ENCLOSURE 1

TRISO-X ENVIRONMENTAL REPORT
CHAPTERS 1-2
PART 1 OF 3 (103 MB)

NON-PROPRIETARY

TRISO

FUEL FABRICATION FACILITY

ENVIRONMENTAL REPORT SUBMITTAL

September 2022

MASTER TABLE OF CONTENTS

CHAPTER 8
SUMMARY OF ENVIRONMENTAL CONSEQUENCES

CHAPTER 9
LIST OF REFERENCES

CHAPTER 10
LIST OF PREPARERS

MASTER LIST OF FIGURES

CHAPTER 5
MITIGATION MEASURES

None

CHAPTER 6
ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

CHAPTER 7
COST BENEFIT ANALYSIS

None

CHAPTER 8
SUMMARY OF ENVIRONMENTAL CONSEQUENCES

None

CHAPTER 9
LIST OF REFERENCES

None

CHAPTER 10
LIST OF PREPARERS

None

CHAPTER 1

INTRODUCTION OF THE ENVIRONMENTAL REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ac.	acres
AGR	Advanced Gas Reactor
AR	Advanced Reactor
ARDP	Advanced Reactor Demonstration Program
ATF	Accident tolerant fuel
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
ER	Environmental Report
EIS	Environmental Impact Statement
GDP	Gross Domestic Product
GMP	Graphite Matrix Powder
ha	hectare
HALEU	High Assay Low Enriched Uranium
HCS	Horizon Center site
HTGRs	high temperature gas reactors
HTR-PM	high-temperature gas-cooled reactor pebble-bed module
IND-2	general industrial district
IND-3	heavy industrial district
INL	Idaho National Laboratory
km	kilometer
LWR	light water reactor
mi.	mile
NE	Office of Nuclear Energy
NEPA	National Environmental Policy Act
NMSS	Nuclear Material Safety and Safeguards
NPDES	National Pollutant Discharge Elimination System

Acronym/Abbreviation	Definition
NRC	U.S. Nuclear Regulatory Commission
R&D	research and development
ROI	Region of Influence
Site	Horizon Center site
SPCC	Spill Prevention, Control and Countermeasure
SHPO	State Historic Preservation Office
TDEC	Tennessee Department of Environment and Conservation
TRISO	TRi-structural ISOtropic
TRISO-X FFF	TRISO-X Fuel Fabrication Facility
TRISO-X	TRISO-X, LLC
TWRA	Tennessee Wildlife Resources Agency
UCO	uranium oxycarbide
UO_2	uranium dioxide
U_3O_8	triuranium octoxide
USACE	U.S. Army Corps of Engineers

CHAPTER 1

Introduction of the Environmental Report

1.0 INTRODUCTION

TRISO-X, LLC (TRISO-X) is the applicant for a license to possess and use special nuclear material in the TRISO-X Fuel Fabrication Facility (TRISO-X FFF). As required by Title 10 of the Code of Federal Regulations (CFR) Part 51 (*Environmental Protection Regulations for Domestic Licensing and Related Functions*), this Environmental Report (ER) is being submitted to the U.S. Nuclear Regulatory Commission (NRC) by TRISO-X to support licensing of the TRISO-X FFF. This fuel fabrication facility utilizes uranium enriched to less than 20 percent to produce Tri-structural Isotropic (TRISO) based particle fuel products to support a variety of advanced reactors (ARs) being considered and planned by the energy and industrial sectors, the Department of Defense, and the National Aeronautics and Space Administration. ARs are being designed to provide clean, reliable energy and provide a viable alternative to the aging, economically challenged, existing nuclear and fossil electric generation stations. TRISO-X plans to locate the TRISO-X FFF on the Horizon Center site (HCS) located in Oak Ridge, Roane County, Tennessee, in accordance with the Atomic Energy Act of 1954, as amended; 10 CFR 70 (*Domestic Licensing of Special Nuclear Material);* 10 CFR 40 (*Domestic Licensing of Source Material)*; and other applicable laws and regulations.

This ER is organized in accordance with the guidance contained in NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs,* dated August 2003. This chapter provides an introduction and discusses why TRISO-X is requesting an NRC license to possess and use special nuclear material in the TRISO-X FFF. Chapter 2 of this Report (*Alternatives*) discusses the Proposed Action and alternatives, including the No Action Alternative and siting alternatives. Chapter 3 (*Description of Affected Environment)* discusses the existing environmental conditions at the HCS, and Chapter 4, (*Environmental Impacts*) discusses how those conditions are affected, if at all, by the Proposed Action. Chapter 5 (*Mitigation Measures*) discusses mitigation measures that could be implemented by TRISO-X to mitigate potential environmental impacts of the Proposed Action. Chapter 6 (*Environmental Measurements and Monitoring Programs*) discusses the environmental measurement and monitoring programs established for the TRISO-X FFF. Chapter 7 (*Cost-Benefit Analysis*) provides an analysis of the costs and associated benefits of the TRISO-X FFF. Chapter 8 (*Summary of Environmental Consequences*) summarizes the potential environmental consequences of the Proposed Action. Chapter 9 (*List of References*) and Chapter 10 (*List of Preparers*) presents the references for, and preparers of, this ER.

1.1 BACKGROUND

The United States pioneered the development of nuclear power to produce electricity in the 1940s. Since then, U.S. leadership in nuclear energy technology has provided a benefit of clean, reliable electricity for nearly seven decades. The U.S. fleet of nuclear power plants supplies approximately 20 percent of the electricity generated in the United States, while avoiding millions of tons of carbon dioxide emissions each year. It is the largest source of clean, carbon-free energy and the most reliable, operating at a capacity factor of more than 93 percent.

Despite these benefits, the U.S. nuclear industry faces significant challenges. Many U.S. reactors face economic challenges or are nearing the end of their planned operating lives. New construction of traditional reactors is costly and time consuming. New AR designs are being developed and demonstrated to provide clean energy and expand market opportunities before key infrastructure and supply chain capabilities are lost in the United States.

The U.S. Department of Energy (DOE) Office of Nuclear Energy (NE) is an applied research and development (R&D) organization that enables innovation, supports unique research infrastructure, and solves crosscutting challenges facing the nuclear sector. The DOE-NE invests in R&D that the private sector or other non-government stakeholders are unable to perform due to the cost, scale, or timeframe required. By leveraging private-public partnerships and the national laboratory system, the DOE-NE makes nuclear energy more cost effective, accelerates AR deployment, makes nuclear fuel more sustainable, encourages a resilient supply chain, and promotes a strong nuclear workforce. Goals cited in the DOE-NE Strategic Vision report include enabling continued operation of existing U.S. nuclear reactors, enabling deployment of advanced nuclear reactors, developing advanced nuclear fuel cycles to include addressing gaps in the domestic nuclear fuel supply chain, and maintaining U.S. leadership in nuclear energy technology. (DOE, 2021)

The Advanced Reactor Demonstration Program (ARDP), within the DOE-NE, is designed to help domestic private industry demonstrate advanced nuclear reactors in the U.S. These advanced nuclear energy systems hold great potential to lower emissions, create new jobs, and build a strong economy. On November 15, 2021, the bipartisan Infrastructure Investment and Jobs Act was signed into law, providing more than $62 billion for the DOE to support innovation as a critical component for meeting climate change goals of reaching 100 percent carbon-free electricity by 2035 and a net-zero-carbon economy by 2050. Within the Act's funding for DOE, the ARDP is fully funded for $2.5 billion to help domestic private industry demonstrate two U.S. advanced nuclear reactor designs through cost-shared partnerships with industry by 2028.

Although nuclear fuel, fuel forms, and operating conditions vary widely across the numerous AR designs under development, TRISO coated particle fuel is essential for many AR designs. TRISO fuel was first developed in the U.S. and United Kingdom in the 1960s with uranium dioxide (UO_2) fuel. In 2002, the DOE initiated the Advanced Gas Reactor Fuel Development and Qualification (AGR) Program to establish the U.S. capability to fabricate high-quality TRISO fuel and improve its performance. In 2009, this improved TRISO fuel set an international record by achieving a 19 percent maximum burnup during a three-year test at Idaho National Laboratory (INL). These tests demonstrate TRISO fuel performance during irradiation and in post-irradiation high temperature accident safety tests. The results of the AGR program have been very successful to date and support current safety design and analysis assumptions about fuel performance and radionuclide retention required for AR designs. Fabrication of high-quality low-defect fuel is now achievable at an industrial scale.

In 2020 under the ARDP, the DOE selected X-energy, LLC (X-energy), the parent company of TRISO-X, to deliver a commercial TRISO fuel fabrication facility and a four-module version of its Xe-100 high temperature gas-cooled reactor by 2027. In April 2021, Energy Northwest, Grant County Public Utility District, both located in Washington State, and X-energy signed a memorandum of understanding establishing a mutual partnership to support the development and commercial demonstration of the country's first advanced nuclear reactor. X-energy is working with Energy Northwest and Grant County Public Utility District to identify a site for this reactor in Washington State, where it will deliver carbon-free power to thousands of local residents. As such, TRISO-X plans to manufacture their own proprietary version of the TRISO

coated particle fuel at HCS to ensure supply and quality control for the Xe-100 to be constructed in Washington State and to satisfy the needs of a variety of other advanced fuel designs and reactors (e.g., pebble bed high temperature gas-cooled, prismatic gas-cooled, molten salt-cooled, accident tolerant fuel, nuclear thermal propulsion, and others). The TRISO-X FFF is the first commercial facility to provide this fuel at an industrial scale. The Xe-100 reactor allows for passive safety systems and a small reactor footprint, allowing flexibility in siting and access to non-traditional markets.

Many ARs require fuel that is enriched to from 5 percent to less than 20 percent Uranium-235 (^{235}U), called High Assay Low Enriched Uranium (HALEU) fuel. TRISO fuel is a HALEU fuel. NRC licensing is a critical element of the process that the AR community must address now to have a credible reactor deployment program by the mid-to-late-2020s. This project proposes the construction and operation of the TRISO-X FFF which includes possession and use of special nuclear material. The TRISO-X FFF produces TRISO-based coated particles and final fuel forms in various shapes and configurations to power the coming fleet of advanced reactors.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The proposed Federal action is the issuance of a license to possess and use special nuclear material, under the provisions of 10 CFR 70, that would allow TRISO-X to possess and use special nuclear material in the TRISO-X FFF to produce TRISO-based coated particles and final fuel forms using uranium enriched to less than 20 weight percent ^{235}U. The Proposed Action is intended to satisfy the need for safe and reliable fuel for ARs. Fuel for ARs:

- *Increase competitiveness of the U.S. nuclear industry:* The Chinese have completed a commercial AR UO_2 TRISO fuel facility and AR power plant (high-temperature gas-cooled reactor pebble-bed module or HTR-PM); the TRISO-X FFF project enables near-term competitiveness by employing a superior fuel [uranium oxycarbide (UCO) TRISO] manufactured in a U.S. fuel fabrication facility (the TRISO-X FFF), as well as supporting the overall deployment of several AR designs.
- *Improve capabilities of the existing fleet:* UCO TRISO particles offer future potential, with additional research, to enable improvements to light water reactors (LWRs) using TRISO-based accident tolerant fuels (ATFs).
- *Improve timelines for AR deployment:* Without a stable source of U.S. HALEU and a licensed Category 2 fuel fabrication facility, the deployment timeline for ARs will be measured in decades. According to the NRC, Category 2 fuel fabrication facilities are categorized as possessing a special nuclear material of moderate strategic significance. The Proposed Action will reduce the timeline for deployment through the licensing, construction, and operation of the TRISO-X FFF.
- *Improve cost and schedule for AR deployment:* UCO TRISO technology offers higher burn-ups and improved safety at high temperatures; this competitive advantage enables U.S. ARs to out-perform and be more economical as compared to foreign UO_2-based ARs.

Issuance of a license that enables the possession and use of special nuclear material at the TRISO-X FFF will be for a first-of-a kind manufacturing operation in the U.S. TRISO fuel has been in development since the 1960s and improvements beginning in 2002 have enhanced performance and manufacturing methods. Production of TRISO fuel supports ARs, creates clean energy, encourages a resilient supply chain, and promotes a strong nuclear workforce. Currently, many U.S. reactors face economic challenges or are nearing the end of their planned

operating lives. New construction of traditional reactors is costly and time consuming. AR designs have the potential to offer lower costs, faster construction, variable size, and more flexible operation, while providing safe, clean energy. The most critical element of design of these reactors is a robust fuel that can withstand very high temperatures while providing greater efficiency than fuel used in the current light water reactor (LWR) fleet. The TRISO-X FFF produces such a fuel for ARs.

