope, goals, schedules, methods, and deliverables) that cover a broad spectrum of environmental media to fulfill its obligation of independent monitoring and oversight of the DOE ORR environmental surveillance program.

The State of Tennessee's DoR-OR projects focus on each of the following:

1. Radiological Monitoring
    a. Environmental Dosimeters
    b. Real Time Measurement of Gamma Radiation
    c. Portal Monitoring
    d. Surplus Sales
    e. Haul Rod Surveys
2. Biological Monitoring
    a. Bat Monitoring
    b. Mercury Uptake in Biota
    c. Radiological Uptake in Vegetation
    d. Benthic Macroinvertebrates
3. Air Monitoring
    a. Fugitive Radiological Air Monitoring
4. Surface Water Monitoring
    a. Ambient Surface Water
    b. Ambient Surface Water Parameters
    c. Rain Event Surface Water
5. Sediment Monitoring
    a. Ambient Sediment
    b. Trapped Sediment
6. Groundwater Monitoring
    a. Downgradient Residential Well Monitoring
    b. Background Residential Well Monitoring
7. CERCLA Landfill (EMWMF)
8. RadNet
    a. RadNet Air Monitoring
    b. RadNet Precipitation Monitoring
    c. RadNet Drinking Water Monitoring

The scope of each project presented in this EMP requires review of the DOE EMP and ASER and/or applicable remedy documents. Data collected during the lifecycle of each project presented in this EMP will be evaluated against various sources of DOE data. Analyzed data include, but are not limited to: data found in the Oak Ridge Environmental Information System (OREIS), data collected by other State regulatory agencies, data obtained through split sampling with the DOE, or data from independent sampling done in accordance with accepted standard procedures (State, EPA, or other standard).

Information analyzed by the TDEC DoR-ORO will be used to make recommendations to existing DOE environmental programs and will be reported in the subsequent FY 2018 Environmental Monitoring Report. All data or information collected by the State of Tennessee will be publicly available through issuance of the Environmental Monitoring Report (EMR) or through public records request.

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AMBIENT SEDIMENT PROJECT CHARTER FY 2019

Project Lead: John (Tab) Peryam

06/30/18

Portions of the Ambient Sediment Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John (Tab) Peryam				Initial Release

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1. BACKGROUND

Contaminated sediments can directly impact benthic life and indirectly pose detrimental effects on other organisms, including humans, through bioaccumulation and subsequent transfer through the food web. Sediment-associated contaminants are accepted as an important ongoing environmental problem that impacts the use of many water bodies. In order to assess the degree of contamination, at the benthic level, attributable to the activities of the DOE, DoR-OR collects sediment samples for chemical analysis from the Clinch River and some of its tributaries. Sediment samples have been and are proposed to to be collected at six locations on ORR exit pathway streams.

Due to the complex nature of the ORR National Priority List (NPL) site, sediment monitoring is necessary for the long term. An ambient sediment project has been implemented by this office each year since 1994. The project began with the monitoring of Clinch River water quality at five locations near the Oak Ridge Reservation (ORR). This project has evolved over the years, resulting in changes in locations and frequency of sampling.

2. PROBLEM STATEMENTS

ORR exit pathway streams are subject to contaminant releases from activities at ETTP, ORNL, and Y-12. These contaminant releases have been detrimental to stream health in the past and present. Identified issues include:

- From 1950 to 1963, Y-12 released approximately 100 metric tons of elemental mercury to East Fork Poplar Creek by spills and leakage from subsurface drains, building foundations, contaminated soil and purposed discharge of wastewater containing mercury. (Turner and Southworth, 1999)
- East Fork Poplar Creek is believed to contribute approximately 0.2 metric tons of mercury to the Clinch River each year. (DOE, 1992)
- Besides mercury, other metals that have been found in ORR exit pathway streams at levels greater than background are cadmium, chromium, lead, nickel, silver and zirconium. (DOE, 1992)
- Water supply facilities, serving an estimated population of 200,000 persons, on the Tennessee River downstream of White Oak Creek, have the potential of being influenced by streams that drain the ORR. (DOE, 1992)
- ORNL has been releasing low-level radioactive liquid wastes to the Clinch River via White Oak Creek since 1943. (Pickering, 1970)
- The Clinch River received approximately 665 curies of cesium-13 (Cs-137) from White Oak Creek from 1954 to 1959. (DOE, 1992)

3. GOALS

- Characterize stream condition through sampling and analysis of sediment.
- Serve as an integral component of watershed monitoring (physical, chemical, and biological condition of the waterbody).
- Assess site remediation efforts through long-term monitoring of sediment.
- Identify trends in data, based on findings, and use those trends to make recommendations to improve sediment quality and the health of affected streams.

4. SCOPE

This program monitors for sediment contaminants in waterways that have been impacted by past and current activities on the ORR. This project is limited to only the tributaries that drain the ORR and the Clinch River from the mouth of White Oak Creek at Clinch River km (CRK) 33.5, downstream to CRK 0.0 where it meets the Tennessee River.

4.1 Assumptions

- Cesium-137 and Sr-90 contamination of White Oak Creek is due to activities at ORNL.
- Mercury contamination of East Fork Poplar Creek is attributable to activities at Y-12.

4.2 Constraints

- This project is contingent on funding, manpower, and access to the ORR.
- White Oak Creek will not be sampled due to significant levels of Sr-90 sediment contamination. Samples taken there typically cannot be removed from ORNL due to radiological contamination.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

Annual sampling is proposed to be conducted at five sampling stations located at points on the major exit pathway streams of the ORR; these are located on Bear Creek, Northwest Tributary 5 of Bear Creek (NT5), East Fork Poplar Creek, Mitchell Branch, and the Clinch River. An additional sixth station is a background location on Mill Branch. Sampling is not conducted at White Oak Creek due to the Sr-90 levels in the sediment. Sampling is conducted in October. Work is conducted according to the Standard Operating Procedure for Sediment Sampling (TDEC 2017).

Sediment samples are collected with stainless steel spoons. The sampling method is accomplished by wading into the surface water body and while facing upstream (into the current), scooping the sample from sediment depositional areas of the stream. This is repeated until enough sediment sample material for the requested analyses has been collected. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampler. The sediment is placed into a stainless steel bowl and stirred until the sample is homogenized. Samples are stored on ice; chemical preservatives are not used for sediment samples. Sediment samples that will be analyzed for metals and/or radiological analyses will be placed in 16 ounce plastic containers with plastic lids. Once these containers are capped, they are then taped with electrical tape to prevent leakage.

Sampling Plan

The proposed annual schedule for sediment sampling at each of six stations will occur in October of 2018. The six stations are listed in the table below and on the figure, Map of Sampling Stations.

Table 2: Proposed Sampling Stations

				Analyses				
Site DWR Name	**DOE-O Site Description**	**DoR-OR Station**	**# samples**	**Gross a/b**	**Gamma**	**Sr-89, 90**	**U Isotopic**	**Metals**
BEAR002.0RO	Bear Creek Mile 2.0	BCK 3.3	1	1	1	1	1	1
BEAR006.5T0.1AN	N. Tributary 5 of Bear Creek	NT5	1	1	1	1	1	1
EFPOP003.9RO	East Fork Poplar Creek Mile 3.9	EFK 6.3	1					1
MITCH000.1RO	Mitchell Branch Mile 0.1	MIK 0.1	1	1	1	1	1	1
CLINC020.3RO	Clinch River Mile 20.3	CRK 32.7	1	1	1	1	1	
FECO67I12	Mill Branch Mile 1.0	MBK 1.6	1	1	1	1	1	1
********.***-FD	Field Duplicate	FD	1	1	1	1	1	1
		Totals:	7	6	6	6	6	6
Metals suite includes: arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, uranium, and zinc.								

Table 3: Sampling Rationale

Monitoring Location	Monitoring Rationale
East Fork Poplar Creek Mile 3.9	Sediment depositional area downstream of Y-12 influence.
Bear Creek Mile 2.0	Sediment depositional area downstream of Y-12 influence.
Mitchell Branch Mile 0.1	Sediment depositional area downstream of some ETTP influences.
North Tributary 5 of Bear Creek	Sediment depositional area downstream of EMWF.
Clinch River Mile 20.3	Sediment depositional area downstream of White Oak Creek.
Mill Branch Mile 1.0	Sediment depositional area in a background stream.

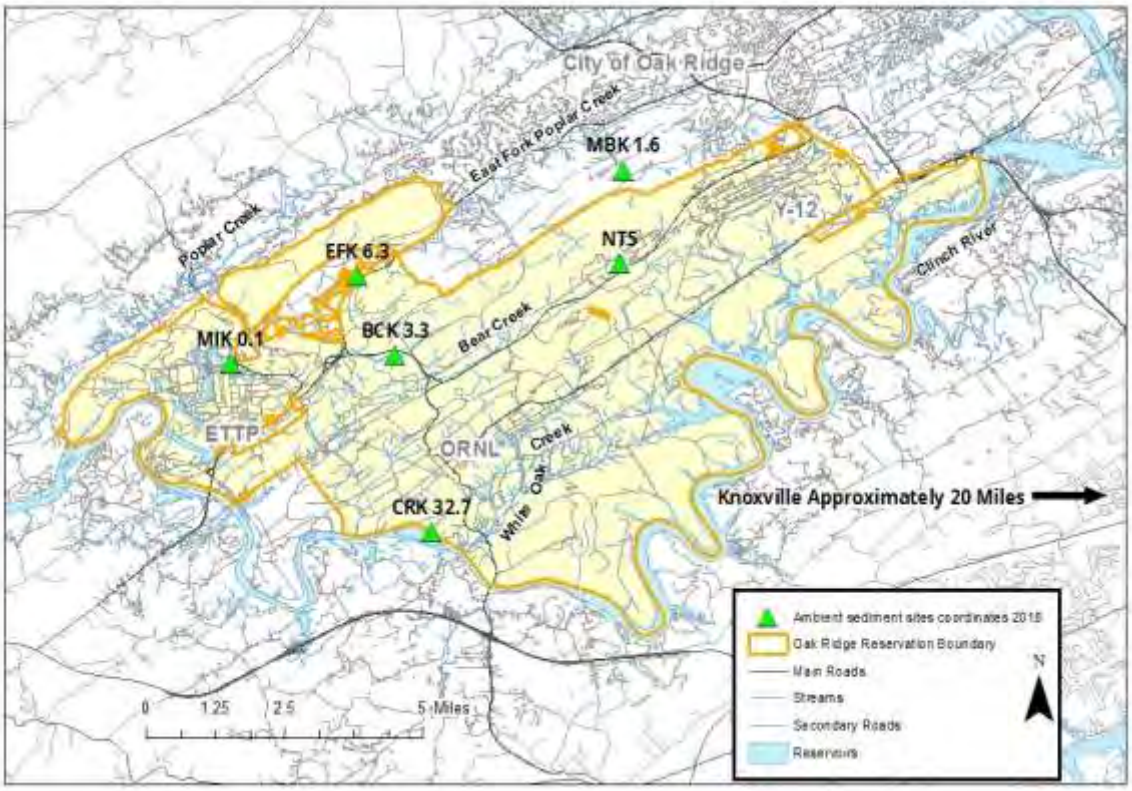

Figure 1: Map of Sampling Stations

6. DELIVERABLES/MILESTONES

Table 4: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Federal Facility Agreement (FFA). (1992) Appendices for the Oak Ridge Reservation. Oak Ridge Site Description – UCOR, Appendix B (2017 revision). DOE/OR-1014. United States Department of Energy. Retrieved from http://www.ucor.com/_docs/ffa/appendices/appendb.pdf

Pickering, R. (1970) Composition of Water in Clinch River, Tennessee River, and Whiteoak Creek as Related to Disposal of Low-Level Radioactive Liquid Wastes. (Geological Survey Professional Paper No. 433–J). Retrieved from https://pubs.usgs.gov/pp/0433j/report.pdf

Quality System Standard Operating Procedure for Sediment Sampling. (2017) Tennessee Department of Environment and Conservation, Division of Remediation Oak Ridge Office, Tennessee.

Turner, R. R., & Southworth, G.R. 1999. Mercury-Contaminated Industrial and Mining Sites in North America: an Overview with Selected Case Studies. *In* R. Ebinhaus, R. R. Turner, L. D. de Lacerda, O. Vasilev, & W. Salomons (Eds.), Environmental Science: Mercury Contaminated Sites. Springer-Verlag.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
ASTM	American Society for Testing and Materials
Benthic Life	Organisms that live on or in the streambed (insects, amphibians, spiders, worms, etc.)
LSC	Liquid Scintillation Counting
MQL	Minimum Quantification Limit
ssMDC	sample specific Minimum Detectable Concentration
Station	A specific location where sampling of sediment takes place.

AMBIENT SURFACE WATER PARAMETERS

PROJECT CHARTER

FY 2019

Project Lead: John (Tab) Peryam

06/30/18

Portions of the Ambient Surface Water Parameters Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John (Tab) Peryam				Initial Release

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1. BACKGROUND

The Oak Ridge Reservation (ORR) is a complex National Priority List (NPL) site. Built in the 1940's, the federally-owned 37,000-acre reservation includes three Department of Energy (DOE) facilities created as integral parts of the Manhattan Project. The three site facilities include the Oak Ridge National Laboratory (ORNL), The Oak Ridge Y-12 Plant (Y-12), and East Tennessee Technology Park (ETTP; former K-25 Plant). Activities at site facilities have resulted in the discharge of hazardous substances (metals, organics, and radioactive materials) leading to the contamination of waterbodies at the site and in the surrounding areas.

Due to the complex nature of the ORR NPL site, monitoring is warranted for many years to come. An ambient surface water parameter project has been implemented each year since 2005. Due to the presence in some areas of anthropogenic point- and non-point source contamination on the ORR, there exists the potential for contamination to impact surface water on the ORR. To assess the degree of surface water impact relative to this potential contamination displacement, stream monitoring data will be collected monthly to establish a database of physical stream parameters (specific conductivity, pH, temperature, and dissolved oxygen).

2. PROBLEM STATEMENTS

ORR exit pathway streams are subject to contaminant releases from activities at ETTP, ORNL, and Y-12; these contaminant releases have been detrimental to stream health in the past and present. Identified issues include:

- From 1950 to 1963, Y-12 released approximately 100 metric tons of elemental mercury to East Fork Poplar Creek by spills and leakage from subsurface drains, building foundations, contaminated soil, and purposed discharge of wastewater containing mercury. (Turner and Southworth,1999)
- East Fork Poplar Creek is believed to contribute approximately 0.2 metric tons of mercury to the Clinch River each year. (DOE, 1992)
- Besides mercury, other metals that have been found in ORR exit pathway streams at levels greater than background are cadmium, chromium, lead, nickel, silver, and zirconium. (DOE, 1992)
- Water supply facilities, serving an estimated population of 200,000 persons, on the Tennessee River downstream of White Oak Creek have the potential of being influenced by streams that drain the ORR. (DOE, 1992)
- ORNL has been releasing low-level radioactive liquid wastes to the Clinch River via White Oak Creek since 1943. (Pickering, 1970)
- The Clinch River received approximately 665 curies of cesium-137 (Cs-137) from White Oak Creek from 1954 to 1959. (DOE, 1992)

3. GOALS

- Create a database/baseline of surface water conditions on and around the ORR.
- Assess site remediation efforts through long-term monitoring of surface water.
- Record ambient conditions that can be used for comparisons in the event of accidents that may have impacted surface water bodies.

4. SCOPE

Due to the presence in some areas of anthropogenic point-and non-point source contamination on the ORR and the potential for contamination to impact surface water parameters, this project is limited to collecting and recording physical stream parameter measurements of ambient surface water of the exit pathway streams that drain the ORR to establish a baseline of conditions on and around the ORR.

4.1 Assumptions

- Ambient physical parameters (specific conductivity, dissolved oxygen, pH, and temperature) measured at the Mill Branch background station are indicative of a normal healthy stream.
- Dissolved oxygen readings, greater than the saturation point for the given water temperature, are indicative of an instrument or calibration error.

4.2 Constraints

- This project is contingent on funding, manpower, and access to controlled areas on the ORR.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Tennessee Wildlife Resources Agency (TWRA)	External
U.S. Fish & Wildlife Service (USFWS)	External

5. METHODS, MATERIALS, METRICS

The surface water physical parameters of temperature, pH, conductivity, and dissolved oxygen will be measured monthly with a YSI Professional Plus multi-parameter water quality instrument. Field monitoring will follow the 2011 Tennessee Department of Environment and Conservation (TDEC), Division of Water Resources (DWR), Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water.

Table 2: Potential Monitoring Locations

Site DWR Name	DOE-O Site Description	DOE-O Site	Site Latitude	Site Longitude
EFPOP014.5AN	East Fork Poplar Creek Mile 14.5	EFK 23.4	35.99596	-84.24004
EFPOP008.6AN	East Fork Poplar Creek Mile 8.6	EFK 13.8	35.99283	-84.31371
BEAR007.6AN	Bear Creek Mile 7.6	BCK 12.3	35.973	-84.27814
BEAR006.0AN	Bear Creek Mile 6.0	BCK 9.6	35.96032	-84.29741
BEAR002.8RO	Bear Creek Mile 2.8	BCK 4.5	35.9375	-84.33938
MITCH000.1RO	Mitchell Branch Mile 0.1	MIK 0.1	35.94146	-84.3922
FECO67I12	Mill Branch Mile 1.0	MBK 1.6	35.98886	-84.28935

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Federal Facility Agreement (FFA). (1992) Appendices for the Oak Ridge Reservation. Oak Ridge Site Description – UCOR, Appendix B (2017 revision). DOE/OR-1014. Retrieved from http://www.ucor.com/_docs/ffa/appendices/appendb.pdf

Pickering, R.J. (1970) Composition of Water in Clinch River, Tennessee River, and Whiteoak Creek as Related to Disposal of Low-Level Radioactive Liquid Wastes. USGS Professional Paper 433-J. Retrieved from https://pubs.usgs.gov/pp/0433j/report.pdf

Tennessee Department of Environment and Conservation. Division of Water Resources. Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water. (2011) Nashville, Tennessee. Retrieved from https://www.tn.gov/content/dam/tn/environment/water/documents/ChemSOP03QUAP.pdf

Turner, R. R. and G. R. Southworth. (1999) Mercury-Contaminated Industrial and Mining Sites in North America: an Overview with Selected Case Studies. Environmental Science: Mercury Contaminated Sites (ed. By R. Ebinghaus et al.) Springer-Verlag.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

AMBIENT SURFACE WATER PROJECT CHARTER FY 2019

Project Lead: John (Tab) Peryam

06/30/18

Portions of this Ambient Surface Water Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John (Tab) Peryam				Initial Release

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1. BACKGROUND

Due to the complex nature of the ORR NPL site, continued monitoring may be necessary. An ambient surface water project has been implemented each year since 1993. The project began with the monitoring of Clinch River water quality at five locations near the ORR. The sampling locations for this project have been modified throughout the years, sometimes adding or discontinuing sampling at particular locations. This project monitors through sampling for contaminants in waterways that have been impacted by past and present activities on the ORR.

2. PROBLEM STATEMENTS

ORR exit pathway streams and the Clinch River are subject to contaminant releases from activities at ETTP, ORNL, and Y-12. These contaminant releases have been detrimental to stream health in the past and present. Identified concerns include but are not limited to the following:

- From 1950 to 1963, Y-12 released approximately 100 metric tons of elemental mercury to East Fork Poplar Creek by spills and leakage from subsurface drains, building foundations, and contaminated soil, as well as purposed discharge of waste water containing mercury. (Turner and Southworth, 1999)
- East Fork Poplar Creek is believed to contribute approximately 0.2 metric tons of mercury to the Clinch River each year. (DOE, 1992)
- Besides mercury, other metals that have been found in ORR exit pathway streams at levels greater than background are cadmium, chromium, lead, nickel, silver and zirconium. (DOE. 1992)
- Water supply facilities, serving an estimated population of 200,000 persons, on the Tennessee River downstream of White Oak Creek have the potential of being influenced by streams that drain the ORR. (DOE, 1992)
- ORNL has been releasing low-level radioactive liquid wastes to the Clinch River via White Oak Creek since 1943. (Pickering, 1970)
- The Clinch River received approximately 665 curies of cesium-137 (Cs-137) from White Oak Creek between 1954 and 1959. (DOE, 1992)

3. GOALS

- Characterize stream conditions through sampling and analysis of surface water.
- Serve as an integral component of watershed monitoring (physical, chemical, and biological conditions of the waterbody).
- Assess site remediation efforts through long-term monitoring of surface water.
- Identify trends in data based on findings, and use those trends to make recommendations in an effort to improve water quality and the health of affected streams.

4. SCOPE

The scope of this project is to characterize stream conditions through sampling and analysis of surface water from the tributaries that drain the ORR and the surface water of the Clinch River spanning from the mouth of White Oak Creek at Clinch River km (CRK) 33.5 downstream to CRK 0.0 where it meets the Tennessee River.

4.1 Assumptions

- Cesium-137 and strontium-90 (Sr-90) contamination of White Oak Creek is due to activities at ORNL.
- Mercury contamination of East Fork Poplar Creek is attributable to activities at Y-12.

4.2 Constraints

- This project is contingent on funding, manpower and access to controlled areas on the Oak Ridge Reservation.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

The Tennessee Department of Environment and Conservation's Division of Water Resources Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water (Nashville, Tennessee. 2011) will be the guide document for this project. This project has two aspects:

- Ambient: Annual sampling is conducted at 13 sampling stations located at points on the major exit pathway streams of the ORR. These are located on Bear Creek, East Fork Poplar Creek, Mitchell Branch, and White Oak Creek. In addition, three ambient background sampling stations are located on Clear Creek, Mill Branch, and Hinds Creek. Sampling is conducted in April. The sampling station at the White Oak Creek headwaters (WCK 6.8) is included in this effort because it is a background location for the benthic macroinvertebrate stream evaluations.
- Sr-90/White Oak Creek: Monthly sampling will be conducted at four sampling stations which were chosen to assess the presence of Sr-90 in the Clinch River in the area near the mouth of White Oak Creek. Three of these stations are located on the Clinch River and one is located at the headwaters of White Oak Creek.

Table 2: Proposed Sampling Plan

					Number of Samples				
DWR Name	Station Description	DoR-OR Name	Latitude	Longitude	Sr-90	Gross a/b	U Isotopic	Nutrients	Metals
CLINC019.9RO	Clinch River Mile 19.7	CRK 32	35.9002	-84.35049	12				
CLINC020.8RO	Clinch River Mile 20.8	CRK 33.5	35.89665	-84.33316	12				
CLINC021.7RO	Clinch River Mile 21.7	CRK 34.9	35.97071	-84.2145	12				
WHITE004.2RO	White Oak Creek Mile 4.2	WCK 6.8	35.94151	-84.30161	12	1	1	1	1
BEAR002.0RO	Bear Creek Mile 2.0	BCK 3.3	35.94354	-84.34911				1	1
BEAR006.0AN	Bear Creek Mile 6.0	BCK 9.6	35.96032	-84.29741				1	1
BEAR007.6AN	Bear Creek Mile 7.6	BCK 12.3	35.973	-84.27814		1	1	1	1
EFPOP015.6AN	East Fork Poplar Creek Mile 15.6	EFK 25.1	35.98456	-84.2551				1	1
EFPOP015.2AN	East Fork Poplar Creek Mile 15.2	EFK 24.4	35.98922	-84.24282				1	1
EFPOP014.5AN	East Fork Poplar Creek Mile 14.5	EFK 23.4	35.99596	-84.24004				1	1
EFPOP008.6AN	East Fork Poplar Creek Mile 8.6	EFK 13.8	35.99283	-84.31371				1	1
EFPOP003.9RO	East Fork Poplar Creek Mile 3.9	EFK 6.3	35.96293	-84.35905				1	1
MITCH000.1RO	Mitchell Branch Mile 0.1	MIK 0.1	35.94146	-84.3922				1	1
WHITE001.4RO	White Oak Creek 1.4	WCK 2.3	35.90834	-84.31856	1	1	1	1	1
WHITE002.1RO	White Oak Creek Mile 2.1	WCK 3.4	35.91778	-84.31612	1	1	1	1	1
WHITE002.4RO	White Oak Creek Mile 2.4	WCK 3.9	35.92435	-84.31579	1	1	1	1	1
ECO67F06	Clear Creek Mile 1.0	CCK 1.6	36.21346	-84.05983				1	1
FECO67I12	Mill Branch Mile 1.0	MBK 1.6	35.98886	-84.28935				1	1
HINDS012.8AN	Hinds Creek Mile 12.8	HCK 20.6	36.15797	-83.99944				1	1
TRIPBLANKDoROR	Trip Blank	TB	36.01752	-84.23844	5	1	1	2	2
FIELDBLANKDoROR	Field Blank	FB	36.01752	-84.23844	5	1	1	2	2
********.***-FD	Field Duplicate	FD	36.01752	-84.23844	5	1	1	2	2
				Totals:	66	8	8	22	22

	Sr-90 White Oak Creek
	Background
	Ambient
	QA/QC

Nutrients suite includes: Ammonia, Nitrate and Nitrite, Total Kjeldahl Nitrogen, Total Phosphorus.
Metals suite includes: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc.