Nuclear energy is an important source of energy in the U.S with nearly 20 percent of the nation's electricity being generated by nuclear reactors. Nuclear power generates nearly 55 percent of the nation's carbon-free electricity. America's nuclear power industry also creates jobs. The industry employs nearly 100,000 people and that number increases to 475,000 when including secondary jobs. Nuclear energy is good for the economy. Nuclear saves consumers an average of 6 percent on electric bills and adds $60 billion to the U.S. Gross Domestic Product (GDP). Nuclear energy is safe, clean, and reliable. Continued use and development of nuclear technology including ARs will lower emissions, create new jobs, and build a strong economy.

Without the Proposed Action, the U.S. would lose its competitiveness in the nuclear industry, there would be limited improvement in fuel types for the existing fleet, and AR deployment would be delayed. The global market for nuclear power could triple by 2050 due to increasing pressures to transition to a carbon-free world. The U.S. industry must be able to compete quickly, in order to ensure our national security and regain leadership from Russia and China in the development and deployment of safe, reliable nuclear energy and its related components.

1.3 THE PROPOSED ACTION

The Proposed Action is for TRISO-X, LLC (the applicant) to possess and use special nuclear material in the TRISO-X FFF at the HCS. The facility will produce nuclear fuel to support next generation reactors in the energy, aerospace, industrial, and defense sectors.

The TRISO-X FFF is located in Oak Ridge, Roane County, Tennessee. A site location map including nearby towns and natural features is provided in Figure 1.3-1. The TRISO-X FFF encompasses approximately 110 acres (ac.) (44.6 ha). The Project layout consists of the main fuel process building, administration building, associated equipment yards, stormwater detention basin, internal roadways, stormwater ditches, permanent parking, and construction laydown area. Additional details regarding the Proposed Action are provided in Section 2.1.2 of this Report (*Proposed Action*).

The TRISO-X FFF is designed to produce coated particle fuel for the next generation of nuclear reactors. TRISO-X FFF manufacturing operations consist of receiving HALEU in the form of triuranium octoxide (U_3O_8) powder enriched to less than 20 weight percent ^{235}U; converting the U_3O_8 into a uranyl nitrate solution, into gel spheres, and then into fuel kernels; and processing the fuel kernels through coating, overcoating, fuel form pressing, and high temperature carbonization. These operations are supported by shipping and receiving, laboratory, quality control, research and development, uranium recovery, and waste disposal processes. The target production capacity is 16 metric tons uranium per year.

The project includes construction, operation, and decommissioning of process buildings. Facility construction (as defined in 10 CFR 70.4) is expected to take two years beginning in 2023 and continue through 2025. In April 2022, TRISO-X submitted the safety and safeguards portions of the License Application. The start of commercial operations is expected to begin in 2025. The

Facility would be initially licensed for 40 years of operations. The following is a list of Proposed Action key dates:

- 2022 – Submittal of license application to NRC
- 2023 through 2025 – Construction (as defined in 10 CFR 70.4)
- 2024 – Anticipated issuance of Environmental Impact Statement by the NRC
- 2025 – Anticipated issuance of 40-year license by the NRC
- 2025 – Start of commercial operation
- 2065 – Potential license renewal or decommissioning of the facility

At the end of the useful life of the TRISO-X FFF, the facility is decommissioned. Decontamination and decommissioning are projected to take two years. The impacts of decommissioning are analyzed in Chapter 4 of this Report, (*Environmental Impacts*); decontamination and decommissioning are also described in Section 2.1.2 of this report (*Proposed Action*).

For the purpose of evaluating the potential impacts that would result from the implementation of the Proposed Action (as presented in Chapter 4 of this Report, (*Environmental Impacts*), impacts are presented for three distinct lifecycle phases. The first phase is the construction phase, which consists of two years of construction activities. This phase would entail the TRISO-X FFF site preparation and construction of the operations building and auxiliary facilities. The second phase is the operation phase, which would consist of 40 years of commercial production. The third and final phase is the decommissioning phase. This phase consists of the scheduled two-year period of decontamination and closure of the TRISO-X FFF.

To measure the overall effect of the Proposed Action, aggregate costs and benefits of the project were examined, including both the socioeconomic and environmental effects of the project. Most of the environmental costs and benefits and some of the economic costs and benefits are measured qualitatively whereas other economic costs and benefits are quantified and valued. Overall, the TRISO-X FFF would be expected to convey positive net benefits.

1.3.1 SITE LOCATION AND LAYOUT

1.3.1.1 SITE LOCATION

The HCS is located within the city limits of Oak Ridge, Roane County, Tennessee. The HCS boundary is approximately 7 mi. (11 km) southwest of the approximate city center of Oak Ridge. The TRISO-X FFF is centered at approximately 35°57’41.132” N latitude, and 84°22’ 13.367” W longitude. A site location map is provided in Figure 1.3-1.

The sensitive populations (e.g., schools, daycare facilities, hospitals), nearest resident, and landmarks (including highways, transportation facilities, rivers and other bodies of water) within the Region of Influence (ROI), which includes Roane, Anderson, Knox, Loudon, and Morgan counties, are discussed within Section 3.10.

1.3.1.2 BOUNDING LIMITS

A circle with a radius of 0.38 mi. (0.61 km) measured from the center point encompasses all of the property within the HCS. This radius is used to define the bounding limits of the project site.

Assessments provided in this ER evaluating impacts to areas away from the project site are defined by adding the required radius for the specific impact assessment to the bounding limits. A bounding limits map is provided in Figure 1.3-2.

1.3.1.3 SITE LAYOUT

Figure 1.3-3 shows the layout of major structures and the site boundary. This figure identifies key buildings and features on the site, including the process building, support structures, drainage features and other infrastructure.

1.3.2 NUCLEAR FUEL FABRICATION FACILITY DESCRIPTION

TRISO-X is in the process of licensing a nuclear fuel fabrication facility to produce TRISO uranium fuel to power high temperature gas reactors (HTGRs) and other users of TRISO-based fuel. The TRISO uranium fuel produced is used for nuclear reactor developers and by the energy, aerospace, industrial, and defense sectors.

1.3.2.1 GENERAL DESCRIPTION OF THE NUCLEAR FUEL FABRICATION PROCESS

The TRISO-X FFF is designed to produce coated particle fuel for the next generation of nuclear power plants and new accident tolerant fuels currently under development for existing light water reactors. While the baseline design targets the fabrication of pebble fuel forms for X-energy's Xe-100 Pebble Bed HTGR, the modular design of the process cells / areas anticipates additional production capabilities to satisfy the needs of a variety of reactors (e.g., prismatic gas cooled, molten salt cooled, accident tolerant fuel, and others) and fuel designs.

TRISO-X FFF manufacturing operations consist of receiving HALEU in the form of triuranium octoxide (U_3O_8) powder enriched to less than 20 weight percent ^{235}U; converting the U_3O_8 into a uranyl nitrate solution, into gel spheres, and then into fuel kernels; and processing the fuel kernels through coating, overcoating, fuel form pressing, and high temperature carbonization. These operations are supported by shipping and receiving, laboratory, quality control, research and development, uranium recovery, and waste disposal processes. The target production capacity is 16 metric tons uranium per year.

1.4 APPLICABLE REGULATORY REQUIREMENTS, PERMITS, AND REQUIRED CONSULTATIONS

This section lists and summarizes the status of Federal, State, local, and other permits and consultations required for the construction and operation of the TRISO-X FFF which includes possession and use of special nuclear material. The applicable law, ordinance, or regulation that governs each permit and/or consultation is also identified.

Table 1.4-1 lists the permits and other approvals required to possess and use special nuclear material as well as construction and operation of the TRISO-X FFF. The table provides the following information for each permit or approval, as applicable:

- Name of the responsible regulatory agency
- Applicable law, ordinance, or regulation
- Name of the permit or approval

- Activity covered by the permit or approval
- Current status

Table 1.4-2 lists the consultations required for construction and operation of the TRISO-X FFF. The table provides the following information for each consultation, as applicable:

- Name of the responsible regulatory agency
- Applicable law, ordinance, or regulation
- Required consultation
- Summary of any surveys required to complete the consultation
- Current status

As discussed in Table 1.4-2, TRISO-X made informal contact with the U.S. Fish and Wildlife Service (USFWS), Tennessee State Historic Preservation Office (SHPO), Tennessee Wildlife Resources Agency (TWRA), U.S. Army Corps of Engineers (USACE), and Tennessee Department of Environment and Conservation (TDEC). The purpose of these informal consultations was to inform the agencies about the project and to coordinate project planning. Copies of regulatory agency consultations and responses are provided in Appendix 1A, Regulatory Correspondence.

The TRISO-X FFF is designed to operate in compliance with all applicable environmental quality standards and regulatory requirements. The facility also complies with current good manufacturing practices.

Table 1.4-1
(Sheet 1 of 5)
Permits and Approvals Required for Construction and Operation

Agency	Regulatory Authority	Permit or Approval	Activity Covered	Status
U.S. Nuclear Regulatory Commission	10 CFR 30	By-Product Material License	Production, possession, and transfer of radioactive by-product material	Addressed in this license application
	10 CFR 40	Source Material License	Possession, use, and transfer of radioactive source material	Addressed in this license application
	National Environmental Policy Act (NEPA) 40 CFR 1500-1508 10 CFR 51	Environmental Assessment or Environmental Impact Statement in accordance with NEPA	Analysis of impacts associated with construction, operation, and decommissioning at the HCS in support of NRC decision-making	Addressed in this license application
	10 CFR 70	Special Nuclear Material License	Receipt, possession, use, and transfer of special nuclear material	Addressed in this license application
	10 CFR 71	Quality Assurance Program for Radiological Material Packages must be approved by NRC	The use of NRC certified transportation packages	Approval not yet submitted
U.S. Environmental Protection Agency	Clean Water Act 40 CFR 112	Spill Prevention, Control and Countermeasure (SPCC) Plans for Construction and Operation	Storage of oil during construction and operation	SPCC Plans not yet prepared
U.S. Department of Transportation	Hazardous Material Transportation Act 49 CFR 107	Certificate of Registration	Transportation of hazardous materials	Registration application not yet submitted
U.S. Army Corps of Engineers	Clean Water Act 33 CFR 320 - 331	Section 404 permit	No jurisdictional waters were identified within the site. However, two channels and one stream were identified within the project survey area, outside the site boundary, with the potential to be regulated by either the USACE and/or TDEC.	Likely not required; pending USACE Jurisdictional Determination

Table 1.4-1
(Sheet 2 of 5)
Permits and Approvals Required for Construction and Operation

Agency	Regulatory Authority	Permit or Approval	Activity Covered	Status
Tennessee Department of Environment and Conservation	Clean Water Act Tennessee Water Quality Control Act of 1977	Section 401 Certification	No jurisdictional waters were identified within the site. However, two channels and one stream were identified within the project survey area, outside the site boundary, with the potential to be regulated by either the USACE and/or TDEC.	Likely not required; See TDEC Concurrence Letter dated May 24, 2022 in Appendix 1A, Regulatory Correspondence
Tennessee Air Pollution Control Board, Department of Environment and Conservation	Federal Clean Air Act Tenn. Code Ann. Title 68	Air Quality Construction Permit	Required to construct a new air contaminant source, the facility has at least one (and possibly several) new effluent discharge stack	Permit application in development, not yet submitted
		Air Pollution Control Operating Permit	Required to operate a new air contaminant source, the facility has at least one (and possibly several) new effluent discharge stack	Permit application not yet submitted
Tennessee Department of Environment and Conservation, Division of Water Resources	Federal Clean Water Act Tenn. Code Ann. Title 69	Notice of Coverage under the General National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharges associated with Construction Activity	Required for clearing, grading, or excavation that disturbs one or more acres	Permit application in development, not yet submitted
		Industrial Storm Water Discharge Permit	Discharge of storm water runoff from the site during facility operation	Permit application not yet submitted

Table 1.4-1
(Sheet 3 of 5)
Permits and Approvals Required for Construction and Operation

Agency	Regulatory Authority	Permit or Approval	Activity Covered	Status
Tennessee Department of Environment and Conservation, Division of Solid Waste Management	Tenn. Code Ann. §0400-12-01 Tenn. Code Ann. §0400-12-02 40 CFR 260 through 279	Hazardous Waste Permit	Required for any person owning or operating a new or existing facility that treats, stores, or disposes of a hazardous waste	Pending applicability
	Tenn. Code Ann. §68-212-101 Resource Conservation and Recovery Act 40 CFR 261 and 262	Acknowledgement of Notification of Hazardous Waste Activity	Generation of hazardous waste	Notification not yet submitted
Tennessee Department of Environment and Conservation, Division of Radiological Health	Chapter 0400-20-05, Standards for Protection Against Radiation 0400-20-19, Licensing and Registration	Specific Radioactive Material License	Required for source material and/or sealed sources above exempt quantities	License application not yet submitted
		General Radioactive Material License	Required for certain types of radioactive sources and devices containing radioactive material require the purchaser to have a general radioactive material license which is provided by the manufacturer	License application not yet submitted
		Registration of X-Ray Producing Equipment	The facility has several types of X-Ray equipment	License application not yet submitted
		Radioactive Waste License-for-Delivery	Transportation of radioactive waste into or within the State of Tennessee to a disposal/ processing facility	License application not yet submitted

Table 1.4-1
(Sheet 4 of 5)
Permits and Approvals Required for Construction and Operation

Agency	Regulatory Authority	Permit or Approval	Activity Covered	Status
City of Oak Ridge Community Development Department	City of Oak Ridge Ordinance	Site Plan Application	A site plan must be submitted for approval before a land disturbance permit and/or building permit can be issued	Site plan application has not yet been submitted for approval. Traffic impact study in progress.
	City of Oak Ridge Ordinance	Building Permit	Construction of buildings	Permit application not yet submitted
	City of Oak Ridge Ordinance	Land Disturbance Permit	Required for land disturbing activity that disturbs more than one acre of land. A required attachment is a TDEC Notice of Coverage under the General NPDES Permit for Stormwater Discharges associated with Construction Activity	Permit application in development, not yet submitted
	City of Oak Ridge Ordinance	Plumbing Permit	Installation of plumbing systems	Permit application not yet submitted
	City of Oak Ridge Ordinance	Electrical Permit	Installation of electrical systems	Permit application not yet submitted
	City of Oak Ridge Ordinance	Mechanical Permit	Installation of mechanical systems	Permit application not yet submitted
	City of Oak Ridge Zoning Ordinance	Zoning Approval	Construction of a nuclear fuel fabrication facility	Rezoning from IND-2 to IND-3 (heavy industrial district) in process two of three required public meetings completed. Third and final meeting scheduled for September 12, 2022
	City of Oak Ridge Zoning Ordinance	Special Exception Requiring Board of Zoning Appeals Approval	Based on the judgment of the Board of Appeals to promote orderly industrial districts containing industries compatible with each other	Not required, does not meet criteria.

Table 1.4-1
(Sheet 5 of 5)
Permits and Approvals Required for Construction and Operation

Agency	Regulatory Authority	Permit or Approval	Activity Covered	Status
	City of Oak Ridge Zoning Ordinance	Temporary Use Permit	Installation of seasonal or non-permanent uses	Pending applicability
		Building Permit	Construction of building	The project is not located within unincorporated Roane County, therefore, please refer to City of Oak Ridge Regulations
		Zoning	Construction of a nuclear fuel fabrication facility	

Sources for identification of permit requirements: City of Oak Ridge, 2022; State of Tennessee, 2022; Tennessee Department of Environment and Conservation, Division of Water Resources, 2022; Tennessee Air Pollution Control Board, Department of Environment and Conservation, 2021; Roane County, 2022.

Table 1.4-2
(Sheet 1 of 2)
Consultations Required

Agency	Regulatory Authority	Required Consultation	Surveys Required	Status
U.S. Fish and Wildlife Service	Endangered Species Act	Consultation regarding potential to adversely impact protected species; concurrence with no adverse impact or consultation on appropriate mitigation measures	Rare threatened and endangered species survey	Initial coordination letter sent March 9, 2022. USFWS response dated April 15, 2022, states the USFWS will conduct a thorough review upon submittal of the Environmental Impact Statement (See Appendix 1A, Regulatory Correspondence). Field surveys conducted in 2021 and 2022 demonstrated no rare, threatened or endangered species on-site.
	Bald and Golden Eagle Protection Act	Consultation regarding potential to adversely impact eagles; concurrence with no adverse impact or consultation on appropriate mitigation measures	Bald eagle survey	Initial coordination letter sent March 9, 2022. USFWS response dated April 15, 2022, states the USFWS will conduct a thorough review upon submittal of the Environmental Impact Statement (See Appendix 1A, Regulatory Correspondence). No bald eagle nests were observed during the 2021 and 2022 field surveys and no large trees typically used for bald eagle nesting (cottonwood or sycamore) were observed on-site.
Tennessee State Historic Preservation Office	National Historic Preservation Act, Section 106	Consultation regarding potential to adversely impact historic resources; concurrence with no adverse impact or consultation on appropriate mitigation measures	Phase I Cultural Resource Survey	Coordination letter sent April 13, 2022 and included the submittal of results of the cultural resource survey. SHPO response dated April 14, 2022, states no historic properties will be affected that are eligible for listing in the National Register of Historic Places (See Appendix 1A, Regulatory Correspondence). Formal Section 106 consultation will be conducted between the SHPO and NRC.

Table 1.4-2
(Sheet 2 of 2)
Consultations Required

Agency	Regulatory Authority	Required Consultation	Surveys Required	Status
Tennessee Wildlife Resources Agency	Tennessee Administrative Code Chapter 1660-01-32 - Rules and Regulations for In Need of Management, Threatened, and Endangered Species	Consultation regarding potential to adversely impact protected species or rare natural habitats species; concurrence with no adverse impact or consultation on appropriate mitigation measures	None	Initial Coordination letter sent March 9, 2022 (See Appendix 1A, Regulatory Correspondence). Response from TWRA not yet received.
U.S. Army Corps of Engineers and Tennessee Department of Environment and Conservation	Section 401/402/404 of the Clean Water Act	Concurrence and/or approval on the findings of the Wetlands and WOTUS Delineation Report (prepared in February 2022)	Wetlands Delineation survey	Consultation letters sent to TDEC and USACE on February 2, 2022. Received concurrence/approval from TDEC on May 24, 2022 (See Appendix 1A, Regulatory Correspondence). Jurisdictional Determination from USACE not yet received.

APPENDIX 1A REGULATORY CORRESPONDENCE

The following documents are included in this appendix:

1. Letter dated February 2, 2022 from Mary Motte Fikri and Stan Rudzinski (Wood Environment & Infrastructure Solutions, Inc.) to Mr. Michael Atchley (Tennessee Department of Environment and Conservation, Knoxville Environmental Field Office), Request for Concurrence – Hydrologic Determination for Horizon Lot 6, Oak Ridge, Roane County, Tennessee. (1 page).

2. Letter dated February 2, 2022 from Mary Motte Fikri and Stan Rudzinski (Wood Environment & Infrastructure Solutions, Inc.) to Eastern Regulatory Field Office U.S. Army Corps of Engineers, Request for Jurisdictional Determination – TRISO-X Facility Project Area, Horizon Center-Lot 6, Oak Ridge, Roane County, Tennessee. (1 page).

3. Letter dated March 9, 2022 from William Elzinga (Wood Environment & Infrastructure Solutions, Inc.) to Brandon Wear (Regional Wildlife Program Manager Tennessee Wildlife Resources Agency), Request for Information on Potential Site for a Proposed Fuel Fabrication Facility in Eastern Tennessee (Horizon Center site). (4 pages)

4. Letter dated March 9, 2022 from William Elzinga (Wood Environment & Infrastructure Solutions, Inc.) to Mr. Robbie Sykes (Permits Coordinator U.S. Fish and Wildlife Service), Request for Information on Potential Site for a Proposed Fuel Fabrication Facility in Eastern Tennessee (Horizon Center site). (4 pages)

5. Email from Steven Alexander (U.S. Fish and Wildlife Service) to Rebecca Porath and William J. Elzinga (Wood Environment & Infrastructure Solutions, Inc.), Subject: TRISO-X Project on the Oak Ridge Reservation, Date: Friday, April 15, 2022 6:08:05 AM. (2 pages)

6. Email from William Elzinga (Wood Environment & Infrastructure Solutions, Inc.) to Steven Alexander (U.S. Fish and Wildlife Service), Subject: Re: TRISO-X Project on the Oak Ridge Reservation, Date: Friday, April 15, 2022 8:05:34 AM. (2 pages)

7. Letter dated April 13, 2022 from William Elzinga (Wood Environment & Infrastructure Solutions, Inc.) to E. Patrick McIntyre, Jr. (Executive Director and State Historic Preservation Officer), Phase I Cultural Resource Survey for the TRISO-X Fuel Fabrication Facility Horizon Center site TRISO-X, LLC U.S. Nuclear Regulatory Commission (NRC) Licensing Application Project, Roane County, Tennessee. (3 pages)

8. Letter dated April 14, 2022 from E. Patrick McIntyre, Jr. (Executive Director and State Historic Preservation Officer) to William Elzinga (Wood Environment & Infrastructure Solutions, Inc.), NRC / Nuclear Regulatory Commission, TRISO-X Fuel Fabrication Facility Horizon Center site TRISO-X, LLC, Oak Ridge, Roane County, TN. (1 page)

9. Email from Steve Brooks (Environmental Scientist, TDEC Division of Water Resources, Knoxville Environmental Field Office) to Mary Motte Fikri (Wood Environment & Infrastructure Solutions, Inc.), Subject: Fwd: HD submittal approval, Tuesday, May 24, 2022 8:25:04 AM. (1 page)

Wood Environment & Infrastructure Solutions, Inc.
3800 Ezell Road, Suite 100
Nashville, Tennessee 37211
T: 615-333-0630
www.woodplc.com

February 2, 2022

Mr. Michael Atchley
Tennessee Department of Environment and Conservation
Knoxville Environmental Field Office
3711 Middlebrook Pike, Knoxville, TN 37921
Michael.Atchley@tn.gov

Subject: **Request for Concurrence – Hydrologic Determination**
Horizon, Lot 6
Oak Ridge, Roane County, Tennessee
Wood Project No. 325221235

Dear Mr. Atchley,

On behalf of X-energy, Wood Environment & Infrastructure Solutions, Inc. (Wood) is requesting a Hydrologic Determination (HD) on several drainages at the approximately 150-acre site identified as Horizon Lot 6 and located along Renovare Boulevard, in Oak Ridge, Roane County, Tennessee. The property is currently owned by the City of Oak Ridge Industrial Development Board. X-energy, an advanced reactor (AR) development company, is in the process of licensing a nuclear fuel fabrication facility to produce Tristructural Isotropic (TRISO) uranium fuel to power high temperature gas reactors (HTGRs) and other users of TRISO-based fuel and plans to purchase the site to develop the facility to fabricate pebble fuel for the Xe-100 pebble bed HTGR as well as for other advanced reactor designs. The license application will include information necessary for the U.S. Nuclear Regulatory Commission (NRC) to conduct an environmental analysis and make a decision regarding approval or denial of the requested license.

Wood conducted a review of the site on September 7-9, 2021. We have enclosed the *Waters of the U.S. Delineation Technical Report*, which includes relevant mapping, photographs, and HD field data sheets for each evaluated channel. Based on our review, we identified two intermittent streams (channel segments 1a, 1b, and 2a) that likely fall under the jurisdiction of the Tennessee Department of Environment & Conservation (TDEC) and the U.S. Army Corps of Engineers (USACE). Other drainages at the site were determined to be wet weather conveyances.

If an on-site review is required, please contact me to arrange access to the site. Should you have any questions regarding the enclosed, please contact me at (615) 424-6279 or email me at marymotte.fikri@woodplc.com.

Respectfully submitted,

Wood Environment & Infrastructure Solutions, Inc.