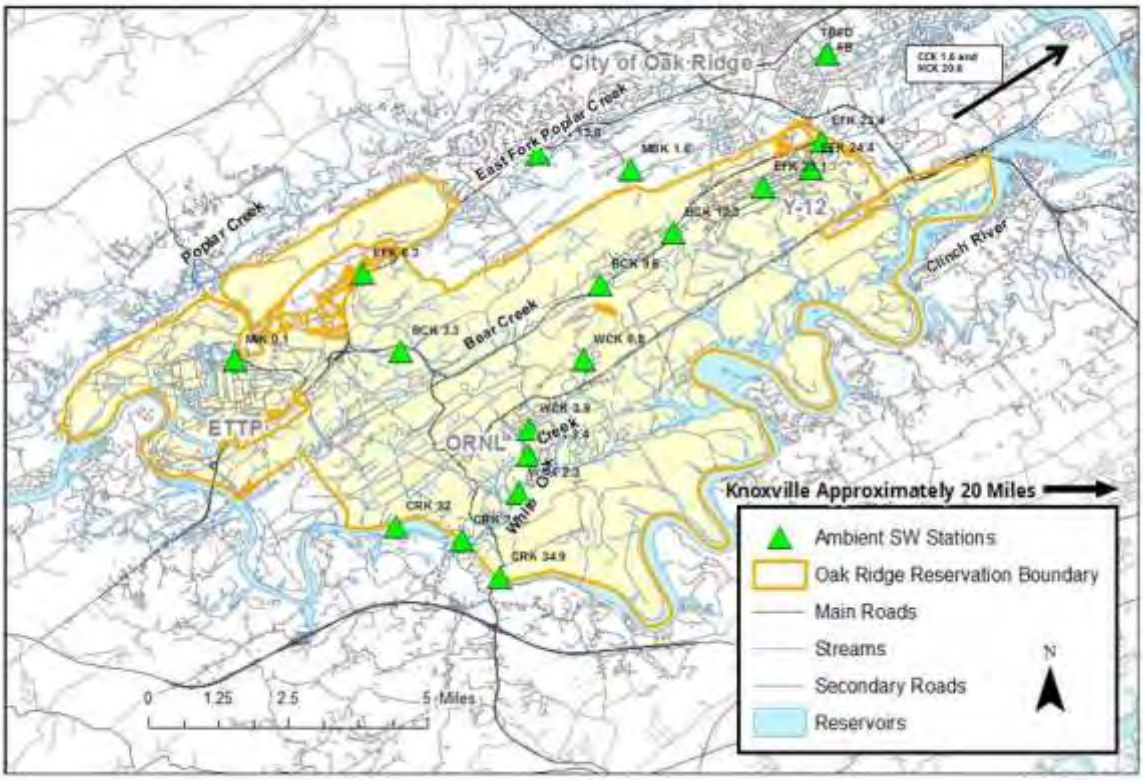

Figure 1: Proposed Sampling Locations

Table 3: Proposed Sampling Rationale

DoR-OR Name	Monitoring Rationale
CRK 32	Surveillance of water quality possibly influenced by radiological contaminants from the Oak Ridge National Laboratory and/or the Melton Valley burial grounds.
CRK 33.5	Surveillance of water quality possibly influenced by radiological contaminants from the Oak Ridge National Laboratory and/or the Melton Valley burial grounds.
CRK 34.9	Surveillance of water quality possibly influenced by radiological contaminants from the Oak Ridge National Laboratory and/or the Melton Valley burial grounds.
WCK 6.8	Background sampling station
EFK 25.1	Surveillance of water quality at East Fork Poplar Creek (EFPC) headwaters.
EFK 24,4	Surveillance of water quality at EFPC intermediate to EFK 25.1 and EFK 23.4.
EFK 23.4	Surveillance of water quality at point where EFPC leaves leaves DOE property and enters Oak Ridge.
EFK 13.8	Surveillance of EFPC water quality just upstream of Oak Ridge sewage treatment outfall.
EFK 6.3	Surveillance of EFPC water quality downstream of Oak Ridge.
BCK 12.3	Surveillance of Bear Creek water quality near headwaters.
BCK 9.6	Surveillance of Bear Creek water quality downstream of Environmental Management Waste Management Facility (EMWMF).
BCK 3.3	Surveillance of Bear Creek water quality downstream of Y-12.
MIK 0.1	Surveillance of Mitchell Branch (MIK) water quality downstream of ETTP.
WCK 3.9	Surveillance of White Oak Creek (WCK) at a point influenced by ORNL.
WCK 3.4	Surveillance of White Oak Creek (WCK) at a point downstream of ORNL.
WCK 2.3	Surveillance of White Oak Creek (WCK) at a point downstream of Melton Valley Burial Grounds.
CCK 1.6	Reference site upstream of DOE facilities.
HCK 20.6	Reference site north of Oak Ridge.
MBK 1.6	Reference site in Oak Ridge.

6. DELIVERABLES/MILESTONES

Table 4: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
APHA	American Public Health Association
Benthic Life	Organisms that live on or in the streambed (insects, amphibians, spiders, worms, etc.)
ref std (reference standard)	A universal reference material that performs equally and consistently between platforms, laboratories, operators and assays.
Station	A specific location where sampling of surface water takes place.
USEPA	United States Environmental Protection Agency

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BACKGROUND RESIDENTIAL WELL STUDY
PROJECT CHARTER
FY 2019

Project Lead: Hannah Klein

06/30/18

Portions of Background Residential Well Study Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Hannah Klein				Initial Release

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1. BACKGROUND

There are portions of the Oak Ridge Reservation (ORR) that have been used for decades as a regional burial ground for hazardous and radioactive wastes, mostly from Department of Energy (DOE). The disposed waste was contaminated with inorganic and organic chemicals including volatile and semi-volatile organic compounds, beryllium, mercury and other heavy metals, polychlorinated biphenyls (PCBs), laboratory and cleaning chemicals, biological waste, and inorganic salts. In many cases, the chemical waste had significant associated radioactivity. Transuranic (TRU) wastes were a part of this disposal. This waste is typically alkaline and nitrate-rich. DOE radioactive waste was disposed of in landfills, shallow burial sites, unlined trenches, waste pits, auger holes, and in the deep wells located at the ORR hydrofracture facilities. Each of these waste disposal sites and methods pose a potential environmental concern (DOE, 1999).

The Valley and Ridge province of eastern Tennessee is composed of bedded carbonates and silicate rocks, generally with carbonates in the valleys and silicates on the ridges, but with the exception of the Knox Group dolomite on the ridges *(Hatcher, et al., 1992)*. These rock formations extend long distances across the eastern United States. The regional groundwater flow is parallel to geologic strike—generally moving from the northeast to the southwest—and has been documented as flowing along long distances *(Davies, Worthington, & Sebastian, 2012)*. For this reason, the fundamental chemical characteristics of groundwater in these similar lithologies, and within similar rock formations, should have comparable chemical compositions across the region.

2. PROBLEM STATEMENTS

Background groundwater studies are focused on individual remedial action sites and not on the ORR as a whole. The sites located on the ORR are often not regionally upgradient and therefore, not true background locations.

National studies of groundwater chemistry in similar rock types to those on and downgradient of the ORR are useful for comparing to the Tennessee Department of Environment and Conservation's (TDEC's) groundwater chemistry results *(DeSimone, 2009)*. However, the national studies are not specific to Oak Ridge, nor do they include all the necessary contaminants of concern. The background samples collected because of this project will help support a specific understanding of the upper and lower ranges of concentrations of chemicals in the regional groundwater.

3. GOALS

The goal of this study is to sample and analyze the chemical composition of the regionally upgradient background groundwater northeast of the ORR which is assumed to be comparable to the chemical composition of the downgradient groundwater and unaffected by DOE ORR operations.

The data collected as a result of this project will be included in the background dataset collected since 2016 strengthening TDEC's interpretation of the impact of DOE's operations on the ORR. This data will also be compared to the data obtained from the offsite residential well study.

4. SCOPE

The scope of this project is to collect groundwater chemical data to establish both the median and the range of chemical concentrations in upgradient regional groundwater flow. Wells sampled since 2016, which are in the same lithologies and upgradient of the ORR, will be resampled for the same analytes as those selected in the offsite residential well study (See Table 1.). The study area is shown as follows in Figure 1. The resulting data from the background groundwater study will be statistically compared to groundwater data collected from and downgradient of the ORR.

Water samples will be collected between July 2018 and April 2019 to allow for the sampling of wet and dry seasons and to review the results for their inclusion in the FY19 Environmental Monitoring Report.

TABLE 1: Groundwater will be sampled for these analytes to establish their range of concentrations in the regional flow system.

VOLATILE ORGANIC COMPOUNDS (VOCs)		
EPA 8260 B list for low level detection		
METALS		
aluminum	copper	potassium
antimony	total hardness, as calcium carbonate	selenium
arsenic	iron	silver
barium	lithium	sodium
beryllium	lead	strontium
boron	magnesium	thallium
cadmium	manganese	vanadium
calcium	mercury	zinc
chromium	nickel	uranium
INORGANICS		
alkalinity as calcium carbonate	sulfate	oxygen-18 (in nitrate)
chloride	nitrate and nitrite	deuterium (in water)
fluoride	ammonia	oxygen-18 (in water)
total dissolved solids	nitrogen-15 (in nitrate)	
RADIONUCLIDES		
gross alpha	tritium	radium-228
gross beta	gamma radionuclides	isotopic uranium
strontium-89	technetium-99	transuranic radionuclides
strontium-90	radium-226	

EPA-8260 B- volatile organic compound analyte list

https://www.epa.gov/sites/production/files/2015-12/documents/8260b.pdf

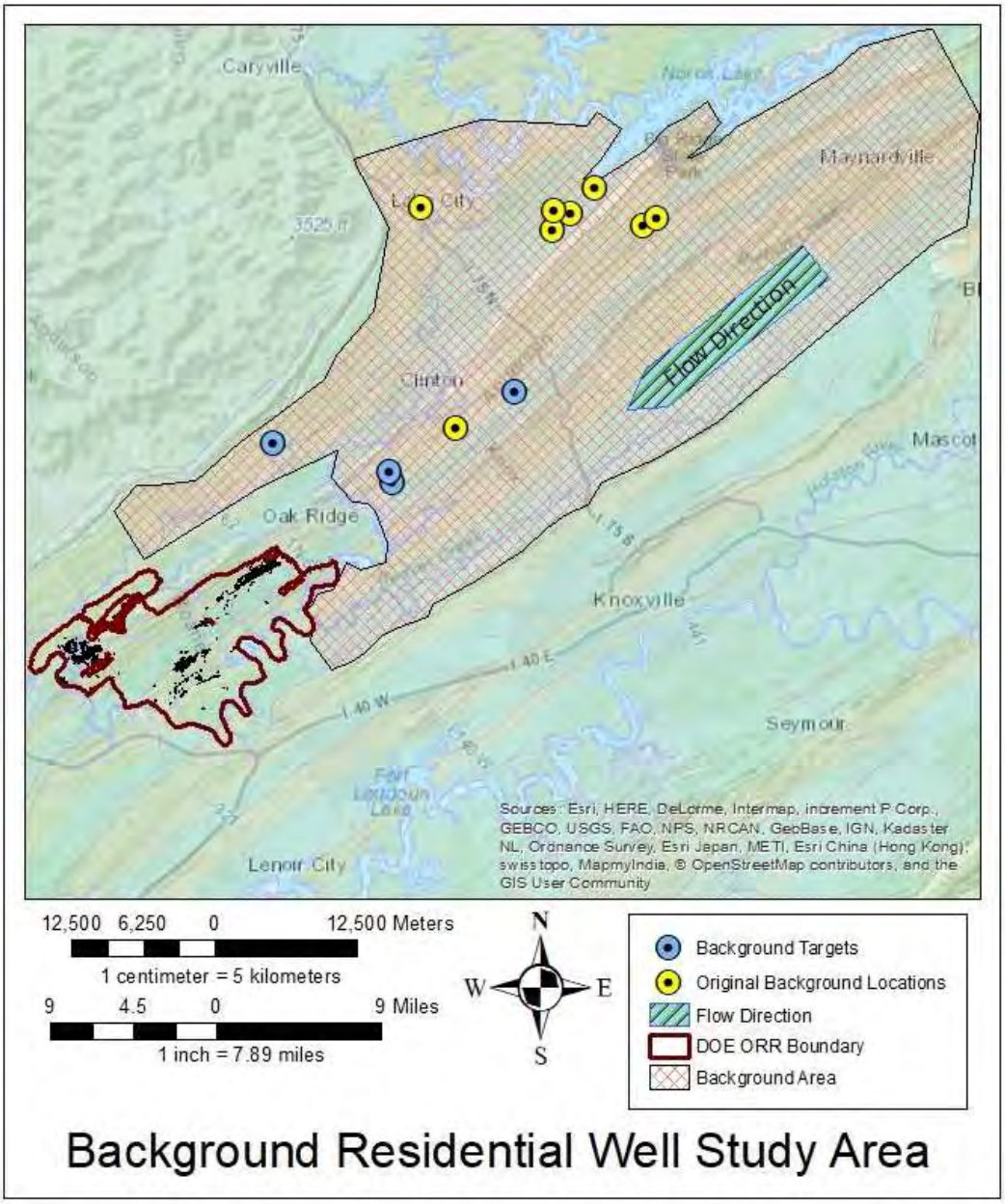

FIGURE 1: FY 2019 Proposed Study Area

4.1 Assumptions

Basic assumptions:

- The background area has been unaffected by DOE operations on the ORR.
- Well-owners will be willing to have their well re-sampled.
- The well depth provided by the well owner is correct.

4.2 Constraints

- The budget and laboratory costs may change during the fiscal year.
- Residents interviewed may not want to participate in the groundwater well study.
- There may not be enough time for all of the sampling and analysis before the 2019 FY EMR is submitted in October.

4.3 Stakeholders

Table 2: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Environmental Protection Agency	External
Tennessee Department of Health	Internal

5. METHODS, MATERIALS, METRICS

Approximately ten (10) samples are proposed to be collected; one will be a quality assurance/quality control (QA/QC) sample which includes both a duplicate sample and field blank. This equates to eight locations, one field blank, and one duplicate, for a total of ten samples. The field parameters that will be collected with the YSI Professional Plus Multiparameter Instrument (or equivalent) are: temperature (°C), electrical conductivity (µS/cm), pH (SU), oxidation reduction potential (mV), dissolved oxygen (mg/L), and turbidity (NTU). These parameters and locations will be recorded in a field book and reported in a trip report. DOE contractors will be given the opportunity to co-sample with TDEC.

The samples will be sent to the Tennessee Department of Health (TDH) central laboratory for volatile organic compounds, metals, inorganics, and radiochemical analysis. The samples requiring preservation are collected in pre-preserved bottles. The analyses and preservative types of these samples are: volatiles in hydrochloric acid (HCl), inorganics/metals in nitric acid (HNO_3), and inorganics/nutrients in sulfuric acid (H_2SO_4), respectively. A mix of historical and samples collected during the current fiscal year will be sent to the University of Arkansas, Department of Geosciences Stable Isotope Laboratory for: 1) stable nitrogen and oxygen analysis in nitrate and 2) stable isotope analysis of deuterium and oxygen in water *(The University of Arkansas)*.

Sampling results from TDH will be compared to EPA National Primary Drinking Water Regulations (NPDWR) and National Secondary Drinking Water Regulations (NSDWR) *(United States Environmental Protection Agency, 2009)*. When neither of these are available, the data will be compared to other EPA standards including: Regional Screening Levels (RSLs) *(United States Environmental Protection Agency, 2017)*, Lifetime Health Advisory Values (LHAV) *(United States Environmental Protection Agency, 2012)*, or Superfund CERCLA Preliminary Remediation Goals (PRGs) *(United States Environmental Protection Agency)*. A summary package of these results will be prepared and provided to the well owners to help inform the sampling results. For health consultation, well owners will be referred to the Tennessee Department of Health. Results will also be reported in the FY 2019 TDEC EMR.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
°C	degrees Celsius
µS/cm	micro Siemens per centimeter
SU	standard units
mV	millivolts
mg/L	milligrams per liter
NTU	nephelometric turbidity units
TDH	Tennessee Department of Health
HCl	hydrochloric acid
HNO_3	nitric acid
H_2SO_4	sulfuric acid
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
RSLs	regional screening levels
LHAV	lifetime health advisory values
PRGs	preliminary remediation goals

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BAT MONITORING ON THE OAK RIDGE RESERVATION

PROJECT CHARTER

FY2019

Project Lead: Gerry Middleton

06/30/18

Portions of this Bat Monitoring on the Oak Ridge Reservation Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Gerry Middleton				Initial Release

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1. BACKGROUND

On the U.S. Department of Energy's Oak Ridge Reservation (DOE, ORR), East Fork Poplar Creek (EFPC) and Bear Creek (BCK) floodplains have been impacted by large historical releases of mercury (Hg) and by past waste management practices associated with the nuclear weapons program at the Y-12 National Security Complex (Y-12 NSC; Brooks et al., 2017). Mercury, released from industry, often finds its way into aquatic systems where it has long residence times and can bioaccumulate in aquatic food webs (Evers et al., 2005). Stream floodplains and wetlands are prime locations for Hg methylation by microorganisms, generating toxic bioavailable methylmercury (MeHg; Wiener, Krabbenhoft, Heinz, & Scheuhammer, 2003). Methylmercury biomagnifies as it moves up aquatic food chains from lower trophic level prey to higher level predators such as bats that use their nocturnal hunting skills to locate insects (Bell & Scudder, 2007).

Bats are frequently subjected to multiple anthropogenic stressors (i.e., heavy metals, organic chemicals) while foraging in stream riparian zones and floodplain wetlands, causing a number of species to become endangered or threatened with extinction (Mickleburgh, Hutson, & Racey, 2002). North American bats are also experiencing rapid population loss due to a disease known as white nose syndrome (WNS; Bernard & McCracken 2017). Tennessee's sixteen known bat species are long-lived nocturnal insectivores (life expectancy range 5 to >20 years), but the seven cave species are under intense survival pressure due to WNS disease (>50 Tennessee counties have confirmed cases of WNS-infected bats; TBWG, 2018).

The incorporation of MeHg from the leaf litter by detritivores and by predaceous invertebrate species (i.e., centipedes and spiders) that feed on detritivores is a direct pathway to elevated Hg exposure for the next highest trophic level, insectivores (i.e., birds and bats; Osborne et al., 2011). Insectivorous (female bats especially) consume a large volume of food every night (i.e., 75-100% of body weight). This is needed to sustain metabolic requirements of flight, for birthing and nursing their pups, and to build up fat reserves for hibernation (O'Shea, Everette, & Ellison, 2001, Nam et al., 2012). The little brown bat (cave bat) forages on a broad prey base including beetles, wasps, cicadas, leaf-hoppers, moths, flies, and caddisflies (Whitaker & Hamilton, 1998). Little brown bats weigh about 7-9 grams and feed for approximately 200 nights per year, thus a single little brown bat consumes 3-4 pounds of insects, annually. Bats feeding at these volumes in higher terrestrial trophic levels in the food web, especially consumption of flying insects with benthic larval stages, are at risk of exposure (i.e., sublethal effects) and bioaccumulation of MeHg in their bodies (Osborne et al., 2011). A laboratory study using small mammals found that individuals with fur-Hg levels of 7.8-10.8 ppm (parts per million) showed decreases in motor skills (Burton et al., 1977).

A study conducted at the Hg-impacted South River (Virginia) revealed that the mean value of Hg in bat fur exceeded 28.0 ppm which was eight times greater than bat fur collected at non-impacted reference sites (Yates et al., 2014). Fur–Hg concentrations in wildlife indicate body burden Hg at the time of fur growth when the Hg is remobilized by muscle and organs and sequestered in growing fur (Evers et al., 2005; Yates et al., 2005). Mercury concentrations >10 ppm in bat fur may be associated with adverse effects such as neurobehavioral disorders (Wobeser, Nielsen, & Schiefer, 1976, Burton et al. 1977; S. Alexander, personal communication, February 8, 2018). Mercury levels exceeding 10 ppm in guano samples could also be associated with adverse effects in bats.

Exposure of bats to persistent food-chain contaminants can be estimated by sampling guano from cave roosts (Clark, LaVal, & Tuttle, 1982; Clark, Moreno-Valdez, & Mora, 1995). O'Shea, Everette, and Ellison (2001) reported that bat guano collected from big brown bat roosts at a contaminated Colorado superfund site had significantly higher concentrations of insecticides, arsenic and Hg, than bat guano collected from a non-impacted reference site. Patterns of contamination in guano and stomach contents of big brown bats at the Colorado superfund site were also seen in bat carcasses and brains (O'Shea, Everette, and Ellison, 2001). However, little is known about Hg concentrations in guano samples as an indicator of internal tissue Hg concentrations. Bat fecal analysis may provide a valuable source of information for feeding habits and metals bioaccumulation in bats without sacrificing or stressing the bats (Belwood & Fenton, 1976).

During 2019, it is proposed that bat guano samples will be collected from fourteen bat houses (if occupied) for Hg and MeHg analysis plus taxonomic evaluation of masticated insect parts in the sample. In the event that guano samples are not available, then, insect prey will be collected as a proxy for bat guano for Hg and MeHg sample analysis.

The presence of bat species will be determined with acoustic surveys with a special emphasis on threatened and endangered (T&E) species. In particular, the acoustics surveys will focus on bat habitats including caves and trees.

2. PROBLEM STATEMENTS

- Bats may be exposed to levels of Hg high enough to cause sublethal effects through the consumption of large quantities of insects that spend their larval stages in Hg-contaminated stream sediments (Hickey, Fenton, MacDonald, and Soulliere, 2001).
- Because there is little or no information regarding Hg concentrations on bat guano in the published literature, the challenge is to understand potentially harmful body burdens of Hg in bat tissue by using guano as a surrogate.
- Bat acoustic surveys can be disturbing to bats but appropriate measures are taken for the protection of T&E species.

3. GOALS

- Determine Hg and MeHg concentrations in ORR bats using the analytical results of bat guano samples as a possible surrogate for internal tissue body burdens.
- Provide and analyze bat acoustic surveys for protection of T&E bat species.

4. SCOPE

During 2019, bat guano samples will be collected from approximately fourteen bat houses for Hg and MeHg analysis plus taxonomic evaluation of masticated insect parts in the sample. Analysis of insect prey items, to be collected during a parallel study, will provide Hg and MeHg analytical support data for this project. In-Scope Tasks and Out-of-Scope Tasks are depicted in the following tables (tables 1 and 2).

Table 1: Boundaries - In-Scope Tasks

In Scope
After occupancy is confirmed, guano samples will be collected from pre-installed ORR bat houses at approximately 14 locations to determine Hg and MeHg concentrations in guano.
Bat acoustic surveys will be used to identify T&E species.
Collect bat prey samples to determine Hg and MeHg content.
Half of each collected guano sample will be used to identify masticated prey (insect exoskeleton parts) and the other half to analyze for Hg and MeHg.
Offsite guano samples will be collected as reference material (Norris Dam State Park resident bat colony).

Table 2: Boundaries - Out-of-Scope Tasks

Out-of-Scope
Mist net captures or handling of bats is not permitted and will not be done.
Bat blood or other tissue samples will not be collected.
Soil, water, or sediment samples will not be collected.
Acoustic monitoring does not involve entering caves; bat detectors are set up outside near the entrance (ORR caves will not be entered).

4.1 Constraints

Table 3: Constraints

Category	Possible Impacts to the Project
Funding	Budget may change and constrain project activities and laboratory analyses.
Bat houses	Success of the project is dependent upon the bats occupying one or more of the pre-installed bat houses.
Samples	Inadequate biomass of bat guano sample material.
Staff	Inadequate resources to conduct field duties.

4.2 Assumptions

Table 4: Assumptions

Assumptions
Adequate funding exists for project activities and the analyses of guano and prey samples for Hg and MeHg analyses.
Bats will occupy the installed bat houses.
Adequate biomass of guano samples (≥5 grams) can be collected.
Adequate staff will be available to assist with field duties.
Acoustic surveys can be conducted at bat habitats such as trees and caves.

4.3 Stakeholders

Table 5: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Tennessee Wildlife Resources Agency (TWRA)	External
U.S. Fish & Wildlife Service (USFWS)	External

5. METHODS, MATERIALS, METRICS

North American bats (Order Chiroptera) use ultrasonic echolocation (i.e., biosonar) as a navigation tool in obstacle avoidance and location of prey (Simmons & Conway, 2003). These ultrasonic echolocation signals can be recorded with acoustic bat detectors which collect data over multiple nights. The recorded data is downloaded and then analyzed with software programs that compare unidentified species' calls with known species' calls to identify bat species present at a study site (McCracken, Giffen, Haines, Guge, & Evans, 2015).

The 2019 ORR bat project has two components: (1) bat guano sampling and analysis, and (2) acoustic bat surveys and analysis. All field and laboratory work will follow the safety guidelines per the TDEC Division of Remediation, Oak Ridge Office, 2017 Health and Safety Plan (TDEC, 2017). Through the detection, recording, and analysis of bat vocalizations, researchers can learn much about bat ecology and behavior (Parsons & Szewczak, 2009), and they can quickly and efficiently characterize and inventory bat communities in multiple areas (O'Farrell & Gannon, 1999).

I. Bat guano sampling

- During the FY 2019, guano samples will be collected at 14 pre-installed bat houses on the ORR (10 in EFPC, 4 in BCK) and at an offsite bat colony at the Norris Dam State Park (Maps 1-2, Table 1).
- Anabat bat detectors will be deployed at each bat house to screen for bat species that may be present.
- Occupied bat houses will be inspected weekly and any guano deposited within the sample buckets will be collected. Once the required biomass of material (5 grams) is collected from each bat house, sampling is completed.
- Collections of reference site guano (Norris Dam State Park bat colony) will involve leaving five 1-gallon buckets below their entry point (building near the swimming pool) to collect bat droppings for 1-2 nights.
- Latex gloves will be worn to collect and prepare each guano sample. Each sample will be mixed thoroughly with a clean spatula. Two samples (5 grams each) will be taken from the mixed material and sealed in labeled bags; samples will be placed into an ice cooler for transport to the DoR-OR (Division of Remediation, Oak Ridge) laboratory to prepare the samples for shipment to the Nashville Environmental Laboratory.

- All guano samples will be stored in the DoR-OR laboratory refrigerator at 4°C (centigrade) until further processing (within 12 hours).
- Guano sampling standard operating procedures will follow the methods of O'Shea, Everette, and Ellison, (2001) and Ellison, Valdez, Cryan, O'Shea, and Bogan, (2013).

Sample handling at the DoR-OR laboratory (bat guano samples)

- In the TDEC DoR-ORO laboratory, guano samples will be weighed to the nearest 0.01 gram and recorded on the laboratory sample log.
- The two representative guano samples, collected from each occupied bat house (or reference bat colony), will be handled as follows:
    1. A taxonomic sample of approximately 5 grams will be used to identify masticated insect parts in the guano to at least Order (or Family).
    2. Approximately 5 grams of guano biomass will be utilized for Hg (low level) and MeHg analyses.
- Biota samples for Hg assays will be placed into special 2-oz QEC (Quality Environmental Containers, Beaver, WI) Level 2 pre-cleaned glass jars (with labels and plastic screw-top lids). These sample jars will be stored at -18ºC in the TDEC DoR-ORO laboratory freezer until shipment to PACE Analytical Services, LLC for analysis.

Analytical laboratory methods

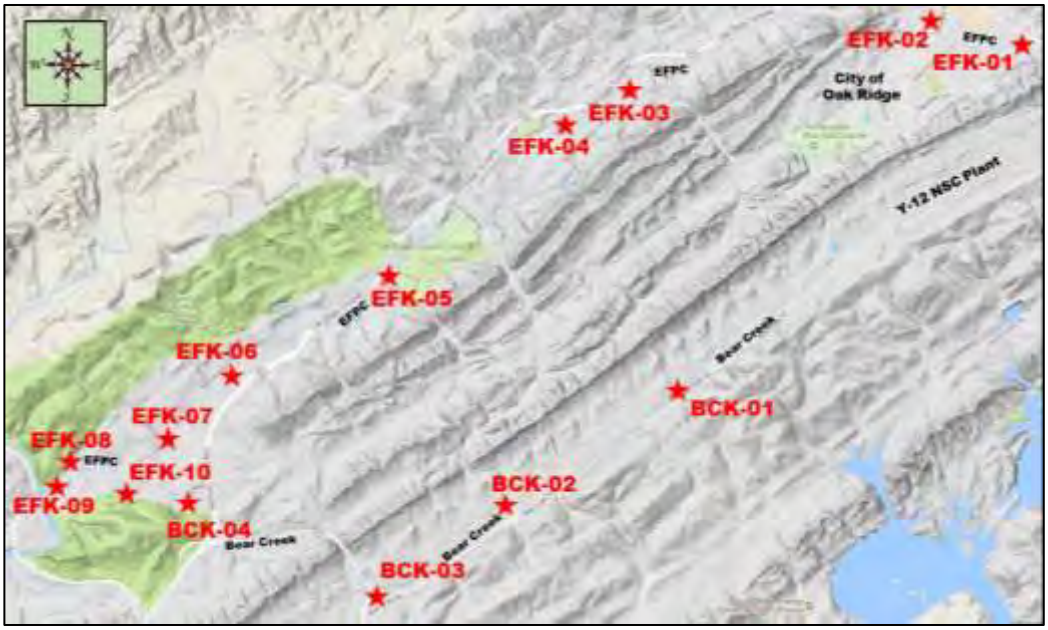
- Guano samples will be shipped to Tennessee Department of Health Nashville Environmental Laboratory (TDH-NEL). For the Hg (low level) and MeHg analyses, TDH-NEL forwards these samples to PACE Analytical Services, LLC (Green Bay, WI) for analysis.
- Mercury (low level) assays will follow EPA method 1631E and MeHg (in tissue) analyses will follow EPA method 1630.

Sample shipping protocol

- Guano samples will be packed and shipped to TDH-NEL as specified in the "Procedures for Shipping Samples to the State Lab in Nashville" (TDEC, 2015).

II. Acoustic bat surveys

- Bat acoustic surveys will be conducted near the pre-installed bat houses and near the non-impacted reference site (Maps 1-2, Table 1) to characterize each site for bat species that may be present.
  Note: The reference site is about twenty miles northeast of the Oak Ridge area.
- Bat acoustic surveys may also be conducted at ORR caves and karst areas suspected of providing bat habitat where T&E species may occur.
- All TDEC DoR-ORO acoustic bat surveys will use Anabat bat detectors (Titley Scientific, Columbia, MO) to record bat echolocation calls.
- Acoustic bat surveying standard operating procedures will follow the methods of Loeb et al., (2015) and USFWS, (2017).



Map 1: Proposed bat house monitoring sites (EFPC and BCK)

Map 2: Norris Dam State Park Reference Site (Park office/pool area bat colony; NOTE: this location is about 20 miles northeast of the Oak Ridge area)

- Anabats will be pre-programmed to record nightly for up to two weeks, beginning thirty minutes prior to sunset and ending 30 minutes after sunrise. Other sounds within the specified frequency range are recorded; these may include insect prey ultrasonic sounds, some of which may be used to jam bat foraging calls, and other non-bat-call noise (McCracken, Giffen, Haines, Guge, and Evans, 2015).
- Bat call files will be recorded and downloaded from the detectors and analyzed with specialized bat identification software [i.e., Kaleidoscope PRO, Wildlife Acoustics, Inc., Concord, MA; and Bat Call Identification, Inc., Kansas City, MO (BCID-East)] to enable acoustic identification of species.

TABLE 6: Proposed monitoring plot locations and descriptions.

Plot I.D.	Latitude	Longitude	Site Description
EFK-01	36.001802	-84.248775	EFPC floodplain, south of Ole Ben Franklin Motors, City of Oak Ridge
EFK-02	36.005552	-84.261485	EFPC floodplain, west of Big Lots, City of Oak Ridge
EFK-03	35.997365	-84.303649	EFPC floodplain, south of TVA substation, City of Oak Ridge
EFK-04	35.992160	-84.315163	EFPC floodplain, south of Big Turtle Park, City of Oak Ridge
EFK-05	35.975329	-84.337810	EFPC floodplain, downstream of Sweetgum Lane bridge, City of Oak Ridge
EFK-06	35.963631	-84.359774	EFPC floodplain, Horizon Center, west of Imperium Drive
EFK-07	35.956318	-84.369584	EFPC floodplain, Horizon Center, west of Novus Drive
EFK-08	35.953279	-84.383004	EFPC floodplain, North Boundary Greenway (East Fork Road), wetlands
EFK-09	35.949624	-84.385836	EFPC floodplain, upstream of North Bounday Greenway bridge (near mouth of EFPC)
EFK-10	35.949106	-84.375202	EFPC floodplain, North Boundary Greenway, stream adjacent to Poplar Creek Road
BCK-01	35.960777	-84.296546	BCK floodplain, west Bear Creek Valley, upstream of BCK 9.6 monitoring station
BCK-02	35.947694	-84.320064	BCK floodplain, west Bear Creek Valley, downstream of Reeves Road bridge (haul road access)
BCK-03	35.937349	-84.339181	BCK floodplain, constructed wetlands near the junction of Bear Creek Road and Highway 95
BCK-04	35.947472	-84.366796	BCK floodplain, North Boundary Greenway (Poplar Creek Road), 2nd BCK bridge
NOR-01	36.239592	-84.109778	Norris Dam State Park (reference), bat colony at bath house (swimming pool area, park office)

6. DELIVERABLES/MILESTONES

Table 7: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (commonly known as Superfund) was enacted by Congress on December 11, 1980.
EPA method 1630	This method is for determination of methyl mercury in filtered and unfiltered water by distillation, aqueous ethylation, purge and trap, desorption, and cold vapor atomic fluorescence spectrometry (CVAFS; USEPA 1998).
EPA method 1631E	Method 1631, Revision E (the "Method") is for determination of mercury (Hg) in filtered and unfiltered water by oxidation, purge and trap, desorption, and cold-vapor atomic fluorescence spectrometry (CVAFS; USEPA 2002).
Sublethal effects	Sublethal effects are defined as biological, physiological, demographic or behavioral effects on individuals or populations that survive exposure to a toxicant at lethal or sublethal dose/concentration. A sublethal dose/concentration is defined as inducing no apparent mortality in the experimental population.
T&E species	State- or Federal-listed threatened and endangered species as protected under the Endangered Species Act of 1973.
White nose syndrome	White nose disease is an emergent fungal disease of hibernating cave (or mine) bats that has spread from the northeastern to the central United States at an alarming rate. Since the winter of 2007-2008 until present, millions of insect-eating bats in 31 states and five Canadian provinces have died from this devastating disease. There are >55 Tennessee counties with infected bats.

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BENTHIC MACROINVERTEBRATE MONITORING ON THE OAK RIDGE RESERVATION

PROJECT CHARTER

FY 2019

Project Lead: John A. Wojtowicz

06/30/18

Portions of this Benthic Macroinvertebrate Monitoring on the Oak Ridge Reservation will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John A. Wojtowicz				Initial Release

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2. PROBLEM STATEMENTS 1

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4. SCOPE 2

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1. BACKGROUND

Stream-bottom communities (aquatic insects and other macroinvertebrate species) serve as indicators of the health of aquatic ecosystems. These organisms spend the majority of their lives in the water, and therefore, they are continually exposed to adverse conditions caused by direct or indirect discharges to these waters.

These streams have been negatively impacted by previous Manhattan Project activities as well as current operational activities at the three facilities on the Oak Ridge Reservation (ORR) [ETTP = East Tennessee Technology Park (formerly known as K-25); ORNL = Oak Ridge National Laboratory; and Y-12 = Y-12 National Security Complex]. Unimpacted reference streams are first used to identify healthy communities and then compared to impacted streams.

ORNL conducts benthic macroinvertebrate monitoring on some of the same streams as Tennessee Departement of Conservation (TDEC) Department of Remediation (DoR), Oak Ridge (OR). The TDEC DoR-OR Benthic Macroinvertebrate Monitoring Project is an ongoing independent project to monitor the current and changing conditions of stream-bottom communities on the ORR.

Four main watersheds are studied at the three facilities on the ORR:
1. White Oak Creek is the primary watershed on the ORNL site
2. Mitchell Branch serves as the main watershed on the ETTP site
3. East Fork Poplar Creek and Bear Creek serve as the watersheds on the Y-12 site

The headwaters of White Oak Creek and Mitchell Branch serve as the reference sites for those watersheds. Because East Fork and Bear Creek are both impacted in the headwaters, other onsite and offsite streams must serve as reference sites for those watersheds.

ORNL conducts benthic macroinvertebrate monitoring on some of the same streams as TDEC DoR, Oak Ridge. However, a number of the specific sites monitored differ between the two organizations in which case, TDEC sampling serves as independent verification of ORNL's monitoring. Determining impacts on stream-bottom communities is a complex undertaking and interpreting the results may be based on variables such as samplers and analyzers. TDEC and ORNL efforts amplify each organization's understanding of actual conditions in the ORR streams.

2. PROBLEM STATEMENTS

Benthic macroinvertebrate communities at the majority of sites on the four main watersheds in this study do not compare well with healthy communities from unimpacted reference sites.

- It has been documented that streams are impacted from both the historical Manhattan Project activities on the ORR facilities as well as current operational activites.
- Industrial releases from past and current operations are impacting the health of the native benthic population at the ORR sampling sites.
- Variability is inherent in the sampling of benthic macroinvertebrate communities due to the natural year-to-year fluctuations in benthic communities. Long-term (year-after- year) monitoring is needed to offset the variability.

3. GOALS

The goals of the Benthic Macroinvertebrate Monitoring Project are varied.

- Primary among these goals is to monitor the current condition and health of benthic communities at stream sites on the ORR. The existence of historical data from these streams will help to determine whether these sites have improved, further degraded, or remained the same since remedial activities began on the ORR.
- Provide bat acoustic surveys in advance of CERCLA-related activities, landfill construction, or remedial actions for protection of T&E bat species.
- A second goal is to provide data for comparison with other ongoing DOE studies of benthic communities. As indicated before, there is a year-to-year variation in benthic communities. A comparison of TDEC and DOE data will help to clarify the actual conditions at the ORR sites.
- A third goal is to better understand what is causing impacts in benthic communities on the ORR. At sites where pollution-tolerant organisms predominate, the problems could be due to organic loading of the streams by point and/or non-point sources. At sites where mayfly populations are absent or extremely limited, metals toxicity problems (of a chronic or acute nature) may be responsible. At sites where benthic community densities (i.e., organisms/m^2) are very low, acute, and/or episodic, toxicity problems (e.g., chlorine or biocides) could be to blame.
- A fourth goal of benthic macroinvertebrate monitoring is to provide recommendations on potential changes that may be made to help improve the current health of streams on the ORR and off the ORR where primary impacts are due to the Oak Ridge facilities. These recommendations could range between pointing out areas where banks need stabilization, defining areas where suitable substrate is unavailable, and potentially identifying data interpretations that add clarity to existing problems.
- A fifth goal is to attempt to elucidate impacts from sources other than the ORR facilities which may be affecting streams that flow both on and off the ORR (e.g., Mitchell Branch, East Fork Poplar Creek, and Bear Creek). Not all impacts to a watershed are caused by ORR facilities. Other sources limiting stream recovery must also be identified.

As remedial activities continue on the ORR, benthic sampling and analysis will help to determine if remedial work being accomplished improves stream conditions or if other factors, not directly related to remedial activities, are responsible for the impacted conditions of the ORR streams.

4. SCOPE

The scope of this project is not only to monitor the current condition of these stream communities but also to note the improvement of conditions as remedial activities conducted under CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act; (also known as Superfund)] continue.

The physical boundaries of the Benthic Macroinvertebrate Monitoring Project include streams of the major watersheds on the three facilities of the ORR. For the ORNL, this would include White Oak Creek from its headwaters to near its confluence with White Oak Lake and Melton Branch. At Y-12, these streams include East Fork Poplar Creek from its headwaters to approximately kilometer 6.3; and Bear Creek from the headwaters to its

confluence with East Fork Poplar Creek. At ETTP, the stream involved is Mitchell Branch from its headwaters to near its confluence with Poplar Creek. Also included in these physical boundaries are offsite reference sites which include Mill Branch, Hinds Creek, and Clear Creek.

The temporal boundaries for the Benthic Macroinvertebrate Monitoring Project are the sampling of all stations in the study between the beginning of May and the middle of June of a given year. Specific sampling dates depend on the availability of staff to perform the sampling, vehicles, and recent weather conditions (i.e., sampling is best completed under normal, not highwater, flows). Note: No current plans suggest any expansion of the overall physical or temporal scope of the Benthic Macroinvertebrate Monitoring Project.

4.1 Constraints

Table 1: Possible Impacts to the Project

Category	Possible Impacts to the Project
Resources	The ESOA grant could reduce the budgeted scope of work.
Resources	A change of priorities could affect the completion of the project.
Resources	Lack or expiration of perishable supplies (i.e., alcohol, sample containers, nets, etc.) acquired for the sampling period.
Resources	The availability of experienced staff for identification and analysis of collected samples.
Conditions	High precipitation events during the sampling period interfering with desirable sampling at normal flows.
Conditions	Incidents resulting in samples being lost, damaged, or dried up before processing.

4.2 Assumptions

Table 2: Possible Impacts to the Project

Assumptions
The budget and project costs may change during the fiscal year.
Access to all sampling sites will be available during the sampling period.
Adequate periods of normal flow will be available during the sampling period.
Adequate experienced staff and vehicles will be available during the sampling period.
Adequate perishable supplies (i.e., alcohol, sample containers, nets, etc.) will be available as needed for the project.

4.3 Stakeholders

Table 3: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	Internal & External
Local Governments	External
Department of Energy	External

5. METHODS, MATERIALS, METRICS

Sample Collection:

The sampling for the project is to include two 1m2 composited samples for each study site. In addition, duplicate samples will be taken at two sites for quality control. On an annual basis the TDEC DoR, Oak Ridge Office conducts benthic macroinvertebrate monitoring surveys of the watersheds, streams, and stations listed in Table 4. The intent of these surveys is to compare TDEC DoR-OR results to the results obtained by ORNL and to provide independent verification and evaluation of results. All work on this project follows the requirements of the TDEC DoR-OR Health and Safety Plan (TDEC 2017).

Sample collection consists of setting a net in place and then using a heavy-duty garden rake to disturb an approximate 1 m2 area of the stream substrate directly upstream of that net. Two such samples are collected at each site and then composited and preserved with 95% ethanol. At two selected sites, duplicate samples are collected (i.e., two sets of two 1 m2 composited samples).

Sample Processing:

Sample processing of benthic samples consist of two major steps. The first of these, called sample sorting, is the removal (separation) of benthic organisms from the detrital material collected along with the organisms.

The majority of the samples are preserved and brought to the laboratory before processing. In the case of White Oak Creek, samples from White Oak Creek Kilometer 3.9 (WCK 3.9), WCK 3.4, and WCK 2.3 and Melton Branch samples from Melton Branch Kilometer 0.3 (MEK 0.3), where elevated levels of radionuclides occur in the samples, processing is performed in the field. Contaminated sediments can therefore be returned to their source and not brought into the laboratory.

The second step in the processing of the sample is the identification of the organisms collected. The larger macroinvertebrates are identified by an experienced taxonomist using a binocular dissecting scope and the appropriate organism identification keys where needed. The smaller macroinvertebrates, which include the Chironomidae (non-biting midges) and the smaller Oligochaeta (worms), are often mounted on slides and identified by an experienced taxonomist using a binocular microscope and the appropriate keys. Most identification is performed to genus level; however, where possible, identifications are taken to the species level.

Data Analysis:

After sample identification is complete, the identifications of each sample are totaled for each genus/species and used for calculation of the various metrics used in the analysis. Metrics are then totaled for each sample and comparisons of impacted sites to reference sites are made.

The use of metrics is one way of evaluating the condition of benthic sites. However, use of only these metrics can lead to some erroneous evaluations and/or conclusions. Therefore further use of the species composition of the sites, as well as the assessment of the total population size (i.e., number of organisms per m2) at the sites, is made to help clarify interpretations.

TABLE 4: Proposed Sampling Sites for Benthic Macroinvertebrate Monitoring Project

Facility	Watershed	Stations	Reference Stations
ORNL	White Oak Creek	WCK 3.9	WCK 6.8
		WCK 3.4	
		WCK 2.3	
		MEK 0.3	
Y-12	East Fork Poplar Creek	EFK 25.1	CCK 1.43
		EFK 24.4	HCK 20.6
		EFK 23.4	
		EFK 13.8	
		EFK 6.3	
	Bear Creek	BCK 12.3	GHK 2.9
		BCK 9.6	MBK 1.6
		BCK 3.3	
ETTP	Mitchell Branch	MIK 0.71	MIK 1.43
		MIK 0.4	

WCK = White Oak Creek Kilometer; MEK = Melton Branch Kilometer; EFK = East Fork Poplar Creek Kilometer; BCK = Bear Creek Kilometer; MIK = Mitchell Branch Kilometer; CCK = Clear Creek Kilometer; HCK = Hinds Creek Kilometer; GHK = Gum Hollow Branch Kilometer; MBK = Mill Branch Kilometer.

Reference Collection:

Specimens that are unique to a given site (i.e., have not been found previously at that site; sensitive taxa found at impacted sites) are separately vialed and placed in a reference collection for the project.

Consult the TDEC DOR-Oak Ridge Standard Operating Procedure (draft) for Benthic Macroinvertebrate Monitoring (TDEC 2018) for details.

6. DELIVERABLES/MILESTONES

The Benthic Macroinvertebrate Monitoring Project has the following deliverables and milestones.

Table 5: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
Benthic	Stream-bottom dwelling organisms.
Biocides	Any product or substance used in a cooling tower which is intended to destroy, control or prevent the effects of algae, bacteria, sulfate-reducing bacteria, protozoa, and fungi.
Dichotomous	Dividing into two parts.
Macroinvertebrates	Animals that live in water, lack backbones and can be seen with the naked eye.
Organism Identification Keys	Dichotomous keys using a series of characters that differentiate among organisms allowing for a final identification of a given organism.

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ENVIRONMENTAL DOSIMETERS
PROJECT CHARTER
FY 2019

Project Lead: John Wojotowcz

06/30/18

Portions of this Environmental Dosimeters Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John A. Wojtowicz				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
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5. METHODS, MATERIALS, METRICS 3
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1. BACKGROUND

Radiation is emitted by various radionuclides that have been produced, stored, and disposed of on the Department of Energy's (DOE) Oak Ridge Reservation (ORR). Associated contaminants are evident in ORR facilities and surrounding soils, sediments, and waters. In order to independently assess the risks posed by these radioactive contaminants, the Oak Ridge Office of the Tennessee Department of Environment and Conservation's Division of Remediation (DoR) began monitoring ambient radiation levels on and near the vicinity of the ORR in 1995. This project provides:

- Conservative estimates of the potential dose to members of the public from exposure to gamma radiation attributable to DOE activities/facilities on the ORR;
- Baseline values used to assess the need and/or effectiveness of remedial actions;
- Information necessary to establish trends in gamma radiation emissions;
- Information relative to the unplanned release of radioactive contaminants on the ORR.

2. PROBLEM STATEMENTS

Since its beginning during the Manhattan Project, the ORR has had a long history of working with or on radioactive materials. From its initial work with the Graphite Rector at the Oak Ridge National Laboratory (ORNL), the Calutrons at Y-12 National Security Complex (Y-12), the Gaseous Diffusion facilities at East Tennessee Technology Park (ETTP), and through a series of reactors that were built and operated at ORNL, some highly radioactive material has been generated.

Activities associated with fuel reprocessing, chemical methods for radioisotope separation, and radioisotope production have further added to the accumulation of these radioactive materials. Radioactive materials have been and are stored or buried at various locations on the ORR. The majority of these locations do not pose any exposure risk to the public; however, certain of these areas could.