Mary Motte Fikri, PWS
Senior Biologist

Stan Rudzinski, CE, CPESC, QHP
Associate Biologist

Enclosure: TRISO-X Facility Environmental Report- Waters of the U.S. Delineation Technical Report, Horizon Center Site – Lot 6

Wood Environment & Infrastructure Solutions, Inc.
3800 Ezell Road, Suite 100
Nashville, Tennessee 37211
T: 615-333-0630
www.woodplc.com

February 2, 2022

Eastern Regulatory Field Office
U.S. Army Corps of Engineers
501 Adesa Blvd, Suite B 250
Lenoir City, Tennessee 37771
NashvilleRegulatory@usace.army.mil

Subject: **Request for Jurisdictional Determination**
TRISO-X Facility Project Area, Horizon Center-Lot 6
Oak Ridge, Roane County, Tennessee
Wood Project No. 325221235

Dear Sir/Madam:

On behalf of X-energy, Wood Environment & Infrastructure Solutions, Inc. (Wood) is requesting a Jurisdictional Determination (JD) on an approximately 150-acre site located along Renovare Boulevard, in Oak Ridge, Roane County, Tennessee. The property is currently owned by the City of Oak Ridge Industrial Development Board. X-energy, an advanced reactor (AR) development company, is in the process of licensing a nuclear fuel fabrication facility to produce Tristructural Isotropic (TRISO) uranium fuel to power high temperature gas reactors (HTGRs) and other users of TRISO-based fuel and plans to purchase the site to develop the facility to fabricate pebble fuel for the Xe-100 pebble bed HTGR as well as for other advanced reactor designs. The license application will include information necessary for the U.S. Nuclear Regulatory Commission (NRC) to conduct an environmental analysis and make a decision regarding approval or denial of the requested license.

Wood conducted a review of the site on September 7-9, 2021. We have enclosed the *Waters of the U.S. Delineation Technical Report,* which includes relevant mapping, photographs, and data sheets. Based on our review, we identified two intermittent streams (channel segments 1a, 1b, and 2a) that likely fall under the jurisdiction of the Tennessee Department of Environment & Conservation (TDEC) and the U.S. Army Corps of Engineers (USACE). Other drainages at the site were determined to be wet weather conveyances. No wetlands were identified at the site.

As indicated in the attached JD Request Form, the proposed project may require authorization from the USACE; however, project development is still in progress and impacts have not yet been identified. The JD would be used to avoid and minimize impacts to jurisdictional aquatic resources and as an initial step in a future permitting process.

If an on-site review is required, please contact us to arrange access to the site. Should you have any questions regarding the enclosed, please contact me at (615) 424-6279 or email me at marymotte.fikri@woodplc.com.

Respectfully submitted,

Wood Environment & Infrastructure Solutions, Inc.

Mary Motte Fikri, PWS
Senior Biologist

Stan Rudzinski, CE, CPESC, QHP
Associate Biologist

Enclosures: Appendix 1 – Request for Corps Jurisdictional Determination Form
TRISO-X Facility Environmental Report - Waters of the U.S. Delineation Technical Report, Horizon Center – Lot 6

March 9, 2022

Wood Environment & Infrastructure Solutions, Inc.
15933 Clayton Road, Suite 215
Ballwin, MO 63011
USA
T: 636-200-5100
www.woodplc.com

Brandon Wear, Regional Wildlife Program Manager
Tennessee Wildlife Resources Agency
Region 3 Office
464 Industrial Blvd.
Crossville, TN 38555

RE: Request for Information on Potential Site for a Proposed Fuel Fabrication Facility in Eastern Tennessee (Horizon Center Site)

Dear Mr. Wear,

Wood Environment & Infrastructure Solutions, Inc. (Wood) has been retained by TRISO-X, LLC (TRISO-X) to assist in the evaluation of construction and operation impacts for a proposed Fuel Fabrication Facility (FFF). TRISO-X is an advanced nuclear reactor design and fuel fabrication company that intends to fabricate advanced nuclear fuels from high assay low enriched uranium (HALEU), based on TRISO-X's uranium oxycarbide tristructural isotropic (TRISO) fuel forms, for use in both advanced reactors and the existing fleet of light-water reactors. TRISO-coated fuels are unique in their multi-layer encapsulation of uranium, providing increased safety, proliferation resistance, and functional containment. TRISO-X has demonstrated TRISO-based fuel fabrication capability at the commercial scale TRISO-X Pilot Facility at the Oak Ridge National Laboratory (ORNL).

A license under 10 CFR Part 70 from the Office of Nuclear Material Safety and Safeguards (NMSS) of the United States Nuclear Regulatory Commission (NRC) will be required for construction and operation of the proposed commercial TRISO-X FFF. TRISO-X is in the process of preparing an Environmental Report (ER) in compliance with NUREG 1748 (Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, issued by NRC) to be used by the NRC to prepare an Environmental Impact Statement (EIS) for compliance with the National Environmental Policy Act (NEPA).

In 2019, a potential site for the facility was identified at the existing Technology & Manufacturing Center in Oak Ridge, Anderson County, Tennessee that is currently operated by Centrus Energy Corporation. A request for information regarding that site was sent to your agency on September 12, 2019. However, TRISO-X has since revised its preferred site for potential construction and operation of the FFF and is considering an undeveloped, approximately 110-acre site identified as the Horizon Center Site (HCS) located near 201 Renovare Boulevard in Oak Ridge, Roane County, Tennessee, approximately 25 miles from Knoxville. The HCS property is currently owned by the City of Oak Ridge Industrial Development Board and TRISO-X may purchase all or a portion of this site for development of the FFF.

HCS has the available space for construction of infrastructure required for all activities from receiving the raw material to the production of the final fuel product, including fuel fabrication, material storage, administrative offices, and other supporting facilities. The site has access to needed utilities, such as

gas, supply of water, electricity, and other utilities. The facility would obtain water, for both potable and industrial use, from the City of Oak Ridge public distribution system. Similarly, the City of Oak Ridge would provide wastewater treatment services to the proposed facility.

The FFF would be constructed mostly on previously disturbed land with herbaceous vegetation cover that is mowed periodically. It would consist of the following features:

- Process building including administration
- Raw material preparation building
- Security/emergency operation building
- Electrical and mechanical equipment yards
- Roadways
- Drainage ditches
- Detention basin
- Shipping and receiving docks
- Gravel surfacing
- Grass seeding area
- Permanent asphalt parking areas
- Temporary construction laydown/parking/access roads
- Temporary sediment basin
- Temporary ditches

The potential area of disturbance during construction would be approximately 90 acres, with approximately 60 acres of permanent development and approximately 15 acres of temporary use areas, including construction parking, laydown, and gravel access roads.

As part of the planning and evaluation process, and to meet requirements in NUREG 1748, we are requesting information and input from Tennessee Wildlife Resources Agency to identify notable environmental resources or issues of concern that should be considered in the construction and operation of the proposed facility. These issues could include state threatened or endangered species, rare species and/or ecological communities listed and/or tracked by the State of Tennessee, "nuisance" species or species considered disease vectors or pests, habitat at the site for important species relative to the habitat available throughout the species' entire range, locations of travel corridors for important terrestrial species that could potentially be affected by use of the site, or the presence of wildlife species important for game or subsistence hunting or fishing.

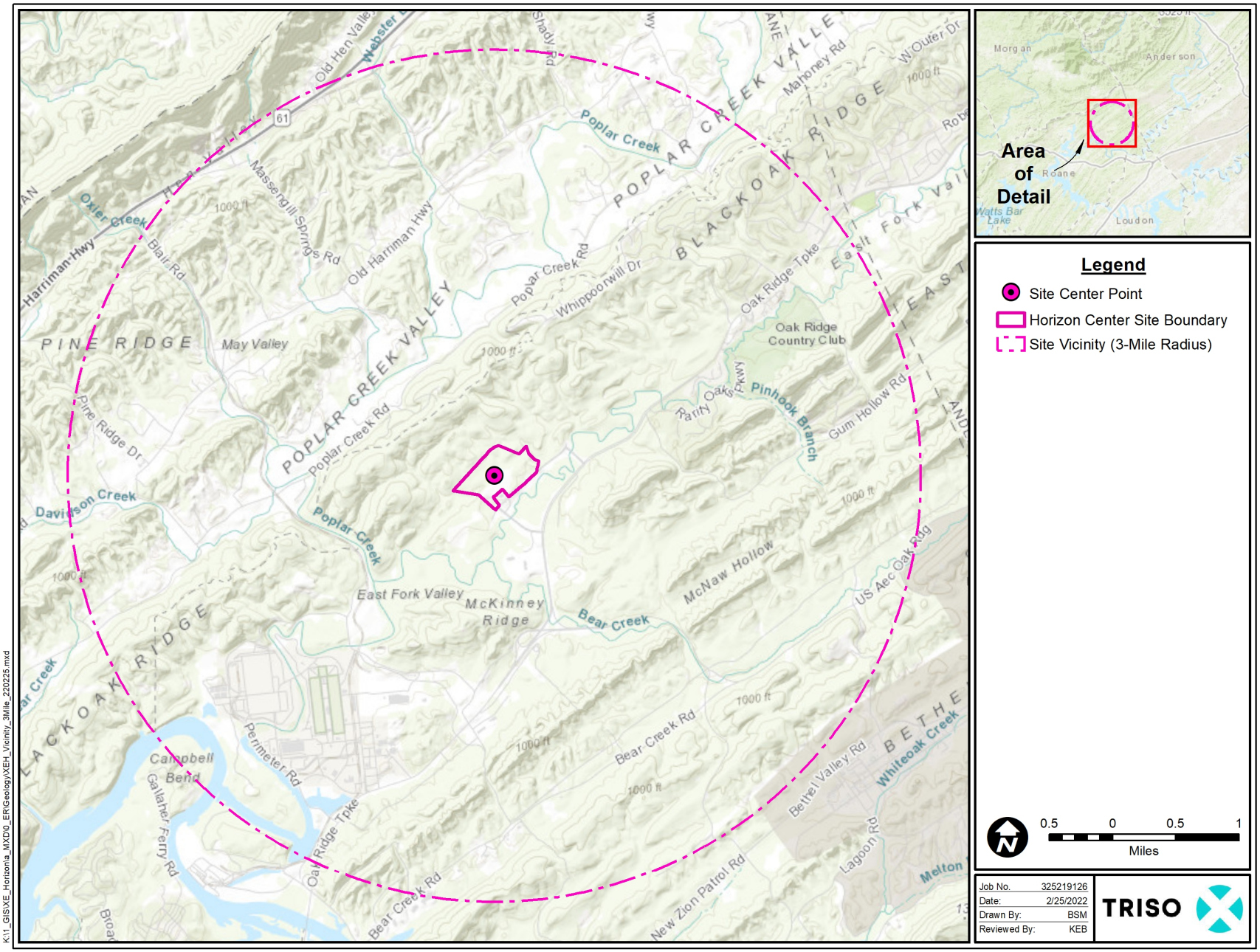
In conjunction with the guidance of NUREG 1748, a full range interdisciplinary analysis will be conducted in the preparation of the ER and the overall licensing process. To assist your consideration of this request, please find attached figures depicting the project site and vicinity. We respectfully request your review and input for our consideration in the development of licensing application materials.