At one time, little of the ORR was accessible to the public, although, more recently, there has been a movement toward making parts of the ORR more accessible to businesses and the public. This is particularly true at ORNL and ETTP. Increased access creates situations where the public (including non-governmental on-site workers) are more likely to be exposed to (temporarily stored or buried) radioactive materials.

Because of this risk, it is important that exposure levels of various areas of the ORR be monitored. Areas where higher levels of radiation are known to exist are important to monitor, but, so are areas where levels are lower. Monitoring elevated activity levels gives information on how high levels are in those areas and how they change as those areas are remediated or materials are moved elsewhere or disposed. It is equally as important to monitor areas with lower radiation levels to identify those areas as low-level and relatively unchanging.

Long-term monitoring of the ORR has shown that the majority of the areas pose no risk to the public. It has also helped to keep a focus on areas where radiation levels may be somewhat elevated.

3. GOALS

The goal of the Environmental Dosimeters Project is to maintain independent monitoring to evaluate DOE's efforts to reduce radiation levels both on and in the vicinity of the ORR. These conditions are expected to improve as remediation activities continue and stored materials are disposed.

Dosimeters will be distributed and retrieved during a two- to three-week period at the beginning of each quarter (in January, April, July, and October). Every attempt will be made to complete the distribution and retrieval (change out) in a two-week period.

4. SCOPE

The purpose of this project is to independently assess if the potential public dose from radiation exposure is kept below the NRC NUREG-1757 reference limit of 100 mrem/yr (Schmidt et al, 2006). The Environmental Dosimeters Project focuses on areas of all three Oak Ridge Reservation facilities, as well as background sites in and near Oak Ridge. Emphasis is placed on areas where radioactive materials are stored, processed, or disposed. Areas where radiation levels are particularly of interest to stakeholders such as the Environmental Management Waste Management Facility (EMWMF) and parts of the ETTP that are now much more accessible to the public are also included in this scope. It is important to know where potential problems exist, but it is equally important to inform stakeholders where problems do not exist.

Optically Stimulated Luminescence Dosimeters (OSLs) are used for the project due to their superior sensitivity compared to Thermoluminescent Dosimeters (TLDs) (Boons, Van Iersel, & Genicot, 2012). The majority of the areas will receive only gamma detecting dosimeters, whereas areas with the potential for neutrons, will also receive neutron-detecting dosimeters.

4.1 Assumptions

Table 1: Assumptions

	Assumptions
1	The budget and dosimeter processing costs may change during the fiscal year.
2	Levels of radiation are expected to change with remediation of areas.
3	Levels of radiation may change from time to time in active work areas based on movement of materials in or out of a given area.

4.2 Constraints

Table 2: Project Constraints

Category	Constraints
Resources	The budget may not allow for an adequate number of dosimeters.
Resources	Missing dosimeters can result in a specific site data not being available and an estimated yearly exposure will have to be projected based on available data.
Scheduling	If dosimeters are late in arriving from Landauer, Inc., distribution and retrieval of dosimeters will also be delayed.
Scheduling	If contacts for distribution of dosimeters are unavailable or an area where dosimeters are placed is temporarily inaccessible, the two to three-week time limit for distribution and retrieval of dosimeters will have to be extended.
Resources	If dosimeters being returned to Landauer, Inc. are x-rayed during shipment, the data for that quarter will be lost and adjustments will need to be made to available data to extrapolate that data to a value for the year.
Scheduling	If a state vehicle is not available on a particular day, the distribution will need to be delayed.
Personnel	If the Project Lead is not available during the distribution period, arrangements will be made for another individual to complete that part of the task or the entire task if needed.

4.3 Stakeholders

Table 3: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee and the General Public	External
Tennessee Department of Environment and Conservation	Internal & External
Local Governments	External
U.S. Department of Energy	External

5. METHODS, MATERIALS, METRICS

All work on the Environmental Dosimeters Project is conducted under the guidance of TDEC DoR-OR's 2017 Health and Safety Plan (TDEC, 2017). In this effort, environmental dosimeters are used to measure the gamma radiation dose attributable to external radiation at selected monitoring stations. Collected data results are compared to background values and the State's primary dose limit for members of the public.

The Environmental Dosimeters Project is conducted on the ORR and at background areas in and around the city of Oak Ridge in order to monitor general radiological conditions. Gamma radiation exposure levels are monitored at all sites and neutron radiation is monitored at select sites. Dosimeters are distributed in select areas of Y-12, EMWMF, the ORNL Main Campus in Bethel Valley, ORNL Melton Valley, ORNL Tower Shielding and Cesium Forest, Spallation Neutron Source at ORNL, ETTP, the City of Oak Ridge and its vicinity, and Norris and Loudon dams.

The dosimeters used in the Environmental Dosimetry Project are OSLs. OSLs are more sensitive than TLDs and they will record levels of exposure as low as 1 mrem vs. the 10 mrem of the TLDs. The dosimeters are obtained from Landauer, Inc. in Glenwood, Illinois.

Dosimeters at all sites are changed out by TDEC DoR-OR and analyzed (by Landauer, Inc.) on a quarterly schedule during the months of January, April, July, and October. A total of 145 dosimeters are distributed/retrieved during each quarter (new ones placed in the field; those in the field returned for processing).

Dosimeters are typically received from Landauer, Inc. during the first week of January, April, July and October. Upon receipt, the dosimeters are logged in (to ascertain that all units were received) and prepared for distribution to the various sites. At the majority of the sites, TDEC DOR-Oak Ridge staff must contact site personnel to arrange for access to certain areas for the distribution. At certain sites, the TDEC DOR-Oak Ridge staff is accompanied by site personnel during the distribution, at others gate keys are borrowed to gain access to the areas.

Every attempt is made to complete the quarterly task within two to three weeks of logging in the dosimeters. Much of this depends on the schedules of site contacts, weather conditions, and other extenuating circumstances (e.g., temporary inability to access certain areas because of ongoing site activities).

After dosimeters are exchanged, those that are destined for analysis are logged back in to determine if any are missing. The dosimeters are then packaged for shipment to Landauer, Inc. for processing. Packages are shipped via ground delivery to avoid the packages being x-rayed in transit (packages shipped via air are likely to be x-rayed; x-raying will impact dose readings and make the data unusable).

After the dosimeters have been analyzed at Landauer, Inc., data files are downloaded, transferred to Excel spreadsheet format, and then placed in a table to be used in the annual Environmental Monitoring Report (EMR). Consult the draft TDEC DOR-Oak Ridge Standard Operating Procedure for the Environmental Dosimeters Project (TDEC 2018) for details.

6. DELIVERABLES/MILESTONES

Table 4: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
mrem	Abbreviation for millirem which is a unit of absorbed radiation dose.

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FUGITIVE RADIOLOGICAL AIR EMISSIONS PROJECT CHARTER FY 2019

Project Lead: Gary Riner

06/30/18

Portions of Fugitive Radiological Air Emissions Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Gary Riner				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
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1. BACKGROUND

The K-25 Gaseous Diffusion Plant, ETTP, began operations in World War II as part of the Manhattan Project. Its original mission was to produce uranium enriched in the uranium-235 isotope (U-235) for use in the first atomic weapons and later to fuel commercial- and government-owned reactors. The plant was permanently shut down in 1987. As a consequence of operational practices and accidental releases, many of the facilities scheduled for decontamination and decommissioning (D&D) at East Tennessee Technology Park (ETTP) are contaminated to some degree. Uranium isotopes are the primary contaminants, but technetium-99 and other fission and activation products are also present, due to the periodic processing of recycled uranium obtained from spent nuclear fuel.

The Y-12 Plant was also constructed during World War II to enrich uranium in the U-235 isotope, in this case by the electromagnetic separation process. In ensuing years, the facility was expanded and used to produce fuel for naval reactors, to conduct lithium/mercury enrichment operations, to manufacture components for nuclear weapons, to dismantle nuclear weapons, and to store enriched uranium.

Construction of the Oak Ridge National Laboratory (ORNL) began in 1943. While the K-25 and Y-12 plants' initial mission was the production of enriched uranium, ORNL focused on reactor research and the production of plutonium and other activation and fission products, which were chemically extracted from uranium irradiated in ORNL's Graphite Reactor and later at other ORNL and Hanford reactors. During early operations, leaks and spills were common and associated radioactive materials were released from operations as gaseous, liquid, and solid effluents, with little or no treatment (ORAU, 2003).

The Environmental Management Waste Management Facility (EMWMF) was constructed in in Bear Creek Valley near the Y-12 plant for the disposal of low-level, radioactive waste, and hazardous waste generated by remedial activities on the reservation.

2. PROBLEM STATEMENTS

- Many of the facilities at ETTP, Y12, and ORNL scheduled for decontamination and decommissioning are contaminated. Decontamination and Demolition (D&D) operations at these facilities, as well as the placement of waste from these facilities at EMWMF, can result in fugitive (non-point source) dispersal of contaminates. This dispersion is aided by winds that tend to blow up the valley (northeast) in the daytime and down the valley (southwest) at night.

- At ETTP, uranium isotopes are the primary contaminants, but technetium-99 and other fission and activation products are also present, due to the periodic processing of recycled uranium obtained from spent nuclear fuel.

- Many of the facilities at ORNL are contaminated with a long list of fission and activation products, in addition to uranium and plutonium isotopes. Some of these facilities are considered the highest risk facilities at ORNL, due to their physical deterioration; the presence of loose contamination; and their close proximity to pedestrian/vehicular traffic, privately funded facilities, and active ORNL facilities. DOE OR provides annual dose assessments, including a dose from the air emissions, to the public from the ongoing operations. At Y12, the facilities contaminated with various isotopes of uranium are scheduled for D&D.

3. GOALS

- To protect health and the environment, DoR-OR will conduct independent air sampling and compare the results with air sampling data provided by DOE.
- DoR-OR and TDEC personnel will review the air monitoring section of DOE (ORR's) Environmental Monitoring Plan and suggest relevant revisions to the DOE EMP.

4. SCOPE

The DoR will conduct continuous Fugitive Air Monitoring to evaluate DOE's compliance with Clean Air Act (CAA) regulatory standards to ensure DOE radiological emissions would not cause a member of the public to receive an effective dose greater than 10 millirem (mrem) in one year, specifically areas of remedial and/or waste management activities.

4.1 Constraints

- It will not be possible to collect and measure all fugitive emissions from any area.
- The 120 volt electrical power required to operate the samplers is not always available at a desired sampling locations.
- Sampler locations and access could be restricted due to site operational or security concerns.

Within these limitations, sampler locations will be selected to maximize the likelihood of collecting representative samples from potential sources of airborne contamination.

4.2 Assumptions

Table 1: Assumptions

Assumptions
Adequate budget will exist to support the methods and materials described for this project.
Adequate staff will be available to assist with field duties.
Sampler locations and access will not be restricted due to site operations or security.

4.3 Stakeholders

Table 2: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

Eight high volume air samplers are proposed for use in the project. One will be stationed at Fort Loudoun Dam in Loudon County, to collect background data for comparison while the remaining samplers will be placed at ORR locations where the potential for the release of fugitive airborne emissions is greatest (e.g., locations of the excavation of contaminated soils, demolition of contaminated facilities, waste disposal operations, etc.).

Each of the air samplers will use an 8x10-inch glass-fiber filter to collect particulates from air as it drawn through the unit at a rate of approximately 35 cubic feet per minute. To ensure accuracy, airflow through each sampler will be calibrated quarterly, using a Graseby General Metal Works Variable Resistance Calibration Kit, in accordance with DOR-OR Standard Operating Procedure (SOP) 202, *Calibrating High Volume Total Suspended Particulate Sampler*. Maintenance on the samplers will be performed as described in DOR-OR SOP 203, *High Volume Total Suspended Particulate System Maintenance.*

Samples will be collected from each sampler weekly, composited every four weeks, and analyzed at the State of Tennessee's Environmental Laboratory based on the contaminants of concern for the location being monitored and previous findings. Where gross analyses are used, radionuclide-specific analysis will be performed if the results exhibit significant spikes, upward trends, consistently elevated results, and/or exceeded screening levels (gross alpha and gross beta measurements will be the CAA limits for uranium-235 and strontium-90, respectively).

To assess the concentrations of the contaminants measured for each location, results from the station will be compared with the background data and the standards provided in the CAA. Associated findings will be reported to DOE and its contractors and included in DoR-OR's annual Environmental Monitoring Report submitted to DOE and the public.

Fugitive air monitoring will be conducted by the DoR to compare to the standards provided by the Clean Air Act. Title 40 of the Code of Federal Regulations Part 61 (40CFR61), National Emission Standards for Hazardous Air Pollutants (NESHAPS), Subpart H (National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities) limits DOE radiological emissions to quantities that would not cause a member of the public to receive an effective dose equivalent greater than 10 millirem (mrem) in a year.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
millirem	A rem is the unit of effective absorbed dose of ionizing radiation in human tissue, equivalent to one roentgen of X-rays. A millirem is one thousandth of a rem.

HAUL ROAD SURVEYS
PROJECT CHARTER
FY 2019

Project Lead: John (Tab) Peryam

06/30/18

Portions of the Haul Road Surveys Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John (Tab) Peryam				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
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1. BACKGROUND

The Haul Road was constructed for, and is dedicated to, trucks transporting CERCLA radioactive and hazardous waste from remedial activities on the ORR to the EMWMF in Bear Creek Valley for disposal. To account for wastes that may fall or be blown from the trucks in transit, DoR-OR personnel perform walk-over radiological surveys of different segments of the nine-mile long Haul Road and associated access roads. The haul road was constructed to avoid transporting waste over public roads.

2. PROBLEM STATEMENTS

- In the history of the haul road, a number of incidents resulting in potentially contaminated materials being freed in transport have highlighted the need for regular radiological surveys
- Throughout the history of the haul road surveys project, numbers of anomalous items have been identified such as waste debris, PPE, tarp patches, waste stickers, etc.

3. GOALS

To prevent the spread of contamination resulting from the transportation of radioactive mixed waste from the originating clean up locations on the ORR to the waste disposal location. In particular, the objectives include the following:

- To locate waste that may have been blown or dropped from waste-hauling trucks in transit.
- To allow DOE and their contractor to continue their waste transportation in a manner that limits the environmental insult to the Haul Road and the surrounding areas.

4. SCOPE

The scope of this project is limited to locating, surveying, and reporting to DOE (for disposition) any ORR-derived waste materials that were lost on the EMWMF Haul Road.

4.1 Assumptions

Radioactive spills or materials found along ORR haul roads can be attributed to the transportation activities on the ORR.

4.2 Constraints

- Unavailability of trained personnel and equipment due to competing projects.
- Heavy vehicular traffic that may result in a stop work.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

As previously noted, the nine-mile long Haul Road is surveyed in segments typically consisting of one to two miles. For safety and by agreement with DOE and its contractors, staff performing the inspections advises site personnel that they intend perform a survey on the Haul Road. The DOE contractor responsible for providing briefings on road conditions and any known situation that could present a safety hazard while on the road. When the DOE contractor is not working, staff members call into the designated DOE site safety office for the segment being surveyed. Should excessive traffic present a safety concern, the survey is postponed to a later date. Alternate entrances are sometimes used to access the road with DOE approval, but the basic requirements remain in effect.

When staff members arrive at the segment of the road to be surveyed, the vehicle is parked completely off the road, as far away from vehicular traffic as possible. No fewer than two people perform the surveys, each walking in a serpentine pattern along opposite sides of the road to be surveyed or one person walking in a serpentine pattern across the entire road accompanied by an approved safety buddy. Typically, a Ludlum Model 2221 Scaler Ratemeter with a Model 44-10 2”X2” NaI Gamma Scintillator probe held approximately six inches above the ground surface is used to scan for radioactive contaminants as the walkover proceeds. A Ludlum 2224 Scaler with a Model 43-93 Alpha/Beta dual detector is used to investigate potential surface contamination on the road surfaces or anomalous items noted along the road that may be associated with waste shipments. Any areas or items with contamination levels exceeding 200 dpm/100 cm2 removable beta, 1000 dpm/100 cm2 total beta, 20 dpm/100 cm2 removable alpha, and/or 100 dpm/100 cm2 total alpha require further investigation.

Anomalous items found during the survey are marked with contractor’s ribbon at the side of the road and a description of the item and its location are logged and reported to DOE and its contractors for disposition. A survey form or equivalent is maintained for each walkover survey and is retained at the DoR-OR Oak Ridge office. When staff members return to the road for the next weekly inspection, they perform a follow-up inspection of items found and reported in previous weeks. If any items remain, they are included in subsequent reports until removed or staff members are advised the item(s) have been determined to be free of radioactive and hazardous constituents.

6. DELIVERABLES/MILESTONES

Table 2: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

MERCURY UPTAKE IN BIOTA
PROJECT CHARTER
FY 2019

Project Lead: Gerry Middleton

06/30/18

Portions of Mercury Uptake in Biota Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Gerry Middleton				Initial Release

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1. BACKGROUND

During the 1950's and early 1960's processes and practices of the nuclear weapons program at the Y-12 National Security Complex (Y-12 NSC; historically known as Y-12 Plant) led to the release of large amounts of mercury (Hg) to the local environment (Brooks et al., 2017). In the East Fork Poplar Creek (EFPC) 100-year floodplain, mercury is extensively dispersed as black band deposits in a wide range of concentrations in the top three meters of the floodplain soil and sediment (Pant, Allen, & Tansel, 2010).

Although the 1995 Lower EFPC Record of Decision (EFPC ROD; Jacobs, 1995) required the removal of soils with Hg concentrations >400 ppm at four downstream EFPC floodplain locations (1996-97), contaminated soils remain in the floodplain with Hg concentrations ranging from 100-400 ppm (Han et al., 2012). The EFPC ROD specifies that those removal actions will be protective of human health and the environment as well as of plant and animal populations (Jacobs, 1995). Mercury concentrations in EFPC floodplain soils prior to remediation were considered a potential threat to biota by Hg exposure through the EFPC food chain (i.e., transfer from aquatic to terrestrial biota via prey/predator relationships; SAIC, 1995).

Mercury in streams and wetlands becomes extensively bound to sediments, undergoes methylation and is transformed into toxic methylmercury (MeHg) in conjunction with the activity of microorganisms (Kalisinska, Kosik-Bogacka, Lisowski, Lanocha, & Jackowski, 2013). Methylmercury is particularly bioavailable to wildlife (and humans) and, if ingested, may cause serious neurological, reproductive, and other physical damage (Standish, 2016). Further, there are seventeen jurisdictional wetlands in EFPC where wetland animals may still be accumulating mercury (Jacobs, 1995).

Methylmercury biomagnifies through food chains in higher-level organisms, such as songbirds and ducks, acquiring increasingly larger body burdens of MeHg through consumption of lower trophic-level prey items such as small invertebrates, benthic larval-stage biota, terrestrial and semi-aquatic spiders and emergent flying insects (Scheuhammer, Meyer, Sandheinrich, & Murray et al., 2007). For example, tree swallows (TS) will eat emergent adult insects (with benthic larval stages) such as dragonflies, damselflies, stoneflies, flies, mayflies, and caddisflies. Tree swallows also consume wasps, beetles, butterflies, moths, spiders and mollusks (Robertson, Stutchbury, & Cohen, 2011). Wood ducks (WD) forage on the water (dabbling) and by walking on land. They consume spiders, beetles, caterpillars, isopods, crayfish, snails, grains, seeds and acorns (Hepp & Bellrose, 1995).

The EFPC ROD calls for appropriate monitoring of EFPC floodplain soils, sediments, surface water and associated biota (Jacobs, 1995). Previous ecological investigations and post-remediation monitoring of EFPC included Hg and MeHg analysis of fish, earthworms, starlings, herons, spiders, benthic macroinvertebrates, small mammals and other biota (SAIC, 1996; Standish, 2016). For example, mean Hg concentrations were significantly greater in feathers and egg tissue of herons collected on the ORR in comparison with those collected off the ORR (Jacobs, 1995). During a 5-year post-remediation ecological assessment of EFPC biota, very high concentrations of bioavailable MeHg were discovered in EFPC floodplain spiders (Mathews, Smith, Peterson, & Roy, 2011). Spiders are preyed upon by some songbirds and also waterfowl.

Decreases in reproductive success of 35–50% have been observed in birds with high dietary methylmercury uptake (USDI, 1998). Mercury concentrations found in the egg and feathers are good indicators of Hg risk to avian reproduction (Furness, Muirhead, & Woodburn, 1986; Wolfe, Schwarzbach, & Sulaiman, 1998). The purpose of this project is to investigate Hg and MeHg concentrations in WD and TS (i.e., in feathers and eggs) and in their associated prey items. Sampling will be conducted at various locations in the impacted EFPC area as well as some non-impacted reference monitoring locations.

2. PROBLEM STATEMENTS

- Nearly 100% of the Hg transferred to eggs is in the form of MeHg with the majority (about 85–95%) deposited into the albumen (i.e., egg whites; Wiener, Krabbenhoft, Heinz, & Scheuhammer, 2003). In some bird species, MeHg levels of ≥1.5 ppm in eggs are associated with decreased egg weight, poor hatchability, and low chick survival (Burger & Gochfeld, 1997).
- Mercury levels in feathers that are known to be associated with adverse reproductive effects and decreased nesting success in birds range from 5.0-≥40 ppm (Burger & Gochfeld, 1997).
- Adults of macroinvertebrates that emerge from contaminated aqueous larval stages are often eaten by terrestrial insectivores such as songbirds, waterfowl, and spiders. This creates a key link of MeHg transfer and accumulation between biota in aquatic environments to those in terrestrial habitats. It is predicted that MeHg and Hg concentrations in biota samples may likely be greater at Hg-impacted EFPC plots than at non-impacted reference plots.
- The ratio of feather-Hg compared to blood-Hg in bald eagles (feather:blood= 6:1) predicts Hg in their blood at time of molting (Weech, Scheuhammer, & Elliott, 2006). The ratio of feather-Hg compared to blood-Hg in tree swallows (feather:blood= 5.8:1) predicts Hg in their blood at time of molting (Brasso & Cristol, 2008). These ratios provide surrogate ratios to apply to wood duck feather samples to predict internal blood-Hg concentrations. Note: In the event that no tree swallows occupy the nest houses, then Carolina wrens will be the preferred songbird species.

3. GOALS

- Supply independently collected data and derived information on Hg and MeHg accumulation in the food chain in support of DOE's five-year post-remediation ecological assessment of EFPC ROD.
- Determine the concentrations of Hg and MeHg for the following biota samples collected from impacted EFPC floodplain monitoring plots and non-impacted reference plots: (1) eggs and feathers from WD, (2) eggs and feathers from TS, (3) adult flying insects, (4) benthic larvae, and (5) spiders.
- Based on available laboratory analysis and biota samples, attempt to examine the predator/prey relationship between WD and TS and their prey (insects and spiders).

4. SCOPE

Table 1: Boundaries – In-Scope Tasks

In Scope
After nest house occupancy is confirmed, then egg and nest-feathers will be collected as environmental samples for Hg and MeHg analyses.
Flying insect samples (beetles, other taxa) will be collected with Lindgren funnel traps that will be installed at each site.
To collect additional flying insect samples (beetles, moths, caddisflies, mayflies, stoneflies), BioQuip black light (ultraviolet, UV) traps may be used for collections.
Benthic larvae samples (caddisflies, mayflies, dragonflies) will be collected using dip-nets.
To collect spider samples, aquarium nets and 12-inch forceps will be used for retrieval of specimens near riparian shoreline.
Work will be completed in compliance with the Migratory Bird Treaty Act (1918) and Tennessee Wildlife Resources Agency permits.

Table 2: Boundaries – Out-of-Scope Tasks

Out-of-Scope
To minimize stress to the wildlife, body tissues will not be sampled. Birds or ducks will only be handled, if necessary, to move the nesting bird slightly to obtain egg or feather samples.
Sediment, soil, and surface water samples are not planned for collection.
Fish samples are not planned for collection.

4.1 Constraints

Table 3: Possible Impacts to the Project

Category	Possible Impacts to the Project
Funding	Inadequate funding to support laboratory analytical costs.
Nest house occupation	Project success for the bird and duck sampling is dependent upon nest house occupation.
Vandalism	Bird houses and other deployed sampling equipment may be vulnerable to theft or vandalism. The risk exists for lost equipment and lost samples at a few sampling plots.
Biota samples	Some biota samples could be <5.0 grams.

4.2 Assumptions

Table 4: Assumptions

Assumptions
Wood ducks and birds will occupy the installed nest houses.
Nest houses will not be damaged or stolen during the monitoring and sampling period.
Five (5.0) or more grams of biomass will be available per biota sample to run both the Hg and MeHg analyses, as per the TDH NEL analytical laboratory recommendation.
Monitoring the newly installed nest houses for occupancy, determining the start of egg-laying activity, and then actual sampling will require a large initial time investment (estimated 4 weeks).
Adequately trained staff will be available for field work for extended periods of time.

4.3 Stakeholders

Table 5: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Tennessee Wildlife Resources Agency (TWRA)	External
U.S. Fish & Wildlife Service (USFWS)	External

5. METHODS, MATERIALS, METRICS

Biota samples will be collected at five Hg-impacted plots (OR-01 through OR-05) and five non-impacted reference plots (OR-06 through OR-10) during 2018 (Maps 1-2, Table 1; Note: Reference sites OR-09 and OR-10 are located approximately twenty-five to thirty miles northeast of the Oak Ridge area). If incidentally collected, species that are state or federal listed as greatest conservation need (GCN), threatened, endangered, or deemed in need of management will not be sampled (unless specified otherwise by conditions of the scientific sampling permit). If such species were to be trapped, then the specimen(s) will be released unharmed at point of capture. State or federal listed species (if encountered) will be reported to TWRA and USFWS within five working days. Application requests have been submitted for required state and federal collection permits. All field and laboratory work will follow the safety guidelines per the TDEC Division of Remediation, Oak Ridge Office, 2017 *Health and Safety Plan* (TDEC, 2017).

Avian sampling

- WD and TS eggs and feathers will be hand-collected from installed nest houses.
- One egg and approximately five grams of nesting feathers will be collected from each occupied nest house.
- SOPs for egg and feather sampling and sample preparation follow the methods of Kennamer et al. (2005), Longcore, Haines, and Halteman (2007) and Evers (2009).

Adult insects, benthic larvae and spider sampling

- About five grams of material will be collected per taxon per site for Hg & MeHg assays.
- Adult flying insects will be collected with black light traps (ultraviolet) and Lindgren funnel traps.
- Benthic larvae will be collected from aquatic substrates with dip nets.
- Spiders will be collected near shorelines with aquarium nets or 12-inch forceps.
- SOPs for sampling and sample preparation follow the methods of Southwood and Henderson (2000), Vincent and Hadrien (2003), CCME 2016 (SOPs no. 14 & 15) and TDEC (2011).

Sample handling at the TDEC DoR laboratory (all biota samples)

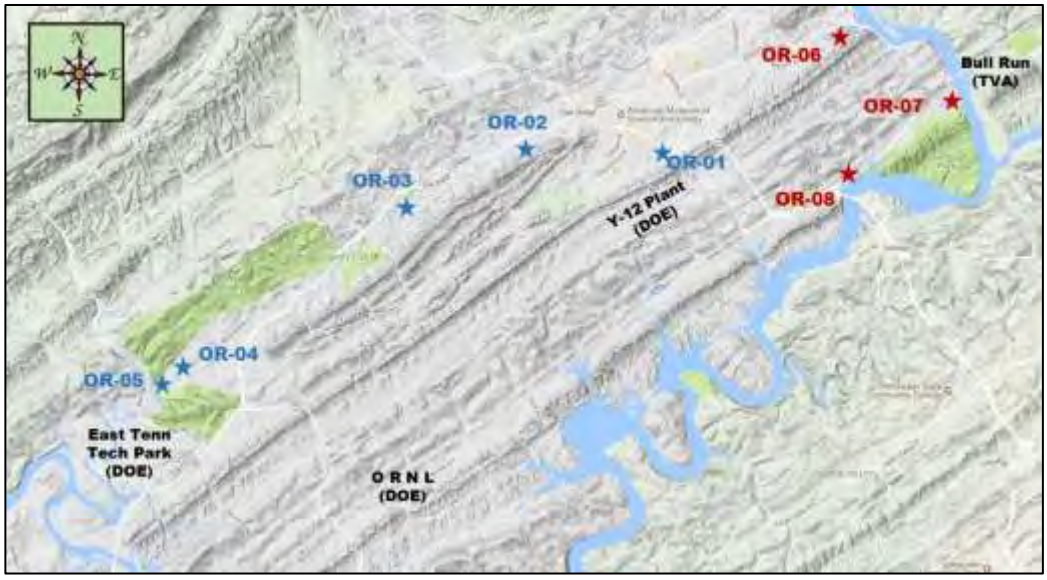
- In the TDEC DoR laboratory (TN Department of Environment and Conservation, Division of Remediation, Oak Ridge Office), all biota samples will be weighed (as received, wet weight) to the nearest 0.01 gram and recorded on the laboratory sample log.
- Biota will be classified at least to Family (or genus) and sorted to create approximately five grams of biomass for each sample.
- Egg samples will be boiled to facilitate separation into: shell, yoke and albumen samples.
- All biota samples will be placed into special two-oz QEC (Quality Environmental Containers, Beaver, WI) Level two pre-cleaned glass jars (with labels and plastic screw-top lids). These sample jars will be stored at -18ºC in the TDEC DoR-ORO laboratory freezer until shipment to PACE Analytical Services, LLC for analysis.

Analytical laboratory methods

- Biota sample materials will be shipped to Tennessee Department of Health—Nashville Environmental Laboratory (TDH-NEL). For the THg and MeHg mercury analysis, TDH-NEL forwards these samples to PACE Analytical Services, LLC (Green Bay, WI) for assays.
- Hg (low level) assays will follow EPA method 1631E and MeHg (in tissue) assays will follow EPA method 1630.

Sample shipping protocol

- Biota samples will be packed and shipped to TDH-NEL as specified in the "Procedures for Shipping Samples to the State Lab in Nashville" (TDEC, 2015).



MAP 1: Oak Ridge plots (EFPC sites: blue numbers/letters; reference: red numbers/ letters.)

MAP 2: Norris Watershed (OR-09) and Big Ridge State Park (OR-10) reference plots. (Note: These sites are approximately 25-30 miles northeast of the Oak Ridge area.)

TABLE 6: Monitoring plot locations and descriptions

SITE I.D.	LATITUDE	LONGITUDE	SITE DESCRIPTION
OR-01	36.001584	-84.249988	East Fork Poplar Creek floodplain / riparian zone southwest of the NOAA office, Oak Ridge, TN
OR-02	36.003528	-84.284545	East Fork Poplar Creek floodplain / riparian zone south of United Grocery Outlet (Bruner site), Oak Ridge, TN
OR-03	35.990542	-84.319510	East Fork Poplar Creek floodplain / Big Turtle Park wetland, Oak Ridge, TN
OR-04	35.953553	-84.382510	East Fork Poplar Creek floodplain / East Fork Road greenway wetland (North Boundary Trail), west Oak Ridge, TN
OR-05	35.949523	-84.386802	East Fork Poplar Creek floodplain / No. Boundary Trail / upstream of East Fork Poplar Creek bridge, west Oak Ridge, TN
OR-06	36.027688	-84.198661	Emory Valley Road at Melton Lake Drive / backwater cove wetland of Clinch River, Oak Ridge, TN (local reference)
OR-07	36.012415	-84.167848	Melton Lake Greenway Trail / backwater cove wetland of Clinch River, Oak Ridge, TN (local reference)
OR-08	35.996862	-84.195356	Backwater pond marsh adjacent to the UT Arboretum, Oak Ridge, TN (southeast arboretum property; local reference)
OR-09	36.213956	-84.058253	Clear Creek (distant reference) / Norris Watershed / Norris, TN
OR-10	36.249241	-83.934538	Big Ridge State Park (distant reference) / Big Ridge Lake area shoreline / Union Co. (Maynardville, TN)

6. DELIVERABLES/MILESTONES

Table 7: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980.
EPA method 1630	This method is for determination of methyl mercury in filtered and unfiltered water by distillation, aqueous ethylation, purge and trap, desorption, and cold vapor atomic fluorescence spectrometry (CVAFS; USEPA 1998).
EPA method 1631E	Method 1631, Revision E (the "Method") is for determination of mercury (Hg) in filtered and unfiltered water by oxidation, purge and trap, desorption, and cold-vapor atomic fluorescence spectrometry (CVAFS; USEPA 2002).
SOP (SOPs)	Standard operating procedure(s). An SOP is a document consisting of step-by-step information and instructions on how to execute scientific tasks and experiments in the field and laboratory.
Sublethal effects	Sublethal effects are defined as biological, physiological, demographic or behavioral effects on individuals or populations that survive exposure to a toxicant at lethal or sublethal dose/concentration. A sublethal dose/concentration is defined as inducing no apparent mortality in the experimental population.
T&E species	State- or Federal-listed threatened and endangered species as protected under the Endangered Species Act of 1973.
White nose syndrome	White nose disease is an emergent fungal disease of hibernating cave (or mine) bats that has spread from the northeastern to the central United States at an alarming rate. Since the winter of 2007-2008 until present, millions of insect-eating bats in 31 states and five Canadian provinces have died from this devastating disease. There are >55 Tennessee counties with infected bats.

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OFFSITE RESIDENTIAL WELL MONITORING PROJECT CHARTER FY 2019

Project Lead: Rebecca Lenz

06/30/18

Portions of Offsite Residential Well Monitoring Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Rebecca Lenz				Initial Release

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1. BACKGROUND

The Oak Ridge Reservation (ORR) is located in Roane and Anderson counties, Tennessee. The ORR played a major role in the atomic bomb development during World War II. Oak Ridge went from being a rural remote farm area to a "secret city" that developed weapons-grade material for the Manhattan Project (Fact sheet: Oak Ridge Reservation, 2018). The three main sites of the ORR are the Oak Ridge National Laboratory (ORNL), formerly X-10; Y-12 National Security Plant, and East Tennessee Technology Park (ETTP), formerly the K-25 Gaseous Diffusion Plant. ORNL (X-10) was the site that developed the processes used to separate plutonium from irradiated fuel for use in the atomic bomb (Facts: Oak Ridge Reservation, 2018). Currently, ORNL is a national laboratory conducting research on applied energy technologies and global security. Fuel reprocessing, isotope production, waste management, radioisotopes, reactor developments, and other laboratory operations produced waste streams that led to releases of radionuclides and hazardous chemicals from ORNL. The Y-12 National Security Complex's historical mission was to separate uranium-235 from other uranium forms by the electromagnetic process. Y-12 served as a weapons component manufacturing facility until the early 1990s, and now serves as part of the U.S. Department of Energy (DOE) weapons dismantlement complex (Oak Ridge Site, no date). ETTP (K-25) was the home of the uranium-235 enrichment for atomic weapons during both World War II and the Cold War. The facilities at ETTP historically released uranium isotopes, technetium-99, and other fission and activation products due to the processing of recycled uranium from spent nuclear fuel. The ORR is responsible for discharging large amounts of mercury into the environment, primarily from the Y-12 West End Mercury Area (WEMA) (TDEC, 2015a; DOE, 2017).

Portions of the ORR were used for decades as a regional burial ground for hazardous and radioactive wastes from other DOE facilities (TDEC, 2018). The disposed waste was contaminated with inorganic and organic chemicals including volatile and semi-volatile organic compounds, beryllium, mercury and other heavy metals, PCBs, laboratory and cleaning chemicals, biological waste, and inorganic salts. Transuranic (TRU) wastes were a part of this disposal. The waste was typically alkaline and nitrate-rich (TDEC, 2018). DOE disposed of radioactive waste in landfills, shallow burial sites, unlined trenches, waste pits, auger holes, and hydrofracture facilities. All of these waste disposal sites and methods were best practices at time of implementation; however, now pose potential environmental concerns.

2. PROBLEM STATEMENTS

Groundwater beneath the ORR was contaminated due to past DOE mission activities (TDEC, 2018; Haase and others, 1987). Figure 1 shows the reservation boundary and the three primary DOE facilities: ETTP, Y-12, and ORNL. Each of these facilities has had some releases and sources of contamination with the extent of the groundwater contamination not well defined and requiring investigation. Since the Clinch River forms one of the boundaries of the ORR, ongoing sampling and analysis in the offsite areas is necessary. Historical waste injections and burial grounds extend into the bedrock below the river level (Haase and others, 1987). The DOE and the Tennessee Department of Environment and Conservation (TDEC) no longer assume that the Clinch River is a groundwater-flow barrier. Contaminated groundwater is capable of moving beneath the Clinch River and may pose threats to residents using the groundwater as a water source.

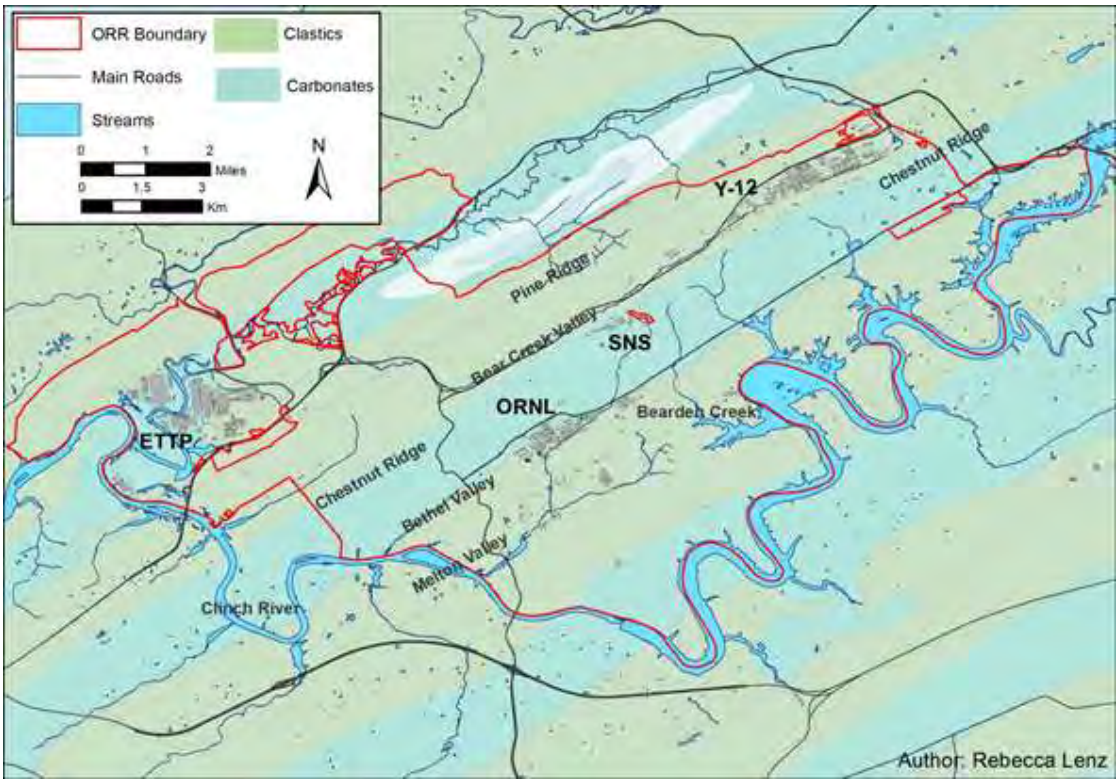

FIGURE 1: Primary DOE facilities, ORR boundary, and basic lithologies with the Valley and Ridge locations.

3. GOALS

The Offsite Residential Well Monitoring Project is intended to collect groundwater samples downgradient of the ORR (south and southwest) to detect and evaluate potential contaminant migration and to assist in the clean-up decision-making process under the Federal Facility Agreement (FFA) by providing data and information and to fulfill TDEC's mission of protecting human health and the environment.

The overarching goal of this project is to identify the possible sources of any contaminants detected in groundwater samples south and southwest of the ORR, and to better understand the nature and extent of ORR-related contamination and associated contaminant transport pathways.

The main objectives are:

1. Collect groundwater samples from approximately 25 residential wells downgradient of the ORR
2. Evaluate received data for potential constituents of concern (COCs) and water chemistry
3. Compare laboratory results to historical data from offsite, onsite, and background locations
4. Use graphing and mapping technology to determine possible trends

The data will be evaluated by comparing against historical and current offsite and background wells, ORR known contaminants, and naturally occurring sources. Some of the analytes are naturally occurring, while some are contamination signatures. Some chemicals (e.g., metals and some radionuclides) exist in nature, but their concentrations may be increased to levels that pose risks to people by release of contaminants. Some parameters like alkalinity and total hardness will be measured to help characterize geochemical conditions or groundwater types within the aquifer.

4. SCOPE

The offsite wells that will be identified for sampling are downgradient along geologic strike. Groundwater and associated contamination flow preferentially along strike—i.e., parallel to the ridges and valleys—throughout the ORR and the surrounding Valley and Ridge province (Hatcher and others, 1992; DOE, 2014).

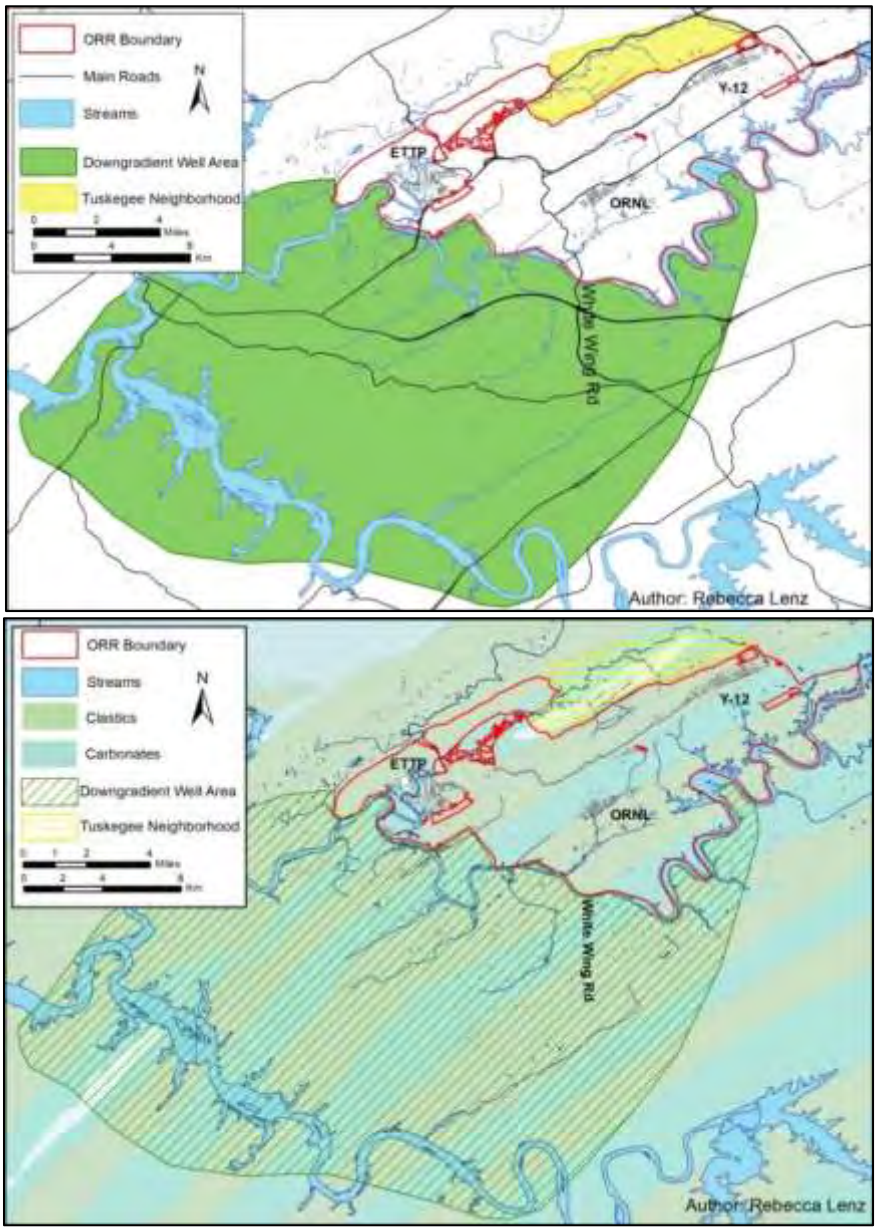

FIGURE 2: Downgradient well study area shown on a location map and a basic geologic map.

The groundwater samples selected for this project will be limited to the areas offsite of the ORR and in the same lithology as the main DOE facilities on the ORR. The main lithologies or rock types are carbonates and clastics (Hatcher and others, 1992). Both of these lithologies transmit groundwater, primarily through natural fractures and conduits. The maps in Figure 2 show the study area. Approximately 25 samples will be collected, and QA/QC samples will be collected from at least 10% of the sample locations. Some previously sampled locations may be resampled, including but not limited to wells in the Tuskegee neighborhood and along White Wing Road. Some of the current fiscal year samples and historical samples which are archived will be analyzed for stable isotopes to determine possible nitrate and recharge source areas.

4.1 Assumptions

The assumptions for the project are:

- The receipt of funding for this project will be timely and adequate.
- Residents will be willing to have their well sampled.
- Residents have accessible groundwater wells.
- Results will arrive in a timely manner from the state and contracted laboratories.
- There will be enough time and personnel to collect approximately 25 samples and analyze results for the EMR.

4.2 Constraints

A few constraints may impact this project:

- Residents interviewed may not want to participate in the groundwater well study.
- The budget and laboratory costs may change during the fiscal year.
- Personnel availability may change.
- It may be difficult or impossible to bypass filtration systems, water softeners, etc. which would affect the quality or usefulness of the data.
- Lack of information on well construction such as depth may make data interpretation and analysis difficult.
- There may not be enough time and personnel for all of the sampling before the EMR.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Environmental Protection Agency	External
Tennessee Department of Health	Internal

5. METHODS, MATERIALS, METRICS

Groundwater samples will be collected from approximately 25 wells with QA/QC samples from at least 10% of the locations. The groundwater samples will be collected from an outside tap located as close to the well as possible and before water passes through filtration and water softener systems. Wells that are not in use may be sampled by peristaltic or bladder-pump depending on well conditions. The wells may be co-sampled with DOE contractors.

The field parameters that will be measured include: temperature (°C), electrical conductivity (µS/cm), pH (SU), oxidation reduction potential (mV), dissolved oxygen (mg/L), and turbidity (NTU). The wells will be purged until the pressure tank has been emptied and these parameters become stable.

Table 2: Proposed Analyses

VOLATILE ORGANIC COMPOUNDS (VOCs)		
EPA 8260 B list for low level detection		
METALS		
aluminum	copper	potassium
antimony	total hardness, as calcium carbonate	selenium
arsenic	iron	silver
barium	lithium	sodium
beryllium	lead	strontium
boron	magnesium	thallium
cadmium	manganese	vanadium
calcium	mercury	zinc
chromium	nickel	uranium
INORGANICS		
alkalinity as calcium carbonate	sulfate	oxygen-18 (in nitrate)
chloride	nitrate and nitrite	deuterium (in water)
fluoride	ammonia	oxygen-18 (in water)
total dissolved solids	nitrogen-15 (in nitrate)	
RADIONUCLIDES		
gross alpha	tritium	radium-228
gross beta	gamma radionuclides	isotopic uranium
strontium-89	technetium-99	transuranic radionuclides
strontium-90	radium-226	

EPA-8260 B- volatile organic compound analyte list

https://www.epa.gov/sites/production/files/2015-12/documents/8260b.pdf

The samples will be sent to the TDH Division of Laboratory Services within specified holding times for volatile organic compounds (VOCs), inorganics, and radiochemical analyses. The samples requiring preservation are collected in pre-prepared bottles. The samples requiring preservation are: volatile organic compounds in HCl, metals in HNO_3, and nutrients in H_2SO_4. A mix of historical and current fiscal year samples could also be analyzed for: 1) stable nitrogen and oxygen analysis in nitrate and 2) stable isotope analysis of deuterium and oxygen in water. Table 2 lists the proposed analyses.

The data will be compared to standards in National Primary Drinking Water Regulations (NPDWR) (EPA, 2009) and National Secondary Drinking Water Regulations (NSDWR) (EPA, no date). When neither of these are available for a particular contaminant, the data will be compared to other EPA standards including: Regional Screening Levels (RSLs) (EPA, 2017), Lifetime Health Advisory Values (LHAV) (EPA, 2012), or Preliminary Remediation Goals (PRG) (EPA, no date). These standards align with Tennessee public water utility standards. A summary package of these results will be prepared and provided to the well owners to help explain the sampling results.