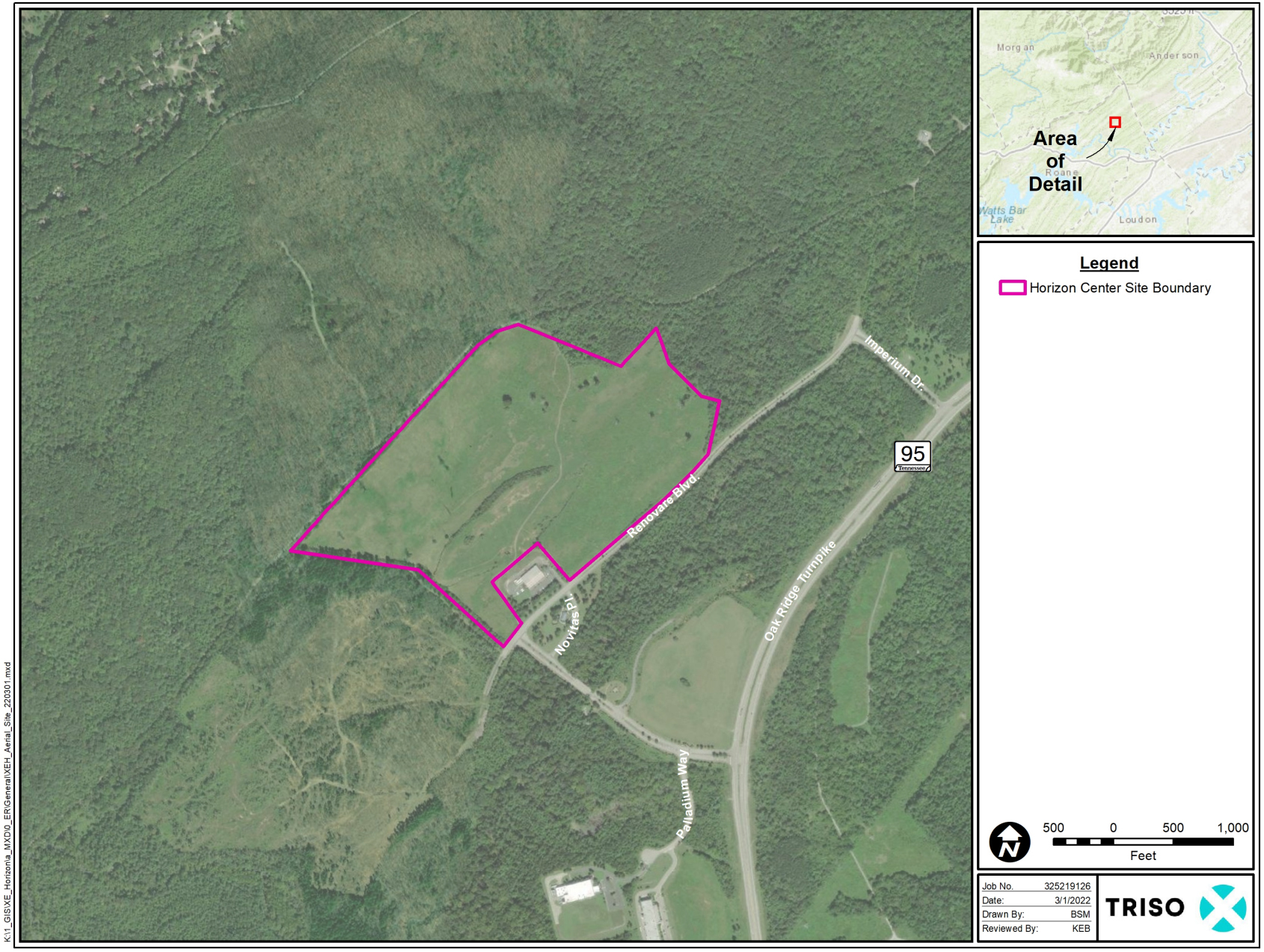
If you have any questions or comments about the proposed TRISO-X FFF or the materials provided, please call me at 314-520-1506.

Respectfully,

William Elzinga
Senior Associate Scientist

Attachment


Area of Detail
Legend
Site Center Point
Horizon Center Site Boundary
Site Vicinity (3-Mile Radius)
0.5 0 0.5 1
Miles
Job No. 325219126
Date: 2/25/2022
Drawn By: BSM
Reviewed By: KEB
TRISO
K:\1_GIS\XE_Horizonia_MXD\0_ER\Geology\XEH_Vicinity_3Mile_220225.mxd


Imperium Dr.
95
Renovare Blvd.
Novitas Pl.
Oak Ridge Turnpike
Palladium Way
Area of Detail
Morgan
Anderson
Roane
Watts Bar Lake
Loudon
Legend
Horizon Center Site Boundary
500 0 500 1,000
Feet
Job No. 325219126
Date: 3/1/2022
Drawn By: BSM
Reviewed By: KEB
TRISO
K:\1_GIS\XE_Horizon\a_MXD\0_ER\General\XEH_Aerial_Site_220301.mxd

March 9, 2022

Wood Environment & Infrastructure Solutions, Inc.
15933 Clayton Road, Suite 215
Ballwin, MO 63011
USA
T: 636-200-5100
www.woodplc.com

Mr. Robbie Sykes, Permits Coordinator
U.S. Fish and Wildlife Service
Tennessee Field Office
446 Neal Street
Cookeville, TN 38506

RE: Request for Information on Potential Site for a Proposed Fuel Fabrication Facility in Eastern Tennessee (Horizon Center Site)

Dear Mr. Sykes,

Wood Environment & Infrastructure Solutions, Inc. (Wood) has been retained by TRISO-X, LLC (TRISO-X) to assist in the evaluation of construction and operation impacts for a proposed Fuel Fabrication Facility (FFF). TRISO-X is an advanced nuclear reactor design and fuel fabrication company that intends to fabricate advanced nuclear fuels from high assay low enriched uranium (HALEU), based on TRISO-X's uranium oxycarbide tristructural isotropic (TRISO) fuel forms, for use in both advanced reactors and the existing fleet of light-water reactors. TRISO-coated fuels are unique in their multi-layer encapsulation of uranium, providing increased safety, proliferation resistance, and functional containment. TRISO-X has demonstrated TRISO-based fuel fabrication capability at the commercial scale TRISO-X Pilot Facility at the Oak Ridge National Laboratory (ORNL).

A license under 10 CFR Part 70 from the Office of Nuclear Material Safety and Safeguards (NMSS) of the United States Nuclear Regulatory Commission (NRC) will be required for construction and operation of the proposed commercial TRISO-X FFF. TRISO-X is in the process of preparing an Environmental Report (ER) in compliance with NUREG 1748 (Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, issued by NRC) to be used by the NRC to prepare an Environmental Impact Statement (EIS) for compliance with the National Environmental Policy Act (NEPA).

In 2019, a potential site for the facility was identified at the existing Technology & Manufacturing Center in Oak Ridge, Anderson County, Tennessee that is currently operated by Centrus Energy Corporation. A request for information regarding that site was sent to your agency on September 12, 2019. However, TRISO-X has since revised its preferred site for potential construction and operation of the FFF and is considering an undeveloped, approximately 110-acre site identified as the Horizon Center Site (HCS) located near 201 Renovare Boulevard in Oak Ridge, Roane County, Tennessee, approximately 25 miles from Knoxville. The HCS property is currently owned by the City of Oak Ridge Industrial Development Board and TRISO-X may purchase all or a portion of this site for development of the FFF.

HCS has the available space for construction of infrastructure required for all activities from receiving the raw material to the production of the final fuel product, including fuel fabrication, material storage, administrative offices, and other supporting facilities. The site has access to needed utilities, such as

gas, supply of water, electricity, and other utilities. The facility would obtain water, for both potable and industrial use, from the City of Oak Ridge public distribution system. Similarly, the City of Oak Ridge would provide wastewater treatment services to the proposed facility.

The FFF would be constructed mostly on previously disturbed land with herbaceous vegetation cover that is mowed periodically. It would consist of the following features:

- Process building including administration
- Raw material preparation building
- Security/emergency operation building
- Electrical and mechanical equipment yards
- Roadways
- Drainage ditches
- Detention basin
- Shipping and receiving docks
- Gravel surfacing
- Grass seeding area
- Permanent asphalt parking areas
- Temporary construction laydown/parking/access roads
- Temporary sediment basin
- Temporary ditches

The potential area of disturbance during construction would be approximately 90 acres, with approximately 60 acres of permanent development and approximately 15 acres of temporary use areas, including construction parking, laydown, and gravel access roads.

As part of the planning and evaluation process, and to meet requirements in NUREG 1748, we are requesting information and input from the U.S. Fish and Wildlife Service to identify notable environmental resources or issues of concern that should be considered in the construction and operation of the proposed facility. These issues could include threatened or endangered species listed under the Endangered Species Act, designated critical habitats, "nuisance" species or species that are of concern as disease vectors or pests, habitat at the site for important species relative to the habitat available throughout the species' entire range, locations of travel corridors for important terrestrial species that could potentially be affected by use of the site, or the presence of wildlife species important for game or subsistence hunting or fishing.

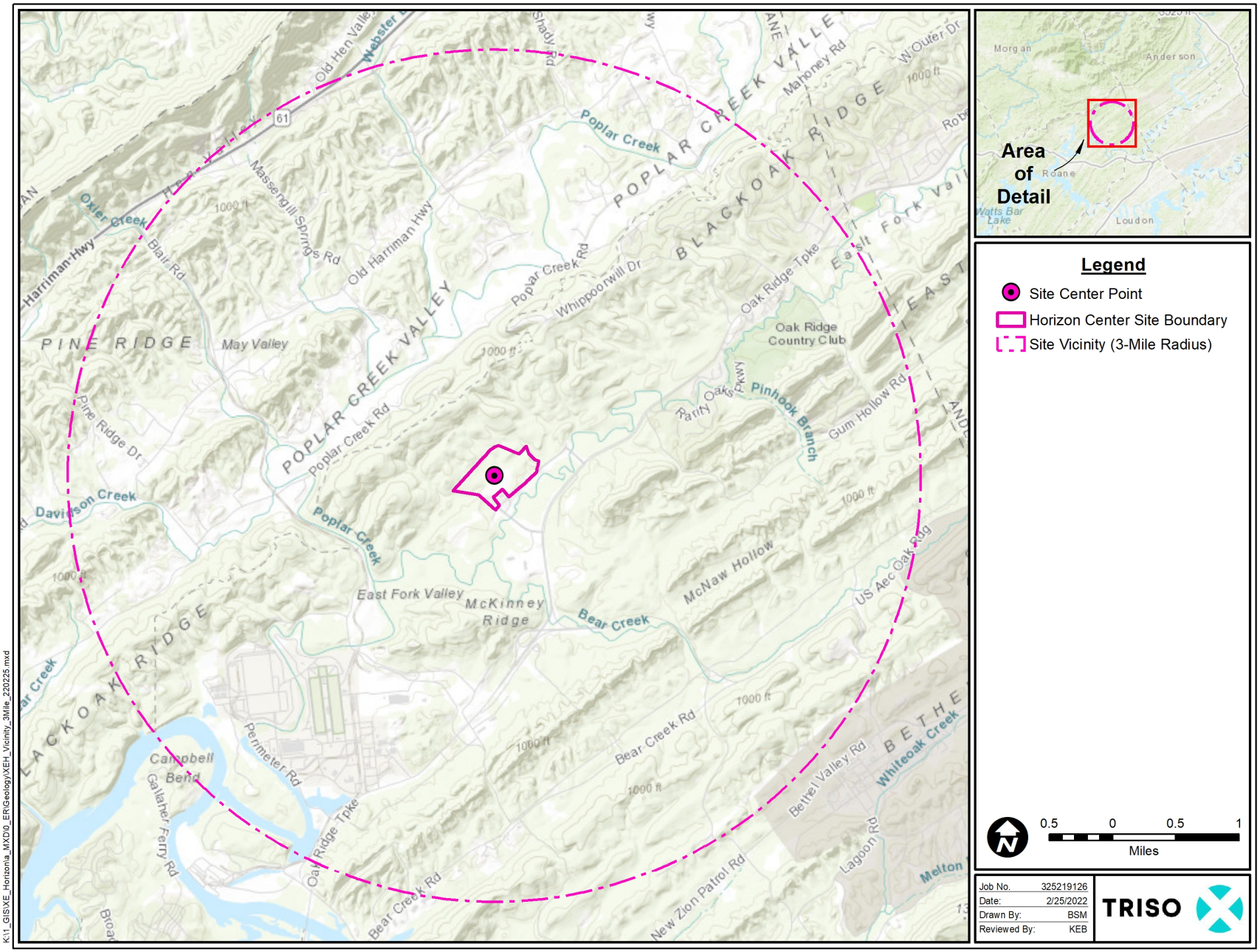
In conjunction with the guidance of NUREG 1748, a full range interdisciplinary analysis will be conducted in the preparation of the ER and the overall licensing process. To assist your consideration of this request, please find attached figures depicting the project site and vicinity. We respectfully request your review and input for our consideration in the development of licensing application materials.