Residents, whose groundwater contaminants exceed drinking water criteria or who would like health information, will be referred to TDH for a health consultation. Wells with exceedances may be resampled in the future.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

Term	Definition
ASTM	American Society for Testing and Materials International
°C	degrees Celsius
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
H2SO4	sulfuric acid
HCl	hydrochloric acid
HNO3	nitric acid
LHAV	Lifetime Health Advisory Values
µS/cm	micro Siemens per centimeter
mg/L	milligrams per liter
mV	millivolts
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
NTU	nephelometric turbidity units
PCBs	polychlorinated biphenyls
PRGs	Preliminary Remediation Goals
QA/QC	Quality Assurance/Quality Control
QAPPs	Quality Assurance Project Plans
RSLs	Regional Screening Levels
SAPs	Sampling and Analysis Plans
SOP	Standard Operating Procedure
SU	standard units
TDEC	Tennessee Department of Environment and Conservation
TDH	Tennessee Department of Health
TRU	transuranic
VOCs	volatile organic compounds
WEMA	West End Mercury Area

PORTAL MONITORING AT EMWMF PROJECT CHARTER

FY 2019

Project Lead: Gary Riner

06/30/18

Portions of the Portal Monitoring at EMWMF Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Gary Riner				Initial Release

1. BACKGROUND 1

2. PROBLEM STATEMENTS 1

3. GOALS 1

4. SCOPE 1

4.1 Assumptions 1

4.2 Constraints 1

4.3 Stakeholders 2

5. METHODS, MATERIALS, METRICS 2

6. DELIVERABLES/MILESTONES 2

7. CONDITIONS AND APPROVALS 3

APPENDIX A: REFERENCES 4

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS 5

1. BACKGROUND

The Environmental Management Waste Management Facility (EMWMF) was constructed for and is dedicated to the disposal of low-level radioactive waste (LLW) and hazardous waste generated by remedial activities on the Department of Energy's (DOE) Oak Ridge Reservation (ORR). Operated under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the facility is required to comply with regulations contained in the Record of Decision authorizing the construction of the facility (DOE, 1999).

2. PROBLEM STATEMENTS

Only low-level radioactive waste, as defined in TDEC 0400-02-11.03(21) with concentrations below limits imposed by Waste Acceptance Criteria (WAC), agreed to by the FFA parties, is approved for disposal in the EMWMF. DOE is accountable for compliance with the WAC and has delegated responsibility of WAC attainment decisions to its prime contractor, which DOE supervises. This includes waste characterization and approval for disposal in the EMWMF (DOE, 2001). The State and EPA oversee and audit associated activities, including decisions authorizing waste lots for disposal.

3. GOALS

To help ensure compliance with the WAC, the DoR-OR has placed a Radiation Portal Monitor (RPM) at the check-in station for trucks transporting waste into the EMWMF for disposal. Trucks entering the facility pass between radiation detectors to ensure that excessive amounts of radiation-emitting materials are not inadvertently disposed of in the facility.

4. SCOPE

This project is limited to entry of waste as measured by the Portal Monitor located at The Environmental Management Waste Management Facility located in Bear Creek Valley near Y-12 on ORR.

4.1 Assumptions

There are no assumptions for this project.

4.2 Constraints

- Due to their size, weight, and charge, alpha and beta particles tend to interact with nearby atoms over short distances. Consequently, alpha and beta radiation are easily shielded and would not be expected to penetrate the steel side walls of truck beds carrying waste into the EMWMF for disposal or, to a large degree, the waste itself.
- The original portal monitor manufacturer no longer provides repair services or replacement parts for this equipment.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

A Canberra RadSentry Model S585 portal monitor is used in the project. The system is comprised of two large area gamma-ray scintillators, an occupancy sensor, a control box, a computer, and associated software. The gamma-ray scintillators and instrumentation are contained in radiation sensor panels (RSPs) mounted on stands on each side of the road at the check-in station for trucks hauling waste into the disposal area. Measurements (one per 200 milliseconds) are initiated by the occupancy sensor when a truck enters the portal. Results are transmitted from the RSPs to the control box where it is stored. Data is routinely downloaded by DoR-OR staff. If radiation levels exceed a predetermined amount, DOE and EMWMF personnel are contacted and the source of the waste passing through the portal monitor at the time of the measurements is determined.

6. DELIVERABLES/MILESTONES

Table 2: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Record of Decision authorizing the construction of the facility (DOE, 1999). TDEC 0400-02-11.03(21)

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

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RADIOLOGICAL CONTAMINATION IN VEGETATION

PROJECT CHARTER

FY 2019

Project Lead: Natalie Pheasant

06/30/18

Portions of the Radiological Contamination in Vegetation Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Natalie Pheasant				Initial Release

1. BACKGROUND 1

2. PROBLEM STATEMENTS 1

3. GOALS 1

4. SCOPE 1

4.1 Assumptions 1

4.2 Constraints 1

4.3 Stakeholders 2

5. METHODS, MATERIALS, METRICS 2

6. DELIVERABLES/MILESTONES 3

7. CONDITIONS AND APPROVALS 3

APPENDIX A: REFERENCES 4

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS 5

1. BACKGROUND

The three facilities on the Oak Ridge Reservation (ORR) have seen a variety of radiological contamination. Much of this comes from past operations and burial of waste, but current cleanup and other activities could also contribute to areas with radiological contamination on the ORR. Sampling has focused on areas likely to have radiological contamination, either from past or current DOE activities.

2. PROBLEM STATEMENTS

Radiological contamination of the Oak Ridge Reservation exists in a variety of locations. If surface water bodies have been impacted by radioactivity, vegetation in the immediate vicinity may uptake radionuclides, causing the bioaccumulation of radiological contaminants.

3. GOALS

This project aims to collect vegetation at locations in and near surface waters of the Oak Ridge Reservation with the potential for radiological contamination. This project will focus on the detection and characterization of radiological constituents that may be bioaccumulated by vegetation on and in the vicinity of the ORR. Results can be used to determine if radiological constituents are migrating into the environment, to see if remedial efforts are decreasing levels of bioaccumulation seen in vegetation downstream of the remediation, to determine areas of contamination that may need further characterization by DOE and the Division of Remediation-Oak Ridge office (DoR-OR). An additional goal of this project is to review and provide constructive comments to DOE on the applicable sections of their EMP and ASER.

4. SCOPE

This project will collect and analyze up to 20 vegetation samples for radiological contamination. Samples will be collected near surface water bodies (potentially impacted by radioactivity) that are on or near the ORR as well as one at a background location. Target vegetation for sampling includes, but will not be limited to, common cattail (*Typha latifolia*) and watercress (*Nasturtium officinale*). Potential monitoring locations include springs, seeps, streams, creeks, wetlands, ponds, floodplains, and adjacent areas. Watersheds such as Bear Creek and its tributaries, White Oak Creek/Lake and its tributaries, Mitchell Branch, and East Fork Poplar Creek are all probable target locations for sampling. Actual sampling locations depend on vegetation availability and other factors. Samples will be analyzed for gross alpha and gross beta activity, and for gamma radionuclides. The results can then be compared to the radiological analysis of vegetation taken from a background or other location with low levels of radiological contamination. Additional analysis may be requested if determined necessary.

4.1 Assumptions

- Most vegetation will uptake at least some of the radiological contaminants to which the plants are exposed.
- Elevated levels of radiological contaminants bioaccumulated in plants can be detected.

4.2 Constraints

- Sampling only captures levels of radiological contaminants at that point in time and may not be indicative of levels at other points in time.
- Sampling only captures the radiological levels in the area where the sampled plants are growing and may vary significantly within short distances.

- Holding time varies based on the types of plants sampled and decomposition can affect suitability of the biological material for analysis.
- Lab results are generally not available very soon after sampling, making resampling less likely to be comparable or available.
- Vegetation sample amounts may vary drastically from one sample to the next, both in total weight and in the amount of water in each sample. This makes it harder to collect equivalent samples in the field.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

Up to twenty vegetation samples will be collected in areas where there is thought to be a greater potential for radiological contamination. Samples will consist of at least one gallon of vegetation, including minimal debris and little or no roots. Samples will then be scanned with a radiological instrument for beta and gamma radiation, double-bagged in re-sealable plastic bags, labeled, and transported back to DoR-OR. Samples are then refrigerated in the office lab refrigerator. When enough samples are collected, they are processed and sent to the Tennessee Department of Health (TDH) environmental laboratory in Nashville for radiological analysis.

The samples, which include a background sample, are collected and analyzed for general radiological contamination. Samples will be collected near ORR surface water sites, including springs, creeks, and wetlands, to determine if radioactive contaminants have accumulated in the associated vegetation. The species sampled will be determined based on what is available at the desired sampling locations. Cattails (Typha spp.), watercress (Nasturtium officinale), and willow (Salix spp.) are especially good at bioaccumulating radiological contaminants. In locations where radiological contamination seems possible or even likely, but where cattails, watercress, and willow are not available or not in large enough quantities, mixed floodplain vegetation will be collected. The mixed floodplain vegetation samples will be collected near the edges of water sources, mainly creeks.

A similar method used by the Federal Radiation Monitoring and Assessment Center (FRMAC) for vegetation sampling will be used (NNSA 2012). Only areas large enough to fill at least a gallon bag will be sampled. Sampling mixed floodplain vegetation allows for a wider variety of locations of potential interest to be sampled by not limiting location to certain vegetation types. In general, samples will be taken at locations thought to potentially contain elevated levels of radiological contamination that could be taken up by the nearby vegetation or at sites with previously elevated results. The vegetation will be analyzed for gross alpha and gross beta activity and gamma radionuclides. The results can then be compared to the radiological analysis of vegetation taken from a background location.

6. DELIVERABLES/MILESTONES

Table 2: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State's commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to assess the adequacy of data and to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

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RADNET AIR MONITORING
PROJECT CHARTER
FY2019

Project Lead: Natalie Pheasant

06/30/18

Portions of this RadNet Air Monitoring Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Natalie Pheasant				Initial Release

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1. BACKGROUND

In the past, air emissions from DOE activities on the ORR were believed to have been a potential cause of illnesses affecting area residents. While these emissions have substantially decreased over the years, concerns have remained that air pollutants from current activities (e.g., production of radioisotopes and demolition of radioactively contaminated facilities) could pose a threat to public health, the surrounding environment, or both. As a consequence, TDEC has implemented a number of air monitoring programs to assess the impact of ORR air emissions on the surrounding environment and the effectiveness of DOE controls and monitoring systems. This program provides additional monitoring along with independent third party analysis.

The RadNet Air Monitoring Program on the Oak Ridge Reservation (ORR) began in August of 1996 and provides radiochemical analysis of air samples taken from five air monitoring stations located near potential sources of radiological air emissions on the ORR. RadNet samples are collected by TDEC and analysis is performed at the EPA National Air and Radiation Environmental Laboratory in Montgomery, Alabama (NAREL).

2. PROBLEM STATEMENTS

The three sites on the Oak Ridge Reservation, Oak Ridge National Laboratory (ORNL), Y-12, and East Tennessee Technology Park (ETTP) can potentially release radioactive contaminants into the air from current operations as well as from the deterioration of contaminated buildings on the sites and the decontamination and decommissioning (D&D) of these facilities.

3. GOALS

The goals for this project follow:

- Protect the human health and the environment by assuring the public that the State of Tennessee independently evaluates gross beta activity in air on the ORR with the five RadNet air monitoring stations.
- Determine that levels of gross beta radioactivity are not above regulatory levels for a beta emitter with stringent criteria, and preferably below screening levels requiring additional analysis.
- Compare gross beta levels to levels seen at the RadNet station in Knoxville, used as a background location.
- Compliment the Fugitive Air Project by providing gross beta analysis (and more if screening levels are triggered) as well as providing additional air monitors which provide greater coverage of areas on the ORR.

4. SCOPE

Five high-volume air samplers will be used to monitor the air for radiological contamination in the RadNet Air Monitoring Program. Two of the samplers will be located at Y-12, one near each end of the plant. One unit will be at ETTP, off of Blair Road. Two samplers will be located at ORNL: one in Bethel Valley and one in Melton Valley. An additional air sampler is located and run by the TDEC field office in Knoxville, and will be used for background comparison. The five RadNet air samplers on the ORR will be sampled Mondays and Thursdays except when a sample is skipped due to a holiday. The samples will be analyzed for gross beta and will receive gamma analysis on samples with elevated gross beta levels

(greater than 1 pCi/m^3). Once every four years, the EPA lab will perform uranium and plutonium isotopic analysis on an annual composite[2] of the filters from each station.

4.1 Assumptions

- Air from various locations on the ORR can be monitored with a particulate air sampler
- Beta analysis of air filters will catch most releases of radiological contaminants. These may trigger further analysis.
- Natural variations in gross beta levels will be similar at all ORR sites.
- Small variations due to weather and other factors will be seen at all stations at ambient conditions.

4.2 Constraints

- It is not possible to collect and measure all air emissions from each of the monitored areas.
- The power needed to run the air samplers occasionally goes down.
- Sampler locations and access can be restricted due to site operational or security concerns.
- The EPA RadNet Air Program provides for specific analysis and no other analyses are available through the program.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

The locations of the five RadNet air samplers are provided in Figure 1 and EPA's analytical parameters and frequencies are listed in Table 1. The RadNet air samplers run continuously, collecting suspended particulates on synthetic fiber filters (10 centimeters in diameter) as air is drawn through the units by a pump at approximately 35 cubic feet per minute. DoR-OR collects the filters from each sampler twice weekly. Following EPA protocol (U.S. EPA 1988, U.S. EPA 2006), the filters are then shipped to EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama for analysis.

NAREL performs gross beta analysis on each sample collected. If the gross beta result for a sample exceeds one picocurie per cubic meter (pCi/m3), gamma spectrometry is performed on the sample. Every four years, a composite of the air filters collected from each monitoring station during the year is analyzed for uranium and plutonium isotopes.

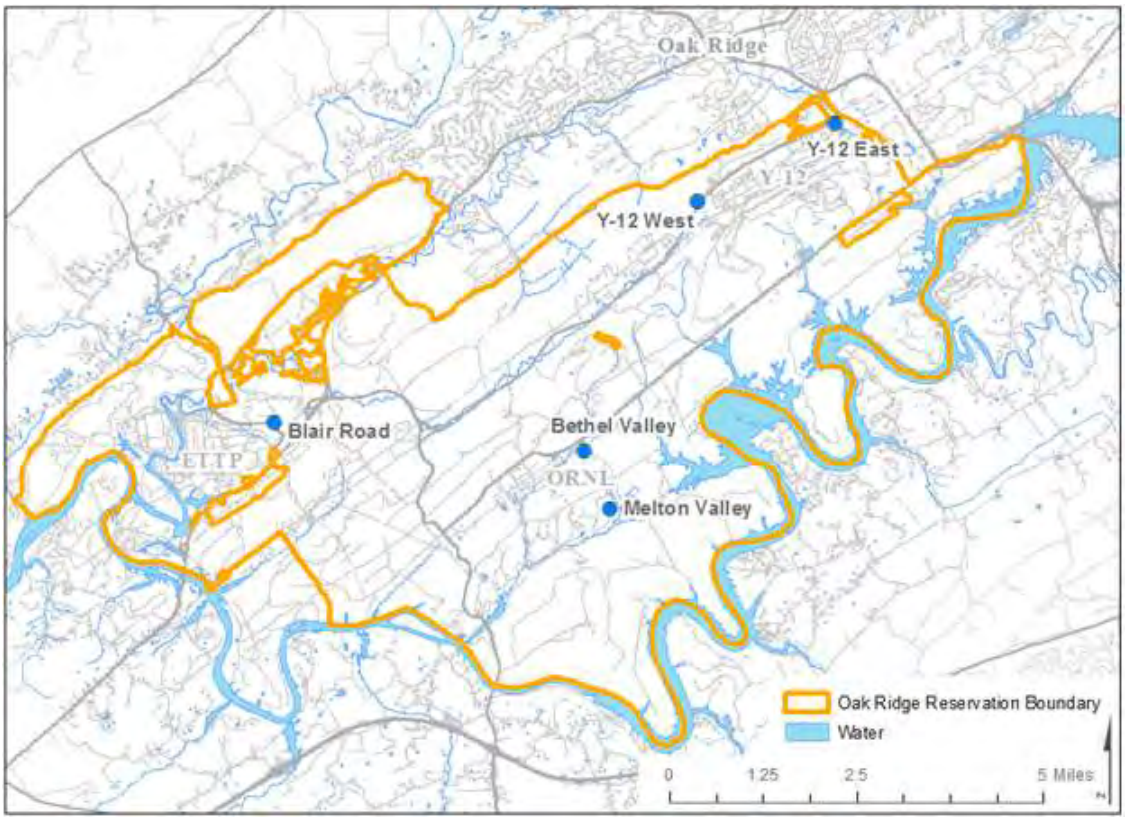

FIGURE 1: Locations of RadNet air monitoring stations on the Oak Ridge Reservation

The results of NAREL's analyses of the nationwide RadNet air data are available at NAREL's website in the Envirofacts RadNet searchable database, via either a simple or a customized search.

TABLE 2: RadNet air monitoring analyses and frequencies

ANALYSIS	FREQUENCY
Gross Beta	Each sample, twice weekly
Gamma Scan	As needed on samples showing greater than 1 pCi/m^3 of gross beta
•Plutonium-238, Plutonium-239, Plutonium-240 •Uranium-234, Uranium-235, Uranium-238	Every four years on an annual composite from each station (started in 2014, previously done annually)

Gross beta from the RadNet Air Monitoring Project will be compared to background data from the RadNet air monitor in Knoxville, Tennessee, and to the Clean Air Act (CAA) environmental limit for strontium-90, because it is a pure beta emitter with a conservative limit.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

ORISE (1993). Environmental Air Sampling Handout from Applied Health Physics Course. Oak Ridge Institute for Science and Education (ORISE).

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U.S. Environmental Protection Agency (2017). NAREL RadNet Data links.
Envirofacts RadNet Searchable Database:
search http://iaspub.epa.gov/enviro/erams_query_v2.simple_query
customized search https://www.epa.gov/enviro/radnet-customized-search

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
Annual Composite Sample	A collection of portions from each sample (a filter, in the case of air samples) collected at that sampling station that year, which is combined and analyzed as a whole.

RADNET DRINKING WATER SAMPLING PROJECT CHARTER FY 2019

Project Lead: Natalie Pheasant

06/30/18

Portions of the RadNet Drinking Water Sampling Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Natalie Pheasant				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS 6

1. BACKGROUND

The RadNet program was developed by EPA to ensure public health and environmental quality as well as to monitor potential pathways for significant population exposures from routine and accidental releases of radioactivity (U.S. EPA, 1988). The RadNet Drinking Water program provides quarterly radiological sampling of finished water at public water supplies near major population centers throughout the United States. The RadNet Drinking Water program in the Oak Ridge area provides for radiochemical analysis of finished water at four public water supplies located near and on the Oak Ridge Reservation (ORR). Quarterly samples are collected by TDEC and analysis for radiological contaminants is performed at the EPA National Analytical Radiation Environmental Laboratory (NAREL).

Radioactive contaminants released on the ORR can potentially enter local streams and be transported to the Clinch River. While monitoring of the river and local water treatment facilities has indicated that concentrations of radioactive pollutants are below regulatory standards, a concern that area water supplies could be impacted by ORR pollutants remains. The RadNet program also provides a mechanism to evaluate the impact of DOE activities on area water systems and to supplement DOE monitoring, providing independent, third-party analysis.

2. PROBLEM STATEMENTS

Past and present radiological contamination on the three sites of the ORR can potentially enter local streams and be transported to the Clinch River and into the local drinking water supply.

3. GOALS

Protect the human health and the environment by assuring that the public drinking water is safe.

- Monitor drinking water to detect radiological contaminants that might be related to the releases of radioactivity from the ORR
- Provide data indicating additional sampling needs or other actions required to ensure public health and environmental quality
- Provide reference data to facilitate evaluation of water quality

4. SCOPE

The RadNet Drinking Water program collects quarterly finished water samples from each of four local water treatment plants ranging from upstream of the City of Oak Ridge along the Clinch River to downstream of the ORR in Kingston, Tennessee. Tritium analysis is performed on each quarterly sample. Other radiological analysis is performed annually.

4.1 Assumptions

Basic assumptions:

- Anomalies in radiological contaminant levels can be detected
- Natural variations in detected levels of radiation will be similar at all RadNet Drinking Water sites

4.2 Constraints

- Data might not be reliable because of dilution provided by the Clinch and Tennessee River as well as their tributaries.
- Quarterly sampling only captures contaminant levels at that point in time and may not be indicative of levels at other points in time.
- Annual and composite analysis could potentially miss smaller releases. However, if a radiological release is known to have occurred, EPA will generally analyze each sample rather than a composite.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

In the Oak Ridge RadNet Drinking Water Program, EPA provides radiochemical analysis of finished drinking water samples taken quarterly by TDEC at four public water supplies located on and in the vicinity of the ORR. The 3.5 liter samples are collected from each of four area water treatment plants using procedures and supplies prescribed by EPA protocol (U.S. EPA, 1988; U.S. EPA, 2013). The samples are analyzed at NAREL for tritium, iodine-131, gross alpha, gross beta, strontium-90, and gamma spectrometry, with further analysis performed when warranted. The analytical frequencies and parameters are provided in Table 2.

The four locations sampled in the Oak Ridge area (listed from upstream to downstream) on the Clinch and then Tennessee River are the Anderson County Water Authority Water Treatment Plant (background location), the Y-12 Water Treatment Plant (run by the city of Oak Ridge), the West Knox Utility District Water Treatment Facility, and the Kingston Water Treatment Plant. Figure 1 depicts the locations of the raw water intakes associated with these facilities.

The results of NAREL's analyses are available, along with nationwide data, at NAREL's website in the Envirofacts RadNet searchable database, via either a simple or a customized search (websites listed in references).

TABLE 2: RadNet Drinking Water Analyses

ANALYSIS	FREQUENCY
Tritium	Quarterly
Iodine-131	Annually on one individual sample/sampling site
Gross Alpha, Gross Beta, Strontium-90, Gamma Scan	Annually on composite samples
•Radium-226 •Uranium-234, Uranium-235, Uranium-238 •Plutonium-238, Plutonium-239, Plutonium-240	Annually on samples with gross alpha >2 pCi/L
Radium-228	Annually on samples with Radium-226 between 3-5 pCi/L

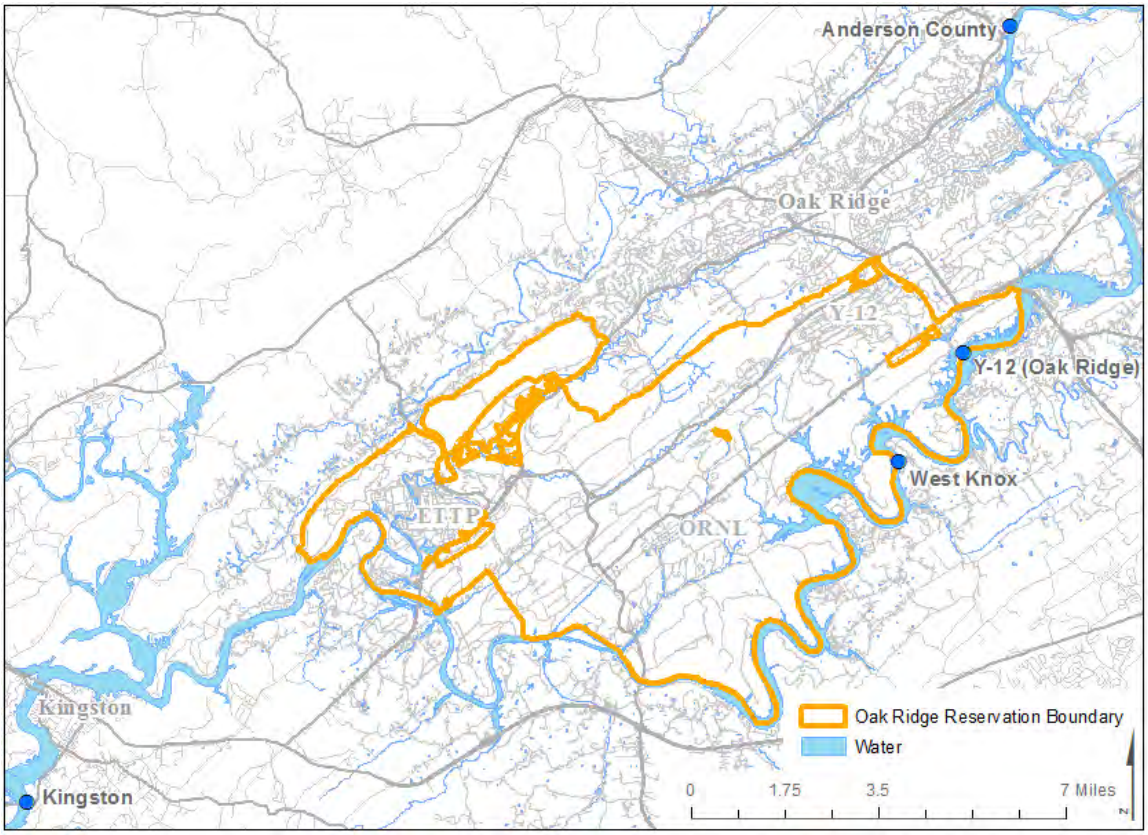

FIGURE 1: RadNet Drinking Water Facility Intakes

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Argonne National Laboratory (2007). Radiological and Chemical Fact Sheets to Support Health Risk Analyses for Contaminated Areas. Human Health Fact Sheet: Potassium-40. https://www.remm.nlm.gov/ANL_ContaminantFactSheets_All_070418.pdf

U.S. Environmental Protection Agency (1988). Environmental Radiation Ambient Monitoring System (ERAMS) Manual. EPA 520/5-84-007, 008, 009.