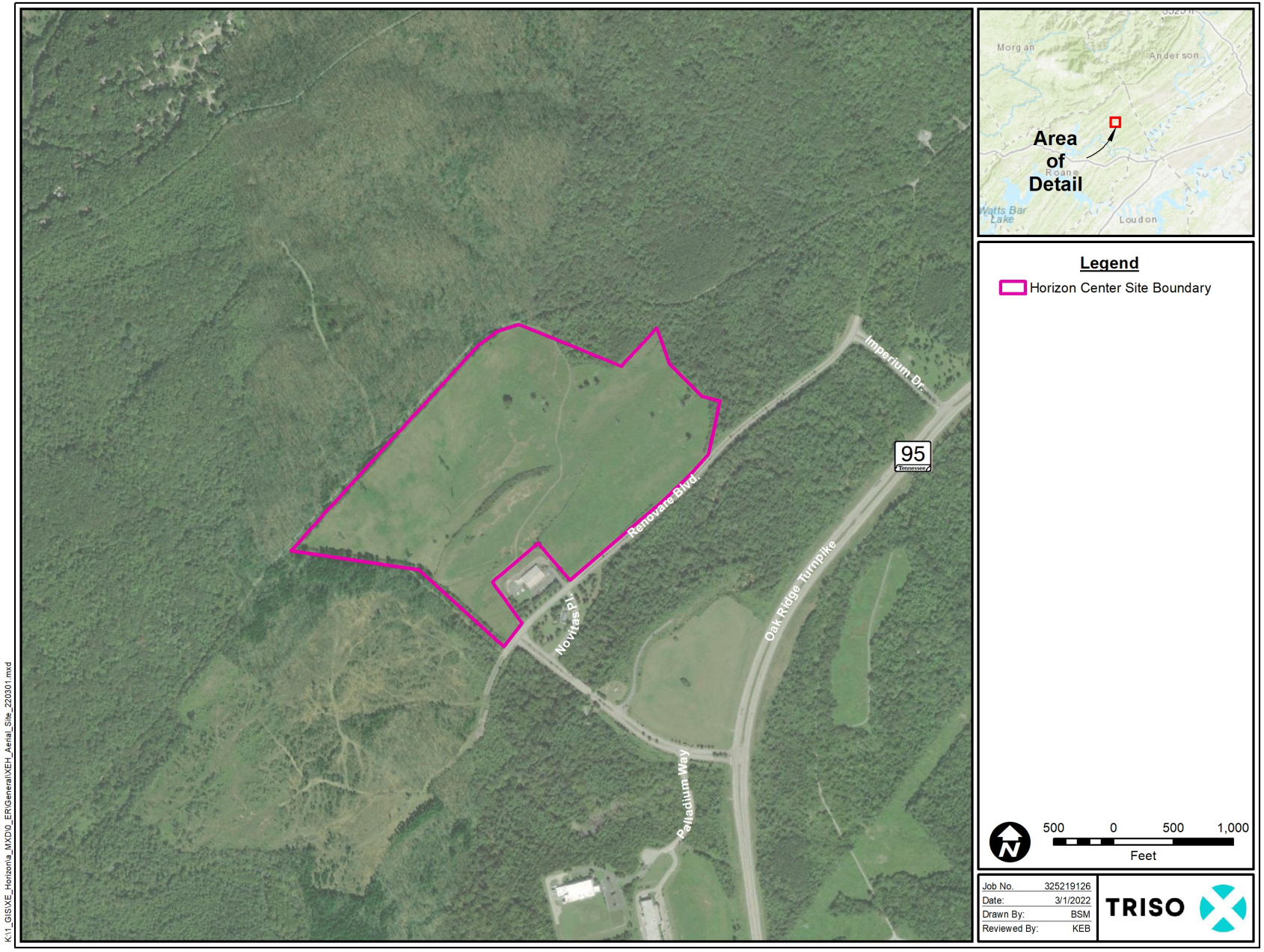
If you have any questions or comments about the proposed TRISO-X FFF or the materials provided, please call me at 314-520-1506.

Respectfully,

William Elzinga
Senior Associate Scientist

Attachment


Area of Detail
Legend
Site Center Point
Horizon Center Site Boundary
Site Vicinity (3-Mile Radius)
0.5 0 0.5 1
Miles
Job No. 325219126
Date: 2/25/2022
Drawn By: BSM
Reviewed By: KEB
TRISO
K:\1_GIS\XE_Horizonia_MXD\0_ER\Geology\XEH_Vicinity_3Mile_220225.mxd


Area of Detail
Morgan
Anderson
Roane
Watts Bar Lake
Loudon
Legend
Horizon Center Site Boundary
Imperium Dr.
95
Renovare Blvd.
Novitas Pl.
Oak Ridge Turnpike
Palladium Way
500 0 500 1,000
Feet
Job No. 325219126
Date: 3/1/2022
Drawn By: BSM
Reviewed By: KEB
TRISO
K:\1_GIS\XE_Horizon\a_MXD\0_ER\General\XEH_Aerial_Site_220301.mxd

From: Alexander, Steven
To: Porath, Rebecca; Elzinga, William J
Subject: TRISO-X Project on the Oak Ridge Reservation
Date: Friday, April 15, 2022 6:08:05 AM

Ms. Porath and Mr. Elzinga –

The U.S. Fish and Wildlife Service has reviewed the IPaC information and your correspondence, dated March 9, 2022, regarding the proposed nuclear fuel fabrication facility at the Horizon Center Site in Roane County. This area of the Oak Ridge Reservation provides significant summer roosting habitats for the federally endangered Indiana bat and threatened Northern long-eared bat. The general project area has significant karst features which support the federally endangered Gray bat and this specific parcel is adjacent to the Black Oak Ridge Conservation Easement.

This parcel was cleared by the Oak Ridge Industrial Development Board several years ago without appropriate environmental review or permitting by the State of Tennessee. There have been numerous protected species surveys on this site and the parcel has deed restrictions which direct appropriate environmental documentation requirements pursuant to the National Environmental Policy Act. We will provide a thorough review of your Environmental Assessment (EA) when completed. This information should include all necessary site infrastructure requirements including source(s) of electricity and water needed to facilitate its construction and operation. Please forward the draft EA and any ancillary project information to my attention.

Sincerely,

Steven R. Alexander

U.S. Fish and Wildlife Service
South Atlantic-Gulf Interior Region
Tennessee Ecological Services Field Office
446 Neal Street
Cookeville, TN 38501
931/525-4980 (office)
931/650-0004 (cell)
931/528-7075 (fax)
steven_alexander@fws.gov
Web: http://cookeville.fws.gov

>>> I am working from home during the COVID-19 pandemic. All calls to my office phone are being forwarded to my cellphone. <<<
****

From: Elzinga, William J
To: Alexander, Steven
Cc: Jennifer Wheeler; Porath, Rebecca
Subject: Re: TRISO-X Project on the Oak Ridge Reservation
Date: Friday, April 15, 2022 8:05:34 AM

Mr. Alexander,

Thank you so much for your prompt response to our letter on behalf of TRISO-X, LLC regarding the proposed TRISO-X Fuel Fabrication Facility in Oak Ridge, Tennessee. We appreciate your comments and acknowledge your observed sensitivities regarding the environmental resources of the Horizon Center Site and it's associated environs. We can assure you that these factors have been taken into full account as part of our analysis.

Our analysis will be included in an Environmental Report (ER) that will be issued by the Nuclear Regulatory Commission (NRC) in their preparation of an Environmental Impact Statement (EIS) for the proposed project in conjunction with their licensing action. The NRC will certainly engage the USFWS as part of their ER review process.

Again, we thank you for your comments and we welcome continued dialog with the USFWS if needed.

Note that for your information I am also copying Ms. Jennifer Wheeler who is the environmental licensing lead for TRISO-X, LLC.

Regards,

Bill Elzinga

From: Alexander, Steven <steven_alexander@fws.gov>
Sent: Friday, April 15, 2022 6:08 AM
To: Porath, Rebecca; Elzinga, William J
Subject: TRISO-X Project on the Oak Ridge Reservation

Ms. Porath and Mr. Elzinga –

The U.S. Fish and Wildlife Service has reviewed the IPaC information and your correspondence, dated March 9, 2022, regarding the proposed nuclear fuel fabrication facility at the Horizon Center Site in Roane County. This area of the Oak Ridge Reservation provides significant summer roosting habitats for the federally endangered Indiana bat and threatened Northern long-eared bat. The general project area has significant karst features which support the federally endangered Gray bat and this specific parcel is adjacent to the Black Oak Ridge Conservation Easement.

This parcel was cleared by the Oak Ridge Industrial Development Board several years ago without appropriate environmental review or permitting by the State of Tennessee. There have been numerous protected species surveys on this site and the parcel has deed restrictions which direct appropriate environmental documentation requirements pursuant to the National Environmental Policy Act. We will provide a thorough review of your Environmental Assessment (EA) when completed. This information should include all necessary site infrastructure requirements including source(s) of electricity and water needed to facilitate its construction and operation. Please forward the draft EA and any ancillary project information to my attention.

Sincerely,

Steven R. Alexander

U.S. Fish and Wildlife Service
South Atlantic-Gulf Interior Region
Tennessee Ecological Services Field Office
446 Neal Street
Cookeville, TN 38501
931/525-4980 (office)
931/650-0004 (cell)
931/528-7075 (fax)
steven_alexander@fws.gov
Web: http://cookeville.fws.gov

>>> I am working from home during the COVID-19 pandemic. All calls to my office phone are being forwarded to my cellphone. <<<
****

April 13, 2022

Wood Environment & Infrastructure Solutions, Inc.
15933 Clayton Road, Suite 215
Ballwin, MO 63011
USA
T: 636-200-5100
www.woodplc.com

Mr. E. Patrick McIntyre, Jr.
Executive Director and State Historic Preservation Officer
Tennessee Historical Commission
State Historic Preservation Office
2941 Lebanon Pike
Nashville, TN 37214

RE: Phase I Cultural Resource Survey for the TRISO-X Fuel Fabrication Facility Horizon Center Site TRISO-X, LLC U.S. Nuclear Regulatory Commission (NRC) Licensing Application Project, Roane County, Tennessee

Dear Mr. McIntyre,

On behalf of TRISO-X LLC, Wood Environment & Infrastructure Solutions, Inc (Wood) is completing environmental reviews and environmental clearance documentation for a proposed project in Roane County, Tennessee. Wood is working to support our client (TRISO-X, LLC) to obtain a license from the United States National Regulatory Commission (NRC) for the proposed nuclear fuel fabrication facility to produce TRistructural ISOtropic (TRISO) uranium fuel to power high-temperature gas reactors (HTGRs). The licensing application includes an Environmental Report (ER) that NRC will use in the consideration of the licensing action and their preparation of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA). The NRC released NUREG-1748 which provides guidance to NRC staff in conducting their environmental review of licensing actions. The environmental review process is initiated by an application for a new license or certification. NUREG 1748, Chapter 6, provides guidance to NRC staff, but this guidance is also used to assist the applicant/licensee in preparing the ER which aids the NRC in preparing an EA or EIS and complying with Section 102(2) of NEPA. Chapter 6.3.8 of NUREG 1748 notes that the ER should include the results of any consultation that the applicant may have had with Federal, State, local, and affected American Indian tribal agencies. The results of the site investigations related to historic properties and the correspondence with the SHPO will be documented in the ER which will be submitted to NRC as part of the license application (Note: the license application will be submitted by TRISO-X, LLC). Formal consultation will be conducted with the Tennessee State Historic Preservation Office (TN-SHPO) by NRC during the process of their review of the ER and their preparation of the EIS in accordance with the Section 106 process. We respectfully request comment from your office on the results of the attached Phase I Cultural Resource Survey Report and will represent the content of your comments in the ER.

The survey area for the archaeological survey consists of 150.1 acres (ac), while the Area of Potential Effect (APE) represents a subset of the survey area equaling approximately 110 acres. After archaeological survey of 150.1 acres was complete, TRISO-X reduced the size of their proposed project to 110 acres, known as the Horizon Center Site (HCS) within the original survey area. Since the survey was already complete and archaeological sites were identified outside the revised proposed project boundary, both the survey area (150.1 acres) and the APE (110 acres) were reported. TRISO-X proposes to build the TRISO-X Fuel Fabrication Facility within the APE and no construction or ground disturbance is planned outside of this boundary.

Wood determined that investigation of a 0.5-mile viewshed or visual Area of Potential Effects (APE) was appropriate to assess impacts on offsite architectural resources. However, background research was conducted for a 2-mile buffer of the survey area for both archaeological and architectural resources in an effort to gain a thorough understanding of the project vicinity prior to initiation of fieldwork.

During the archaeological survey, a total of five archaeological sites and one historic cemetery were documented: 40RE637, 40RE638, 40RE639, 40RE640, 40RE641, and the McKamey and Carmichael Cemetery. Sites 40RE637, 40RE638, and a portion of the McKamey and Carmichael Cemetery are located within the APE. The remaining sites (40RE639, 40RE640, and 40RE641) are located in the survey area but outside of the APE and no proposed construction or ground disturbance is planned at these sites.

Site 40RE637 is a historic domestic dwelling dating to the mid-nineteenth century and 40RE638 is a historic dwelling dating to the early-nineteenth to early-twentieth century. Wood recommends site 40RE637 and 40RE638 be considered not eligible for the National Register of Historic Places (NRHP) and no further archaeological work is recommended.

Sites 40RE639 and 40RE640 are historic domestic dwellings dating to the early- to mid-nineteenth century into the late-nineteenth century. Site 40RE639 contains a pile of cut stone with brick present that may represent a fallen chimney. Roughly 50 m east of 40RE639 is site 40RE640, a historic domestic dwelling with intact features. Site 40RE640 is a multicomponent historic domestic dwelling dating to the early-nineteenth century that continued into the early-twentieth century. 40RE640 also contains several intact and remnant historic features, including at least two large cut limestone piles, a stacked cut limestone wall within a deep depression that likely represents a cellar, and a large semi-circular wet and shallow area lined on its western side with cut limestone. Wood recommends avoidance of sites 40RE639 and 40RE640. If avoidance is not possible, additional archaeological and archival work is recommended to determine their NRHP eligibility.

Site 40RE641 is a multicomponent site containing three pieces of prehistoric lithic debitage of unknown temporal affiliation and a historic domestic dwelling dating to the late-nineteenth to early-twentieth century. Wood recommends 40RE641 be considered not eligible for the NRHP and no further archaeological work is recommended.

The McKamey and Carmichael Cemetery is a family cemetery dating to the mid-nineteenth to mid-twentieth century. The cemetery contains 22 possible grave markers and may represent a minimum of 16 graves. The earliest readable death date is Mary J. Carmichael, died Dec. 17, 1867, and the latest

readable headstone is Sarah Carmichael, born 1885, aged 62 years, equalling a death date of 1947. Wood recommends avoidance of the cemetery and its associated 100 ft (30.48 m) buffer. Based on the APE, the edge of the cemetery buffer is encroached upon by a distance of up to 50 ft (15.2 m). If avoidance is not possible, Wood recommends additional archaeological work that includes the use of near-surface geophysics to identify any unmarked graves within or surrounding the cemetery enclosure and associated buffer and archaeological monitoring of all proposed work within the cemetery or associated buffer.

The architectural viewshed survey identified one aboveground resource over 50 years of age within the survey area in Roane County. The resource located within the architectural survey area consists of the Silvey Cemetery dating to the mid-nineteenth to early-twentieth century. This historic resource is not eligible for listing on the NRHP.

We respectfully request your review and comment in regard to the attached report that summarizes Wood's findings and NRHP recommendations resulting from our cultural resources investigations.

If you have any questions or additional concerns, please contact me at 314-520-1506 or by email at: William.elzinga@woodplc.com.

Respectfully,

William Elzinga
Principal Scientist

Enclosure

cc. Jennifer Wheeler, TRIS-X, LLC

TENNESSEE HISTORICAL COMMISSION
STATE HISTORIC PRESERVATION OFFICE
2941 LEBANON PIKE
NASHVILLE, TENNESSEE 37243-0442
OFFICE: (615) 532-1550
www.tnhistoricalcommission.org

April 14, 2022

Mr. William Elzinga
Wood Environmental and Insfrastructure Solutions, Inc.
15933 Clayton Road, Suite 215
Ballwin, MO 63011

RE: NRC / Nuclear Regulatory Commission, TRISO-X Fuel Fabrication Facility Horizon Center Site
TRISO-X, LLC, Oak Ridge, Roane County, TN

Dear Mr. Elzinga:

In response to your request, we have reviewed the cultural resources survey report and accompanying documentation submitted by you regarding the above-referenced undertaking. Our review of and comment on the proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicants for federal assistance to consult with the appropriate State Historic Preservation Office before they carry out their proposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739).

Considering the information provided, we find that no historic properties eligible for listing in the National Register of Historic Places will be affected by this undertaking. As noted in your correspondence, the Nuclear Regulatory Commission (NRC) has not consulted with our office directly. This letter serves only to concur with the applicant's proposed determinations of effect. Final formal consultation and determinations of effect will be conducted between our office and the NRC. If project plans are changed that may affect potentially eligible sites 40RE639 and/or 40RE640 or archaeological remains are discovered during project construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act. Questions or comments may be directed to Jennifer Barnett (615) 687-4780, Jennifer.Barnett@tn.gov.

Your cooperation is appreciated.

Sincerely,

E. Patrick McIntyre, Jr.

E. Patrick McIntyre, Jr.
Executive Director and
State Historic Preservation Officer

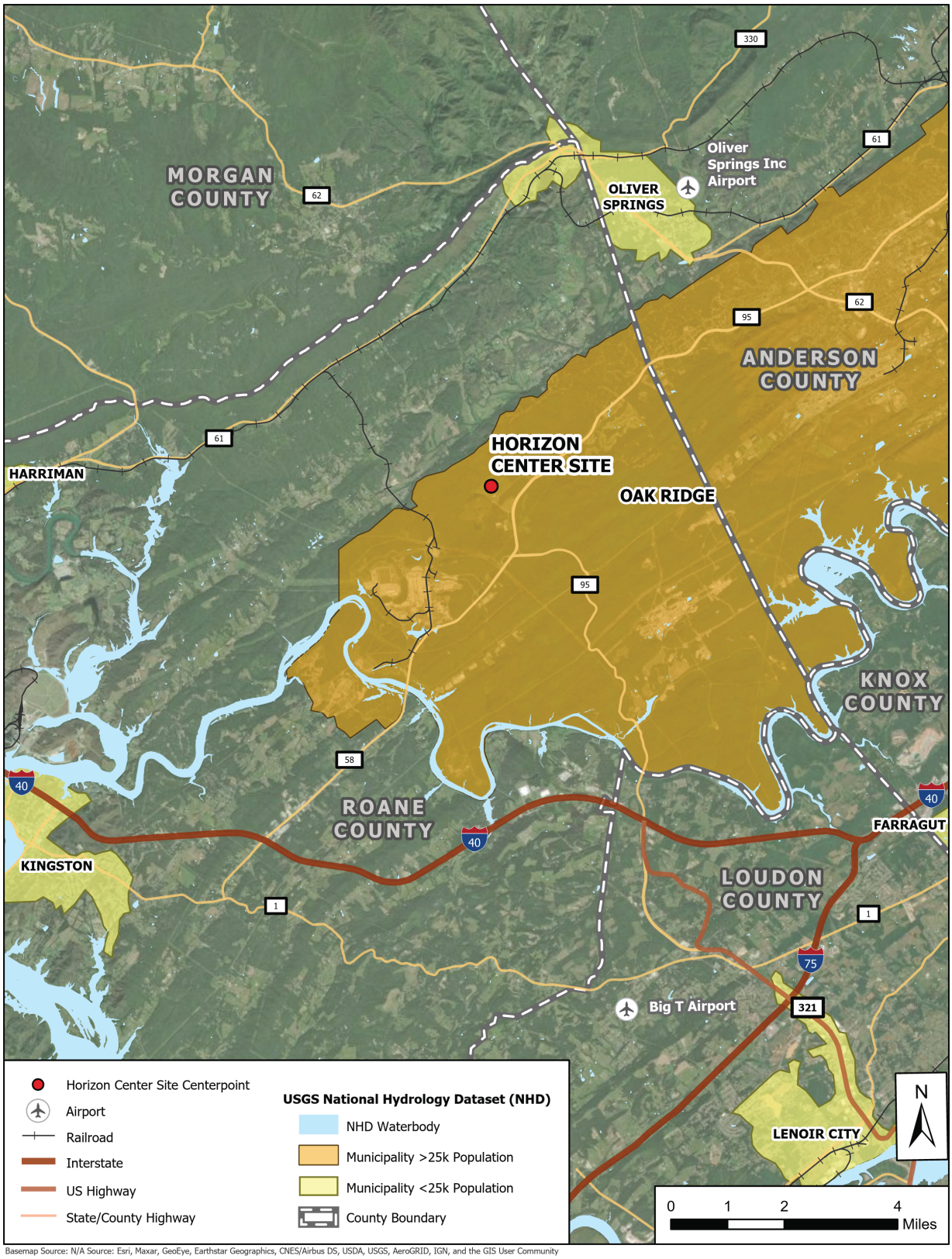
EPM/jmb

Sent: Tuesday, May 24, 2022 8:25 AM
To: Fikri, Mary Motte
Subject: HD submittal approval

I have reviewed a letter and submittal dated Feb 2, 2022 for Horizon Lot 6 (Wood project No. 325221235). This HD is approved as submitted and the data contained within it will be added to our HD database.
Please reply or call if you have any questions. Thanks,

Steve Brooks | Environmental Scientist
Division of Water Resources
Knoxville Environmental Field Office
3711 Middlebrook Pike
Knoxville, TN 37921
865-364-9498 Direct
865-594-6035 Switchboard
865-594-6105 Fax
888-891-8332 Toll Free
Email: steven.brooks@tn.gov
https://tn.gov/environment/section/wr-water-resources

Figure 1.3-1
Site Location



Basemap Source: N/A Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 1.3-2
Bounding Limits