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U.S. Environmental Protection Agency (2017). NAREL RadNet Data links.
Envirofacts RadNet Searchable Database:
search http://iaspub.epa.gov/enviro/erams_query_v2.simple_query
customized search https://www.epa.gov/enviro/radnet-customized-search

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

RADNET PRECIPITATION MONITORING PROJECT CHARTER FY 2019

Project Lead: Natalie Pheasant

06/30/18

Portions of the RadNet Precipitation Monitoring Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Natalie Pheasant				Initial Release

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1. BACKGROUND

Nationwide, the RadNet Precipitation Monitoring Project measures radioactive contaminants that are washed out of the atmosphere and carried to the earth's surface by precipitation. On the Oak Ridge Reservation (ORR), the RadNet Precipitation Monitoring Project provides radiochemical analysis of precipitation samples taken from monitoring stations at three locations. Samples are collected by DoR-OR and analysis is performed at EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama. While there are no standards that apply directly to contaminants in precipitation, the data provides an indication of the presence of radioactive materials that may not be evident in the particulate samples collected by the DoR-OR air monitors.

EPA has provided three precipitation monitors which are co-located at RadNet air stations at each of the ORR sites. One is in Melton Valley, in the vicinity of ORNL. Another is east of ETTP off Blair Road. The third is with the RadNet air station east of Y-12. The first precipitation monitor provided by EPA is located at ORNL in Melton Valley in the vicinity of ORNL's HFIR (High Flux Isotope Reactor) and the Solid Waste Storage Area 5 (SWSA5) burial grounds. The second precipitation monitor is located off Blair Road to monitor contaminants from demolition activities at ETTP. The third station is located at the east end of Y-12. In addition to monitoring Y-12, this station could potentially provide an indication of any gamma radioisotopes traveling towards the city of Oak Ridge from ORNL. Analysis for gamma radionuclides is performed on the monthly composite samples for each of the three precipitation monitoring locations. Figure 1 depicts the locations of the RadNet Precipitation samplers.

2. PROBLEM STATEMENTS

The three sites on the ORR, ORNL, Y-12, and ETTP can potentially release radioactive contaminants into the air from current operations as well as from the deterioration of contaminated buildings and the decontamination and decommissioning (D&D) of these facilities.

This project measures radioactive contaminants that are washed out of the atmosphere and reaches the earth's surface through precipitation. The data provides an indication of the presence of radioactive materials that may not be evident in the particulate samples collected by air monitors.

3. GOALS

The goal of the RadNet Precipitation Monitoring Project is to measure radioactive contaminants that are washed out of the atmosphere and reach the earth's surface through precipitation. It compares results of drinking water limits used by EPA as conservative reference values to assure the public that human health and the environment are being protected. The results from the project can also be used to identify anomalies in radiological contaminant levels, to assess the significance of precipitation in contaminant pathways, to evaluate associated control measures, to appraise conditions on the ORR compared to other locations in the nationwide EPA RadNet Program, and to determine levels of local contamination in the case of a nuclear disaster anywhere in the world.

4. SCOPE

Three precipitation samplers will be used to monitor the precipitation for radiological contamination. Each sampler is co-located at RadNet air stations at each of the three ORR

sites. One sampler is located at the east end of the Y-12 plant. One unit is at ETTP, off of Blair Road. The third sampler is located at ORNL in Melton Valley. The three RadNet air samplers on the ORR will be sampled Mondays and Thursdays, except when a sample is skipped due to a holiday. The samples will be composited monthly at the EPA lab and analyzed for gamma radionuclides. Additional analysis on individual samples would likely be run in the event of a large release.

1.1 Assumptions

Basic assumptions:

- Gamma analysis of monthly composite precipitation samples will indicate most releases of radiological contaminants; however, further analysis may be warranted.
- Anomalies in radiological contaminant levels can be detected.
- Natural variations in gamma levels will be similar at all ORR sites.

1.2 Constraints

- This project only monitors potential radiological emissions when there is a precipitation event that the plume passes through.
- Monthly composite analysis could potentially miss smaller releases. However, if a radiological release is known to have occurred, EPA will generally analyze each sample rather than a composite.

1.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

The precipitation samplers provided by EPA's RadNet project are used to collect samples for the RadNet Precipitation Project. Each sampler drains precipitation that falls on a 0.5 square meter fiberglass collector into a five-gallon plastic collection bucket. A sample is measured, then collected from the bucket (in a four-liter Cubitainer®). and sent to EPA when a minimum of two liters of precipitation has accumulated in the Cubitainer®, or potentially less than that if it is the final sample of the month. The sample is processed as specified by EPA (US EPA 1988, US EPA 2013) and is shipped to NAREL in Montgomery, Alabama, for analysis. The NAREL laboratory composites the samples collected during a month for each station and analyze each composite by gamma spectrometry/gamma radionuclides. Not all gamma isotopes have EPA drinking water limits, so only those that do are compared and only those that have been seen in RadNet Precipitation samples.

Since there are no regulatory limits for radiological contaminants in precipitation, the results of the gamma analyses are compared to drinking water limits used by EPA as conservative reference values. EPA's Radionuclides Rule for drinking water allows gross

TABLE 2: EPA Drinking Water Limits (MCLs) for select isotopes

Isotope	EPA limit (pCi/L)
Barium-140 (Ba-140)	90
Beryllium-7 (Be-7)	6,000
Cobalt-60 (Co-60)	100
Cesium-134 (Cs-134)	80
Cesium-137 (Cs-137)	200
Tritium (H-3)	20,000
Iodine-131 (I-131)	3

alpha levels of up to 15 picocuries per liter (pCi/L), while beta and photon emitters are limited to four millirem (mrem) per year and are radionuclide specific. The results from ORR sampling locations are compared to EPA's drinking water limits and can also be compared to data from other sites nationwide. While the stations located on the ORR are in areas near nuclear sources, most of the other stations in the RadNet Precipitation Monitoring Project are located near major population centers, with no major sources of radiological contaminants nearby. Table 2 shows the maximum contaminant levels (MCLs) of beta and photon emitters that EPA uses as drinking water limits for select isotopes.

The results of NAREL's analyses are available at NAREL's website in the Envirofacts RadNet searchable database, via either a simple or a customized search. The data are used to identify anomalies in radiological contaminant levels, to assess the significance of precipitation in contaminant pathways, to evaluate associated control measures, to appraise conditions on the ORR compared to other locations in the RadNet project, and to determine levels of local contamination.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

U.S. Environmental Protection Agency (1988). Environmental Radiation Ambient Monitoring System (ERAMS) Manual. EPA 520/5-84-007, 008, 009.

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U.S. Environmental Protection Agency (2015). Derived Concentrations of Beta and Photon Emitters in Drinking Water. https://www.epa.gov/sites/production/files/2015-09/documents/guide_radionuclides_table-betaphotonemitters.pdf

U.S. Environmental Protection Agency (2017). NAREL RadNet Data links.
Envirofacts RadNet Searchable Database:
•search http://iaspub.epa.gov/enviro/erams_query_v2.simple_query
•customized search https://www.epa.gov/enviro/radnet-customized-search

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

RAIN EVENT
PROJECT CHARTER
FY 2019

Project Lead: Robert Bishop

06/30/18

Portions of the Rain Event Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Robert Bishop				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
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1. BACKGROUND

The Oak Ridge Reservation (ORR), a government-owned, contractor-operated facility, contains three major operating sites: the Y-12 National Security Complex (Y-12), Oak Ridge National Laboratory (ORNL), and East Tennessee Technology Park (ETTP). The ORR was established in the early 1940s as part of the Manhattan Project that produced the materials for the first atomic bombs. That work and subsequent research, development, and production activities, have involved and continue to involve radiological and hazardous materials.

On November 21, 1989, the Environmental Protection Agency (EPA) added the ORR to the National Priorities List. The State of Tennessee, the EPA, and the Department of Energy (DOE) entered into a Federal Facility Agreement (FFA) under Section 1200 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) in November 1991.

As of November 2017, DOE lists more than 400 sites at ETTP, more than 300 sites at ORNL, more than 100 sites at Y-12, and at least 8 sites off the ORR – each of which are under the guidelines of CERCLA. In June of 2017 there was removal of an estimated 12,500 cubic yards of contaminated soils in progress at ETTP, with an estimated soil excavation at Y-12 of more than 80,000 yards and greater than 100,000 cubic yards excavation estimated for ORNL.

Rain water and groundwater is not static. It accumulates, pools, and makes its way into basements, basins, and soil excavations (from decontamination and decommissioning (D&D) and remedial action (RA) activity sites. Most of this water accumulation contains at least one contaminant required to be treated before discharging it to the environment. (Estimated volumes of this water at ETTP range from 200 gallons to 1.5 million gallons.)

2. PROBLEM STATEMENTS

- Contamination from legacy and ongoing activities can be disturbed and transported beyond the physical boundaries of the ORR by D&D or RA activities during a rain event.
- Water can accumulate in D&D or RA areas through entry into basins, sumps, basements, or during soil remediation activities. Accumulated water may become contaminated and dispersed into the environment.

3. GOALS

The goal of this project is to obtain the data to evaluate DOE's remedial actions and to provide input into the future of cleanup decisions. Actions to achieve this goal follow:

- Monitor storm drains near remediation activities to gather data for evaluations of D&D activities.
- Review and comment on documents related to D&D work.
- Use split and or independent sampling to monitor releases into the environment.
- Observe D&D and RA activities to ensure compliance with TDEC, EPA, and DOE negotiated and agreed to discharge criteria.
- Review DOE sampling results, to ensure compliance with negotiated and agreed to criteria for release.

4. SCOPE

A rain event is defined by the Division of Water Quality QS-SOP for Chemical & Bacteriological Sampling of Surface Water (TDEC, 2011) as greater than or equal to 0.25 inches of rain in the last 24 hours prior to sample collection during the wet season (January to March) or greater than or equal to 0.5 inches of rain in the last 24 hours prior to sample collection during the dry season (August to October). Samples taken in months outside of this definition will be taken after a measurable rain of 0.5 inches or greater. The scope of this project is to assess, monitor, sample, observe, and analyze data pertaining to rain events associated with DOE's remedial actions. Please refer to Tables 1 and 2.

Table 1: Boundaries – In-Scope Tasks

BOUNDARIES – IN-SCOPE TASKS
Samples taken during D&D and RA activities will ensure release criteria are being met.
All samples will be collected, preserved, and shipped following approved TN Division of Water Resources, TN. Department of Health (TDEC, 2011), and TN DOR-OR office standard operating procedures.
Independent sampling will occur to confirm DOE sampling results.
Operations will be observed to ensure compliance with site-specific performance documents.
Possible new or ongoing releases to the environment, (which are not being monitored by DOE), may warrant the sampling of seeps, drains, burial grounds, etc.

Table 2: Boundaries – Out-Of-Scope Tasks

BOUNDARIES – OUT-OF-SCOPE TASKS
Sampling at a permitted outfall within the defined parameters of the NPDES permit.
Sampling during or after rain events that do not meet the stated precipitation volumes.

4.1 Assumptions

- Legacy contaminants are transported offsite or into receiving bodies of water during or following a rain event.
- Staff will be available for field work on short notice to perform sampling when notification is given by DOE.
- During D&D and RA, not all Contaminants of Concern (COC's) are kept within the facility boundaries or transported offsite for final disposal.
- During D&D and RA, COC's that have entered containment areas, sumps, and storm drains may not be detected by the sampling performed under parameters set forth by the National Pollutant Discharge Elimination System (NPDES) Permit.

4.2 Constraints

- Availability of DOE to accompany and facilitate entry to work areas.
- Availability of DoR personnel to assist with sampling.
- Availability of a suitable vehicle to transport equipment and personnel to sampling sites.
- Lack of or late notification by DOE concerning water discharges.

4.3 Stakeholders

Table 3: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

Sample collection will be conducted following the guidelines set forth in the *Tennessee Department of Environment and Conservation's, Division of Water Quality QS-SOP for Chemical & Bacteriological Sampling of Surface Water Revision 3* (TDEC, 2011). A brief treatment of the sampling procedure is described in the paragraphs that follow.

If the surface water body can be waded, the easiest way to collect a sample is by the dip method. Sampler should face upstream so that sample can be taken without collecting disturbed sediment. Sampler loosens the lid of the sample container, submerges the container and finishes removing lid. If possible, after sample is collected, lid is replaced under water.

For samples, containing a preservative, bottles must be closely observed and when the sample volume reaches the neck of the bottle, the bottle is removed from the flow. This ensures that the sample preservative is not diluted or allowed to enter the stream.

If the sampler has any concern using the direct method on a preserved sample, then the sampler may employ the dip method. The sample is taken by dipping a clean non-preserved bottle and transferring the sample collected into the prepared sample container. This can be accomplished from either sampling by hand or from attaching the dip bottle to a device that will allow the sampler to extend their reach safely. Care must be taken not to touch the dip container to the prepared sample bottle.

Samples of water that have to be pumped from a location will be done after enough water transfer has occurred to allow for purging of the transfer line. Samples will be taken randomly to attempt to get a representative sample.

Sampling Plan

Samples will be collected at storm drains (for oversight of D&D work) on a quarterly basis. At discharge points for surface impoundments and other locations samples will be collected as needed. Refer to Table 4 for analysis methods.

Table 4: Laboratory Analysis

Analysis	State Laboratory Analysis Method
ICP Digestion	200.2
Metals IP-OES	200.7
Metals IP-MS	200.8
Total Suspended Solids	2540-D
Hexavalent Chrome	218.6
PCB's	8082
Mercury	245.1
Gamma Analysis	901.1
Gross Alpha/Beta	D7283-13
Strontium 90	D5811
Technetium 99	TWC02
Isotopic Uranium	U-02-RC
Tritium	906

6. DELIVERABLES/MILESTONES

Table 5: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Tennessee Department of Environment and Conservation, Division of Remediation-ORO, Health and Safety Plan. Oak Ridge, Tennessee. 2017

Tennessee Department of Environment and Conservation, Division of Remediation-ORO, SOP for Shipping Samples to Nashville Lab, Oak Ridge, Tennessee March, 2015

Tennessee Department of Environment and Conservation, Division of Remediation-ORO, Standard Operating Procedure for Rain Event Monitoring. Oak Ridge, Tennessee. December 2017.

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The United States Environmental Protection Agency Region IV and The United States Department of Energy and The Tennessee Department of Health and Environment Federal Facility Agreement UNDER SECTION 120 OF CERCLA AND SECTION 3008 (h) AND 6001 OF RCRA, 1991

Remediation Activities on the Oak Ridge Reservation, presentation by DOE, June 2017.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

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REAL TIME MONITORING OF GAMMA RADIATION ON THE OAK RIDGE RESERVATION

FY 2019

Project Lead: Gary Riner

06/30/18

Portions of the Real Time Monitoring of Gamma Radiation on the Oak Ridge Reservation Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Gary Riner				Initial Release

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1. BACKGROUND

The K-25 Gaseous Diffusion Plant, ETTP, began operations in World War II as part of the Manhattan Project. Its original mission was to produce uranium enriched in the uranium-235 isotope (U-235) for use in the first atomic weapons and later to fuel commercial and government-owned reactors. The plant was permanently shut down in 1987. As a consequence of operational practices and accidental releases, many of the facilities scheduled for decontamination and decommissioning (D&D) at ETTP are contaminated to some degree. Uranium isotopes are the primary contaminants, but technetium-99 and other fission and activation products are also present, due to the periodic processing of recycled uranium obtained from spent nuclear fuel.

The Y-12 Plant was also constructed during World War II to enrich uranium in the U-235 isotope, in this case by the electromagnetic separation process. In ensuing years, the facility was expanded and used to produce fuel for naval reactors, to conduct lithium/mercury enrichment operations, to manufacture components for nuclear weapons, to dismantle nuclear weapons, and to store enriched uranium.

Construction of the X-10 Plant (now known as the Oak Ridge National Laboratory) began in 1943. While the K-25 and Y-12 plants initial missions were the production of enriched uranium, the ORNL site focused on reactor research and the production of plutonium and other activation and fission products. These were chemically extracted from uranium irradiated in ORNL's graphite reactor and later at other ORNL and Hanford reactors. During early operations, leaks and spills were common in the facilities and associated radioactive materials were released from operations as gaseous, liquid, and solid effluents, with little or no treatment (ORAU, 2003). The EMWMF was constructed in Bear Creek Valley near the Y-12 National Security Complex to dispose of low-level radioactive waste and hazardous waste generated by remedial activities on the reservation.

2. PROBLEM STATEMENTS

Facilities on the ORR have the potential to release variable amounts of gamma radiation. Monitoring in the project focuses on the measurement of exposure rates under conditions where gamma emissions can be expected to fluctuate substantially over relatively short periods. There is a potential for an unplanned release of gamma emitting radionuclides to the environment.

3. GOALS

Monitored sites will be compared to the State limit (2 mrem in any one hour period) for the maximum dose to an unrestricted area, and the State and DOE primary dose limits for members of the public (100 mrem/year).

4. SCOPE

Candidate monitoring locations include remedial activities, waste disposal operations, pre- and post-operational investigations, and environmental response activities. Anomalous results from DoR-OR's environmental dosimetry program may warrant additional monitoring. Data recorded by the monitors are to be evaluated by comparing the data to background concentrations and the State maximum dose limit.

4.1 Assumptions

There are no assumptions pertaining to this project.

4.2 Constraints

- Placement of the gamma radiation monitoring instrument can be less than optimal due to facility operational constraints because placement cannot interfere with traffic or access.
- Monitor placement is limited to locations where security of the instrument can be assured. At most locations, the monitor can be chained and locked for security.
- Monitoring data must be downloaded manually requiring the technician to visit the site. Results may be delayed preventing timely response to anomalies.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

The gamma exposure rate monitors deployed in the program are manufactured by Genitron Instruments and are marketed under the trade name GammaTRACER®. Each unit contains two Geiger Mueller tubes, a microprocessor controlled data logger, and lithium batteries sealed in a weather resistant case to protect the internal components. The instruments can be programmed to measure gamma exposure rates from one μrem/hour to one rem/hour at predetermined intervals from one minute to two hours. The results reported are the average of the measurements recorded by the two Geiger Mueller detectors. The data for any interval from each detector can be accessed. The results recorded by the data loggers are downloaded to a computer by DoR-OR personnel using an infrared transceiver and associated software.

6. DELIVERABLES/MILESTONES

Table 2: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A:

None.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.

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SEDIMENT TRAPS

PROJECT CHARTER
FY 2019

Project Lead: John (Tab) Peryam

06/30/18

Portions of the Sediment Traps Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John (Tab) Peryam				Initial Release

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1. BACKGROUND

A sediment trap project has been implemented each year since 2015. The project began with the monitoring of sediment quality at six locations on or near the Oak Ridge Reservation (ORR). This project has evolved over the years, resulting in changes in locations and frequencies of sampling. This program monitors for sediment contaminants in waterways that have been impacted by past and present activities on the ORR.

Contaminated sediments can directly impact benthic life and pose detrimental indirect effects on other organisms, including humans, through bioaccumulation and subsequent transfer through the food web. Sediment-associated contaminants are accepted as an important ongoing environmental problem that impacts the uses of many water bodies. In order to assess the degree of contamination at the benthic level, attributable to the activities of the DOE, the Tennessee Department of Environment and Conservation (TDEC), Department of Remediation (DoR) Oak Ridge Office (OR) is collecting sediment samples for chemical analysis from tributaries of the Clinch River that drain the ORR.

2. PROBLEM STATEMENTS

ORR exit pathway streams are subject to contaminant releases from activities at ETTP, ORNL, and Y-12. These contaminant releases have been detrimental to stream health in the past and present. Identified issues include:

- From 1950 to 1963, Y-12 released approximately 100 metric tons of elemental mercury to East Fork Poplar Creek by spills and leakage from subsurface drains, building foundations, contaminated soil, and purposed discharge of wastewater containing mercury. (Turner and Southworth, 1999)
- East Fork Poplar Creek is believed to contribute approximately 0.2 metric tons of mercury to the Clinch River each year. (DOE, 1992)
- Besides mercury other metals that have been found in ORR exit pathway streams at levels greater than background are cadmium, chromium, lead, nickel, silver and zirconium. (DOE, 1992)
- Water supply facilities, serving an estimated population of 200,000 persons, on the Tennessee River downstream of White Oak Creek have the potential of being influenced by streams that drain the ORR. (DOE, 1992)
- ORNL has been releasing low-level radioactive liquid wastes to the Clinch River via White Oak Creek since 1943. (Pickering, 1970)
- The Clinch River received approximately 665 curies of cesium-13 (Cs-137) from White Oak Creek from 1954 to 1959. (DOE, 1992)

3. GOALS

The goals of this project are:

- Determine stream health through sampling and analysis of suspended sediment.
- Assess site remediation efforts through long-term monitoring of suspended sediment.
- Identify trends in data, based on findings, and use those trends to make recommendations in order to improve sediment quality and the health of affected streams.

4. SCOPE

This project will provide independent data to assist in the evaluation of streams that drain the ORR.

4.1 Assumptions

The assumptions for the project are:

- Cesium-137 and Sr-90 contamination was and continues to be released to streams on the ORR due to past and current activities.
- Mercury contamination of East Fork Poplar Creek is attributable to past and current releases from activities at Y-12.

4.2 Constraints

A few constraints may impact this project:

- Access to DOE facilities and property.
- Inadequate funding to support laboratory analytical costs.
- Unavailability of staff for field work for extended periods of time.

Note: White Oak Creek will not be sampled due to significant levels of Sr-90 sediment contamination. Samples taken there typically cannot be removed from ORNL due to radiological contamination.

4.3 Stakeholders

Table 1: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

In order to monitor for changes in contaminant flow through sediment transport, passive sediment samplers (traps) are deployed. Annual sampling is proposed for the major exit pathway streams of the ORR; including but not limited to Northwest Tributary 5 of Bear Creek (NT5), East Fork Poplar Creek, and Mill Branch. Mill Branch is a background location. Samples will be retrieved from the sediment traps at scheduled intervals throughout the year.

Sediment samples will be analyzed for metals (arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, uranium, and zinc) and radiological parameters (Sr-90 and Cs-137). The metals data will be compared to the Consensus-Based Sediment Quality Guidelines (CBSQGs) (MacDonald et al. 2000). Radiological data will be compared to data from background locations. Note: Sampling will not be conducted at White Oak Creek due to the Sr-90 levels in the sediment.

Method Summary

The standard operating system used for this project is the TDEC DoR-OR Standard Operating Procedure for Sediment Trap Sampling (TDEC DoR-OR 2017). Suspended sediment samples may be collected by using fixed sediment collection devices (traps). Sediment traps are installed in a stream bed in a position where considerable flow through the body of the trap occurs. Suitable sites are limited in a stream and careful consideration must be given to selecting installation locations for the sediment traps. Sufficient flow and adequate depth must be sufficient to completely immerse the sediment traps.

Following a collection period of a minimum of six months, the collected sediment is emptied from a sediment trap and is transferred to a clean bucket where the sediment is allowed to settle on ice for 24 to 48 hours. After the sediment is allowed to settle, the supernatant water is carefully drawn off the sample with a peristaltic pump. Sediment samples are spooned from the bucket into sample containers of appropriate size and construction for the requested analyses.

Table 2: Potential Sampling Locations

Monitoring Location	DWR ID	Alt. ID	Monitoring Rationale	Latitude	Longitude
East Fork Poplar Creek Mile 14.5	EFPOP014.5AN	EFK 23.4	Surveillance of suspended sediment at point where EFPC leaves DOE property.	35.99596	-84.24
Northwest tributary 5 of Bear Creek	BEAR006.5T0.1AN	NT5	Sediment depositional area downstream of EMWF.	35.96603	-84.2902
Mill Branch Mile 1.0	FECO67I12	MBK 1.6	Surveillance of suspended sediment at a background site.	35.9856	-84.2872

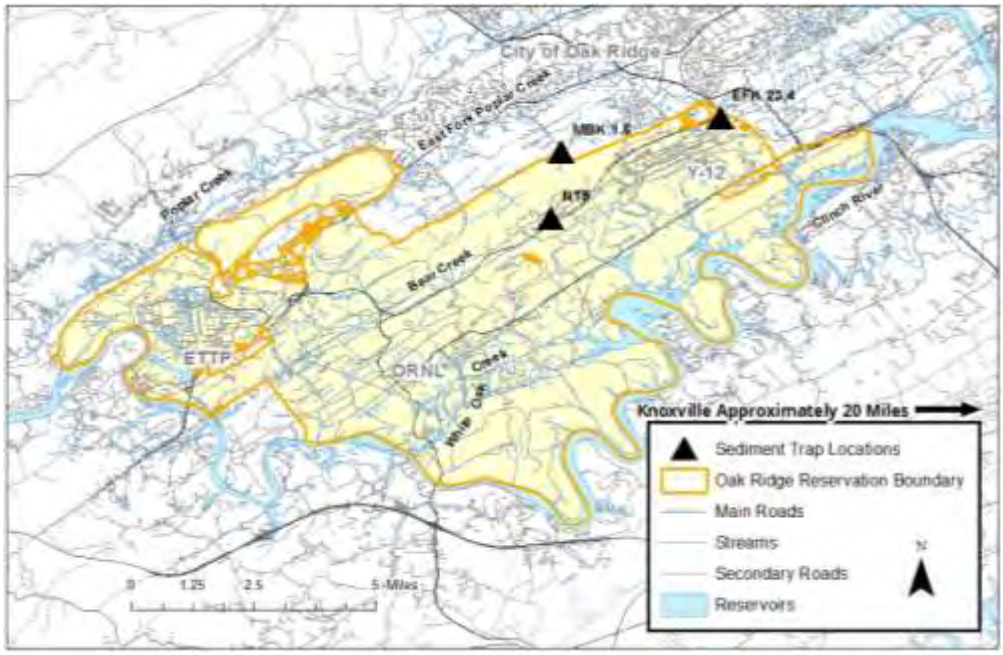

Figure 1: Map of Potential Sampling Stations

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

DOE. (1992). Federal Facility Agreement (FFA). Appendices for the Oak Ridge Reservation. Oak Ridge Site Description – UCOR, Appendix B (2017 revision). DOE/OR-1014. Retrieved from http://www.ucor.com/_docs/ffa/appendices/appendb.pdf

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Pickering, R. (1970). Composition of Water in Clinch River, Tennessee River, and Whiteoak Creek as Related to Disposal of Low-Level Radioactive Liquid Wastes. (Geological Survey Professional Paper No. 433–J). Retrieved from https://pubs.usgs.gov/pp/0433j/report.pdf

TDEC DoR-OR. (2017). Quality System Standard Operating Procedure for Sediment Trap Sampling. Tennessee Department of Environment and Conservation, Division of Remediation, Oak Ridge Office, Oak Ridge, Tennessee.

Turner, R. R., & Southworth, G.R. (1999). Mercury-Contaminated Industrial and Mining Sites in North America: an Overview with Selected Case Studies. In R. Ebinhaus, R. R. Turner, L. D. de Lacerda, O. Vasilev, & W. Salomons (Eds.), Environmental Science: Mercury Contaminated Sites. Springer-Verlag.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
Station	A specific location where sampling of surface water takes place.

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SURFACE WATER MONITORING AT THE EMWMF

PROJECT CHARTER

FY 2019

Project Lead: Don Gilmore

06/30/18

Portions of this Surface Water Monitoring at the EMWMF Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Don Gilmore				Initial Release

1. BACKGROUND 1

2. PROBLEM STATEMENTS 1

3. GOALS 2

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4.1 Assumptions 4

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APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS 9

1. BACKGROUND

The Environmental Management Waste Management Facility (EMWMF) was constructed for the disposal of low-level radioactive waste and hazardous waste generated by remedial activities on the ORR and is operated under the authority of CERCLA. While the facility holds no permit from any state agency, it is required to comply with substantive portions of relevant and appropriate legislation contained in the CERCLA ROD (DOE, 1999) and DOE directives developed to address responsibilities delegated to the agency by the Atomic Energy Act of 1946.

Currently, the only authorized discharge from EMWMF is contaminated storm water (contact water), which tends to pond in the disposal cells above the leachate collection system. The contact water is routinely pumped from the disposal cells to holding ponds and tanks and then it is sampled. Based on the results, it is either treated onsite or released to a storm water sedimentation basin which discharges to the NT-5 tributary of Bear Creek.

The EMWMF was designed with a 5% slope along the centerline of each disposal cell to direct storm water and leachate to the southern (lower) end of the cells (Williams, 2004). This design feature, along with the abundant rainfall of the region and low porosity native soils used as a protective layer over the leachate collections system, have resulted in excessive pooling of the contact water at the lower end of the cells (Williams, 2004). Heavy rainfall the first year of operations resulted in the storm water and associated leachate overflowing the cell berms, releasing contaminants to adjacent land and into the NT-5 tributary. To avoid similar incidents, the allowable release limits at the contact water ponds were relaxed and the compliance point moved from the ponds to the discharge from the storm water sedimentation basin.

The limits on releases from the holding ponds/tanks to the sedimentation basin are based on requirements contained in DOE Order 5400.5 which restricts the release of liquid wastes containing radionuclides to an average concentration equivalent to 100 mrem/year. The limit for discharges from the sedimentation basin to NT-5 are based on state regulations (TDEC 0400-20-11-.16{2}) restricting concentrations of radioactive material released to the general environment in groundwater, surface water, air, soil, plants, or animals to an annual dose equivalent of 25 mrem. In addition, DOE Order 458.1 limits gross alpha and gross beta activity of settle-able solids in liquid effluents to 5.0 pCi/g and 50 pCi/g, respectively.

2. PROBLEM STATEMENTS

- Contaminated materials from CERCLA remediation activities are buried in the EMWMF.
- These contaminants may leach out and enter the environment. Rain water or surface water may carry these contaminants off site in concentrations or activities above agreed-to limits.

3. GOALS

The Surface Water Monitoring of the EMWMF Project aims to accomplish the following goals:

- To provide assurance through the independent monitoring efforts and evaluation of DOE's data that operations at EMWMF are protective of public health and the environment and meet the remedial effectiveness objectives.
- To verify that DOE discharges of contaminated storm water (storm water that has contacted waste) into Bear Creek without treatment comply with the established limits and operational requirements.
- To provide independent data on discharges from the underdrain and to evaluate its effectiveness in lowering the groundwater table under the landfill.

4. SCOPE

The Surface Water Monitoring of the EMWMF Project proposes each of the following tasks:

- To monitor water parameters leaving the EMWMF, continuous water quality parameters will be taken at two locations: EMWMF-2 (underdrain) and EMWMF-3 (Sediment Basin v-weir discharge).
- Staff will monitor these sites at least twice weekly with the use of a YSI-Professional Plus water quality instrument or equivalent.
- To ensure contaminants from the cell are not adversely affecting the surrounding environment, water samples will be collected on a routine basis from select sites.
- Sediment samples will be collected from the sediment basin as available. These samples will be composited into one sample for analysis
- To ensure best practices are utilized to limit contaminant migration, site visits will be made at least twice weekly to monitor ongoing activities at the EMWMF.
- To ensure EMWMF is meeting its operational requirements, discharge data collected by EMWMF will be reviewed quarterly.
- TDEC will collect confirmation samples identified in Table 1 and shown in Figure 1.
- Samples will be collected from the weirs (EMWMF-2 monthly and EMWMF-3 quarterly).
- DOE collects samples quarterly from EMWMF-1 (GW-918) and DoR-OR will analyze the samples quarterly.
- EMWMF-3A and EMWMF-4B will be sampled and analyzed semi-annually.
  Note: This is a total of 23 samples for analysis.

- To ensure best practices are utilized to limit contaminant migration, site visits will be performed to monitor ongoing activities at EMWMF.

Table 1 and Figure 1 depict locations of interest, analytes, and rationale for sampling at the EMWMF as laid out in the methods, materials, and metrics (Task 1 and Task 2).

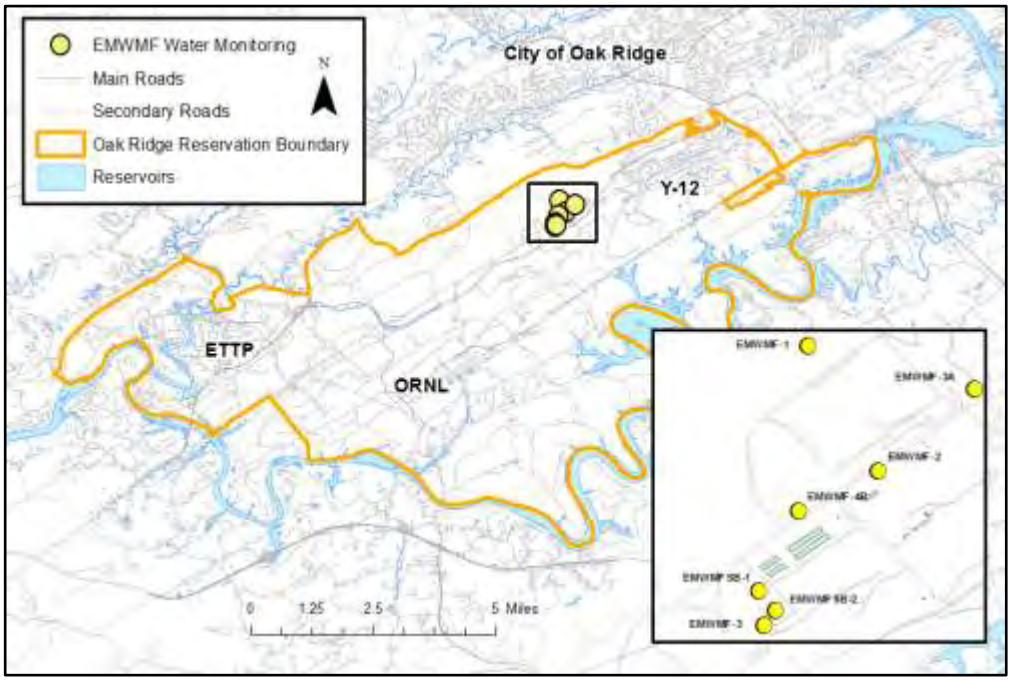

Figure 1: Proposed EMWMF Sampling and Monitoring Locations

Table 1: Proposed EMWMF Sampling and Monitoring Locations

Station	Sample ID	Frequency	Sampling Rationale
GW-918	EMWMF-1	Quarterly	Upgradient well linked to a spring. The spring is the headwaters for both NT-4 and NT-5. This sample is collected by a DOE contractor and analyzed for quality control.
EMWMF Underdrain	EMWMF-2	Monthly	NT-4 discharge below the landfill. The underdrain was installed below Cell 3 and it is theorized that if cells 1, 2, and 3 were to leak contaminants, they would first be observed at this location.
Sediment Basin effluents	EMWMF-3	Monthly	Sampling at this location provides confirmation of contaminant levels being discharged from the sediment basin.
NT-3 Tributary	EMWMF-3A	SemiAnnually	Up-stream surface water location to be used as a baseline.
Sedimentation Basin Sediment	EMWMFSB-1, EMWMFSB-2	Annually	This location is only sampled when the sediment basin is dry. The results are used to observe the loading of radionuclides in the sediment of the basin.
Cell 6 Drainage	EMWMF-4B	SemiAnnually	This location is sampled to verify that water collected in Cell 6 (prior to waste placement) is only storm water.

GW - groundwater
EMWMF - Environmental Management Waste Management Facility
NT - North Tributary of Bear Creek

4.1 Assumptions

- Locations selected for sampling will have adequate water for sampling
- Weather will not be a factor hindering sampling

4.2 Constraints

The constraints listed in the following table could adversely impact the success of this project. TDEC will take the appropriate measures to identify, monitor, and mitigate the probability and impact of each of the following identified risks.

Table 2: Constraints

Constraints	
Budget	The lab analysis budget may not allow for enough samples to be collected.
Manpower `	Manpower may not be available at optimum sampling times.
Schedule	Samples need to be collected within a time frame to ensure lab analysis will be completed in time to include with report.

4.3 Stakeholders

Table 3: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External

5. METHODS, MATERIALS, METRICS

Table 1 and Figure 1 depict locations of interest, analytes and rationale for sampling at the EMWMF as laid out in the methods, materials, and metrics (Task 1 and Task 2).

Task 1:

- The continuous water quality parameters of temperature, pH, conductivity, dissolved oxygen, turbidity, and water level (converted to discharge) will be measured with an In-Situ® Troll 9500.
- Precipitation data will be collected from the closest ORR meteorological tower. The continuous water quality monitoring will follow the 2011 TDEC Water Pollution Control Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water.
- The continuous water quality dataloggers will be visited once per week to aid in determining calibration drift, to check on any sedimentation and/or biological problems at the locations, and to make sure the instruments are functioning properly. In addition, staff will perform basic monitoring of these locations for temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential at least twice weekly utilizing a YSI-Professional Plus water quality meter.

- Calibration or confidence check of this instrument is performed prior to field use. Locations and rationale are listed in Table 1.

Task 2:

- Water samples will be collected on a routine basis, as opportunity arises or as conditions merit the monitoring of water discharges.

- To assess compliance with the DOE limit placed on radionuclides released from the contact water ponds and tanks (100 mrem/yr), samples will be collected of the discharged contact water as it is pumped to the drainage ditch from the contact water pond. To assess compliance with the TDEC limit placed out the outfall of the sedimentation basin, samples will be taken from the discharge from the v-weir at the basin (EMWMF-3).

- Analysis will focus on those radionuclides that have historically contributed the most to the annual dose limits for each location. To evaluate the performance of the landfill liner and associated EMWMF monitoring, samples will be collected from the underdrain (EMWMF-2).

- To capture contaminants that could be migrating from the cells laterally in shallow groundwater, the NT-3 tributary will be sampled down gradient of the waste cells under base flow and high flow conditions, at the locations currently monitored under the EMWMF surface water program (EMWF-3A). EMWMF-1 (GW-918) will be co-sampled with DOE as a background well.

- Groundwater sampling will follow TDEC DoR Quality Assurance Project Plan (2015) and the Sampling and Analysis Plan (2016). All collected samples will follow the Sampling and Analysis Plan developed for the DOR Oak Ridge Office.

Methods: Lab Methods

The Tennessee Department of Health Laboratory uses EPA methods for sample analysis. The requested analytical methods are listed below:

Table 4: Lab Methods and Analyses

Method Designation	Test Name	Analytes
Method 200.7	ICP-OES	Metals
Method 200.8	ICP-MS	Metals
Method 245.1	Mercury	Mercury
Method 8260B	GC/MS	Volatile Organic Compounds
Method 901.1	Gamma water	Gamma radiation
Method ENV-Rad-SOP-401-R.1.3	Gross Alpha-Beta water by LSC	Gross alpha-beta activity
Method 905.0	Sr-89-90 water	Strontium 89-90
Eichrom Method TCW02	Technetium-99 water	Technetium-99
Method 906.0	Tritium water	Tritium

Laboratory analyses will be entered into an Excel database for interpretation. Interpretation may include construction of tables and graphs illustrating ranges and limits of constituents over the course of the project. Included on the graphs will be pertinent water quality criteria from the EPA and TDEC. In certain circumstances, DOE criteria may be used for additional illustration.

6. DELIVERABLES/MILESTONES

Table 5: Deliverables/Milestones

Deliverable	Due Date
2019 Environmental Monitoring Plan	6/30/2018
Quarterly Reports	Quarterly
2019 Environmental Monitoring Report	10/31/2019
TDEC DoR-OR will provide reviews and evaluations of DOE data, including but not limited to ASER and RER comments.	As applicable

7. CONDITIONS AND APPROVALS

This project charter was prepared to assist with the State of Tennessee's (State) commitments under both the Environmental Surveillance Oversight Agreement (ESOA) and the Federal Facilities Agreement for the Oak Ridge Reservation (FFA). In accordance with those agreements, a portion of the time spent on this project will be in reviewing the Department of Energy (DOE) Environmental Monitoring Plan (EMP) and Annual Site Environmental Report (ASER) for the Oak Ridge Reservation (ORR) and/or applicable FFA remedy documents. This project may evaluate data from various sources to include, but not limited to: data uploaded to the Oak Ridge Environmental Information System (OREIS), data provided to or collected by other State regulatory agencies, split sampling with DOE parties, or independent sampling in accordance with accepted standard procedures. Information analyzed by the TDEC Division of Remediation, Oak Ridge Office (DoR-OR) will be used to make recommendations to existing DOE environmental surveillance programs.

APPENDIX A: REFERENCES

Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water, Tennessee Department of Environment and Conservation, Division of Water Pollution Control (2011).

Sampling and Analysis Plan for General Environmental Monitoring of the Oak Ridge Reservation and its Environs, Division of Remediation Oak Ridge (2016).

Environmental Sampling of the Oak Ridge Reservation and its Environs Quality Assurance Project Plan, Division of Remediation Oak Ridge: (2015)

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

The following table provides definitions for terms relevant to this document.

Term	Definition
EMWMF	Environmental Management Waste Management Facility
DoR	Division of Remediation
DoR-OR	Division of Remediation Oak Ridge
TDEC	Tennessee Department of Environment and Conservation
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan

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SURPLUS SALES VERIFICATION PROJECT CHARTER FY 2019

Project Lead: John A. Wojtowicz

06/30/18

Portions of Surplus Sales Verification Project Charter will be included in the Environmental Monitoring Plan.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	John A. Wojtowicz				Initial Release

1. BACKGROUND 1
2. PROBLEM STATEMENTS 1
3. GOALS 1
4. SCOPE 2
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1. BACKGROUND

The Tennessee Department of Environment and Conservation, Division of Remediation Oak Ridge Office (DoR-OR), in an oversight capacity of the U.S. Department of Energy (DOE) and its contractors, conducts radiological surveys of surplus materials that are designated for sale to the public from the Oak Ridge Reservation (ORR). In addition to performing the surveys, the office reviews the procedures used for release of materials under DOE radiological regulations. DOE currently operates their surplus materials release program under DOE O 458.1 Admin Chg 3, Radiation Protection of the Public and the Environment.

Some materials, such as scrap metal, may be sold to the public under annual sales contracts, whereas other materials are staged at various sites around the ORR awaiting auction i.e., sale. Practices have changed at both the Y-12 National Security Complex (Y-12) and at the Oak Ridge National Laboratory (ORNL) regarding surplus sales. With rare exceptions, materials are no longer sold directly to the public by either facility.

Y-12 now uses an out-of-state contractor to handle the majority of their sales. ORNL has a list of nine or ten organizations approved to bid on sales of materials by the truckload. DoR-OR, at the request of ORNL and Y-12 Property Excessing staff, conducts radiological verification screening surveys to help ensure that no potentially contaminated materials reach the public. In the event that elevated radiological activity is detected above the removable contamination limits set forth in NUREG-1757, Volume 1, Revision 2, Section 15.11.1.1 Release of Solid Materials with Surface Residual Radioactivity (Schmidt et al., 2006) or Reg. Guide 1.86, a quality control check is made with a second meter. If both meters show elevated activity, DoR-OR immediately reports the finding(s) to the surplus sales program supervisor. A removable contamination assessment may be performed. Later, readings are converted to dpm/100 cm^2 (dpm = disintegrations per minute) and reported. DoR-OR then follows the response of the sales organizations to see that appropriate steps (i.e., removal of items from sale, resurveys, etc.) are taken to protect the public.

2. PROBLEM STATEMENTS

- Although the procedure for surplus of materials from the ORR has changed (materials are no longer directly auctioned to the public) the potential for items being released to pre-approved bidders may potentially reach the public. Y-12 now uses an off-site contractor to handle their sales leaving ORNL property sales as the prime focus of this project.
- Even when items of concern are found, they may not ultimately prove to be problematic. For example, radon is notorious for adhering to the surface of various items of varied composition. What first appears as an item with surface contamination may (with proper resurvey techniques) prove to be an instance where radon adhered to the surface of the item and then rapidly decayed away.

3. GOALS

DoR-OR's intent is to verify materials that have been staged for sale at ORNL's 115 Union Valley Road Property Excessing Facility or other locations. The project attempts to locate any contaminated items that may have evaded detection prior to being staged for sale. In rare instances where items of concern are found, it prevents the release of potentially contaminated materials to the public.

4. SCOPE

DoR-OR staff performs pre-auction verification surveys on items being auctioned by ORNL's Excess Properties Sales. These surveys are performed at the request of ORNL's Excess Properties staff. When a request is received, every attempt is made to fulfill that request. Typically, no more than eight events occur during a calendar year. DoR-OR has had no difficulty responding to all requests.

4.1 Assumptions

- Funding and budget will be sufficient.
- State vehicle will be adequate and available for survey.
- Adequate staff will be available for survey.
- Sufficient number of alpha/beta scintillation meters will be available for survey.
- DoR-OR will follow-up on resolution of the identified potential issues.

4.2 Constraints

Possible constraints for the Surplus Sales Verification Project are included in the following table.

Table 1: Constraints

Category	Constraints
Resources	State vehicle not available for survey.
Resources	Adequate staff not available for survey.
Resources	Adequate number of alpha/beta scintillation meters unavailable on day of survey.
Resources	The budget and equipment calibration costs may change during the fiscal year.

4.3 Stakeholders

The Surplus Sales Verification Project involves the following stakeholders.

Table 2: Project Stakeholders (Internal and External)

Stakeholders	
Citizens of Tennessee	External
Tennessee Department of Environment and Conservation	External and Internal
Local Governments	External
DOE and Contractors	External
Oak Ridge National Laboratory	External
Y-12 National Security Complex	External

5. METHODS, MATERIALS, METRICS

Surplus sales verification work is performed under the guidance of DoR- OR's 2017 Health and Safety Plan (TDEC 2017), and the draft DoR-OR Standard Operating Procedure for Surplus Sales Verification (TDEC 2018).

Prior to sales of surplus items from ORNL or Y-12 to the public, DoR-OR conducts a pre-auction survey. The intent of this survey is to spot check items that are for sale with appropriate radiation survey instruments in order to ensure that no radioactively contaminated items are released to the public. Not all items or surfaces of a specific item are surveyed for potential radioactive contamination. Specific attention is paid to well-used items where material damage, uncleanliness, or staining is present. However, clean looking items may also be checked. When activity (alpha or beta/gamma) above the removable contamination limits is detected, the item is brought to the attention of Property Excessing staff.

Based on DoR-OR's survey results, it is Property Excessing's decision whether or not to have the item rechecked by ORNL RADCON. DoR-OR does not attempt to determine if a particular item meets DOE release criteria, but does try to locate items where, depending on the isotopes involved, there is a potential for the item not to meet release criteria.

6. DELIVERABLES/MILESTONES

Table 3: Deliverables/Milestones

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APPENDIX A: REFERENCES

Schmidt, D.W, K.L. Banovac, J.T. Buckley, D.W. Esh, R.L. Johnson, J.J. Kottan, C.A. McKenney, T.G. McLaughlin, S. Schneider. (2006) Consolidated Decommissioning Guidance, NUREG-1757 2. Retrieved from https://www.nrc.gov/docs/ML0630/ML063000252.pdf

TDEC. (2018) Standard Operating Procedure: Surplus Sales Verification (Draft). Tennessee Department of Environment and Conservation, Division of Remediation, Oak Ridge Office. Oak Ridge, Tennessee.

TDEC. (2017, January). 2017 Health and Safety Plan Including Related Policies. Tennessee Department of Environment and Conservation, Division of Remediation, Oak Ridge Office. Oak Ridge, Tennessee.

U.S. Nuclear Regulatory Commission (NRC). (1974, June) Termination of Operating Licenses for Nuclear Reactors. Regulatory Guide 1.86, Washington, D.C.

APPENDIX B: ACRONYMS, ABBREVIATIONS, TERMS

None.