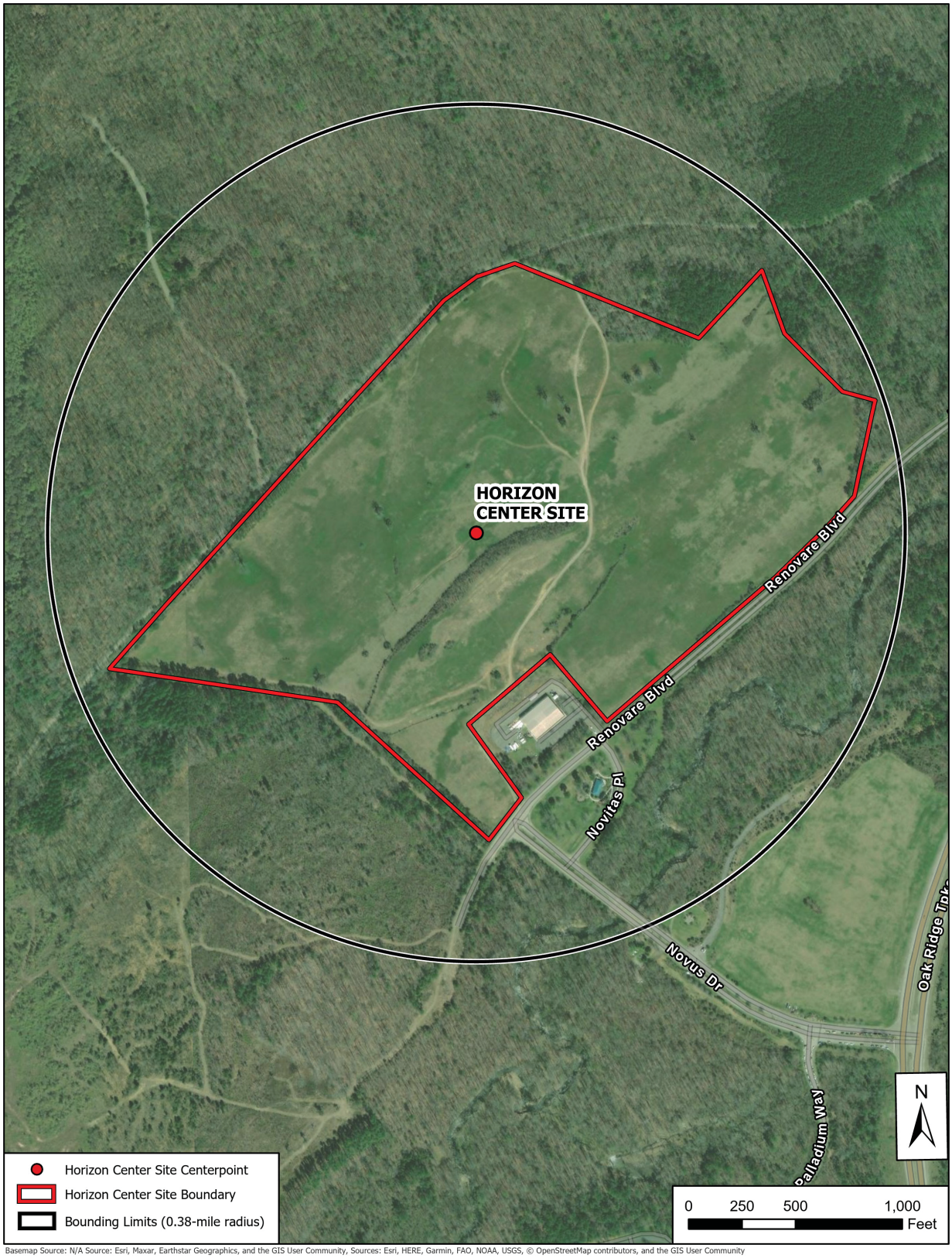
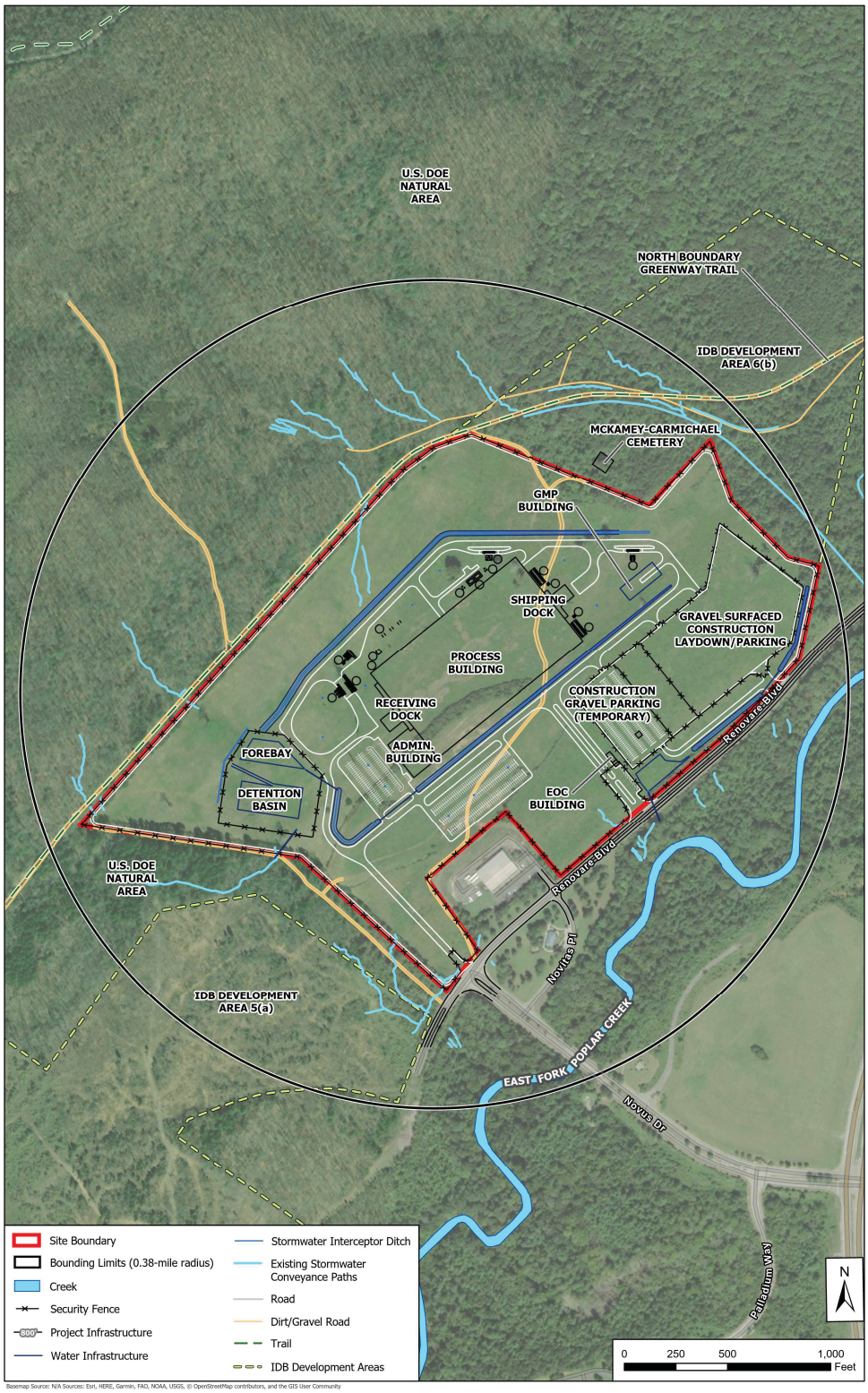


Figure 1.3-3
Site Plan



CHAPTER 2
ALTERNATIVES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ac.	acre
ACP	American Centrifuge Plant
ADUN	acid deficient uranyl nitrate
AEA	Atomic Energy Act
AGR	Advanced Gas Reactor
ARC15	Advanced Reactor Concept 2015
ASME	American Society of Mechanical Engineers
ATF	Accident tolerant fuel
Btu/hr	British thermal units per hour
C	degrees Celsius
CAS	Chemical Abstracts Service
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CCS	Closed Cooling System
DAW	Dry active waste
DFP	Decommissioning funding plan
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EGU	Electric Generating Unit
EIA	Energy Information Administration
EMDF	Environmental Management Disposal Facility
EPRI	Electric Power Research Institute
ER	Environmental Report
ETTP	East Tennessee Technology Park
^{o}F	degrees Fahrenheit
GE	General Electric

Acronym/Abbreviation	Definition
GMC	General Motors Corporation
GMP	Graphite matrix powder
GNF	Global Nuclear Fuel
ha	hectares
HALEU	High-assay low enriched uranium
HCS	Horizon Center site
HEPA	High-efficiency particulate air
HMTA	Hexamethylenetetramine
hr.	hour
HTGR	High-Temperature Gas-cooled Reactor
HVAC	Heating, ventilation, and air conditioning
IBC	Intermediate Bulk (Storage) Container
INL	Idaho National Laboratory
KCF	Kernel Conversion Furnace
km	kilometer
LWR	Light Water Reactor
m^3	cubic meters
mi.	mile
MSR	Molten Salt-Cooled Reactor
MSW	municipal solid waste
MTS	Methyltrichlorosilane
MTU	metric tons uranium
NASA	National Aeronautics and Space Administration
NE	Office of Nuclear Energy
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NRC	U.S. Nuclear Regulatory Commission
NMSS	Nuclear Material Safety and Safeguards
NQA	Nuclear Quality Assurance

Acronym/Abbreviation	Definition
NTP	Nuclear Thermal Propulsion
OCP	Overcoated particle
OMA	Organic Mix Area/Chemical Storage Area
ORED	Oak Ridge Electric Department
ORETTC	Oak Ridge Enhanced Technology and Training Center
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PHRS	Process Heat Removal System
PPE	personal protective equipment
QC	Quality control
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
scf	Standard cubic feet
SMR	Small modular reactor
SRS	Savannah River Site
TCF	TRISO Coating Furnace
TDEC	Tennessee Department of Environment and Conservation
TMC	Centrus Technology Manufacturing Center
TRISO	TRi-structural ISOtropic
TRISO-X	TRISO-X, LLC
TRISO-X FFF	TRISO-X Fuel Fabrication Facility
TSDF	Treatment, storage, or disposal facility
TSP	Temporary sediment pond
U_3O_8	Triuranium octoxide
^{235}U	Uranium-235
USEPA	U.S. Environmental Protection Agency
USNC	Ultra Safe Nuclear Corporation
WQV	Water quality volume

Acronym/Abbreviation	Definition
y^3	cubic yards
Y-12	Y-12 National Security Complex

CHAPTER 2

Alternatives

This chapter of the Environmental Report (ER) describes the alternatives considered by TRISO-X, LLC (TRISO-X) for the TRISO-X Fuel Fabrication Facility (TRISO-X FFF) that is located at the Horizon Center site (HCS). Section 2.1 identifies and describes the No--Action Alternative, the Proposed Action, and any reasonable alternatives to the Proposed Action. Section 2.2 identifies potential alternatives that were not considered to be reasonable and were therefore eliminated from further study. Section 2.3 provides a discussion of reasonably foreseeable future actions that could result in cumulative impacts when combined with the Proposed Action. Lastly, Section 2.4 provides a summary and comparison of the impacts of the Proposed Action, the No-Action Alternative, and the reasonable alternatives.

2.1 DETAILED DESCRIPTION OF THE ALTERNATIVES

This section of the ER identifies and describes the No-Action Alternative, the Proposed Action, and any reasonable alternatives, including the technical design requirements for the Proposed Action. This section of the ER also discusses any potential options for the Proposed Action.

2.1.1 NO-ACTION ALTERNATIVE

The Proposed Action and the purpose and need for the Proposed Action are described in Section 1.3 and Section 2.1.2 of the ER. The proposed Federal action is the issuance of a license by the U.S. Nuclear Regulatory Commission (NRC) for the construction and operation of the TRISO-X FFF at the HCS.

The TRISO-X FFF produces TRi-structural ISOtropic (TRISO) particle fuel, which is a High-Assay Low-Enriched Uranium (HALEU) nuclear fuel based on the TRISO fuel form (see Section 1.1). TRISO-X uses uranium oxide that is enriched to less than 20 percent uranium-235 (^{235}U).

The TRISO-X fuel is used in the following types of nuclear facilities:

- National Aeronautics and Space Administration (NASA) Nuclear Thermal Propulsion (NTP) concepts.
- U.S. Department of Defense (DOD) micro-reactors.
- High-Temperature Gas-cooled Reactors (HTGRs).
- Molten Salt-cooled Reactors (MSRs).
- Light Water Reactors (LWRs) that use TRISO-based accident tolerant fuel (ATF).

The Proposed Action improves the overall economic outlook for the U.S. nuclear power industry by contributing to the development of domestic nuclear fuel providers and enabling them to expand and compete internationally. The production of TRISO-X fuel, which the U.S. Department of Energy (DOE) Office of Nuclear Energy (NE) has called “the most robust fuel on Earth” (DOE-NE, 2019) contributes substantially to the fuel supply chain, making the U.S. a global leader in safe, reliable, and economically feasible nuclear energy.

Under the No-Action Alternative, the NRC does not issue a license for the construction and operation and the TRISO-X FFF is not be built. The facility is not available for the production of TRISO-X fuel and the fuel would not be available from this facility for the nuclear industry. Therefore, the No-Action Alternative negatively impacts the domestic and international availability of TRISO-X fuel.

Under the No-Action Alternative, it is expected that other types of power generation are used in place of advanced reactors, including fossil-fuel based thermal power plants. Fossil-fuel use contributes to greenhouse gas emissions and other forms of air pollution that are not associated with nuclear power plants. Nuclear energy is a reliable energy source and creates higher paying jobs. Under the No-Action Alternative, the country uses less reliable sources of energy and creating fewer high paying jobs.

The No-Action Alternative does not result in any of the potential environmental impacts from the construction and operation of the TRISO-X FFF at the HCS, as described in Chapter 4 and summarized in Section 2.4 below. If the action doesn't proceed, then the adverse impacts associated with the nuclear industry, including spent fuel or radioactive waste transportation, storage and disposal do not have to be dealt with.

Under the No-Action Alternative, there are no impacts to the ecology, floodplains, wetlands, historical and cultural resources, public and occupational health, waste management, environmental justice, and visual/scenic conditions. The current terrain, groundwater, and surface water availability and quality would remain the same.

The current levels and/or projections of land development and transportation would not be affected. Under the No-Action Alternative, the area would not benefit from the expected positive impacts of the Proposed Action on local employment, income, and tax revenues during the construction, manufacturing, operation, and decommissioning phases.

2.1.2 PROPOSED ACTION

This section provides a description of the Proposed Action, including a facility description, summary of construction, operations, and decommissioning activities and a summary of potential impacts.

2.1.2.1 Description of Proposed Action

The proposed Federal action is the issuance of a license to possess and use special nuclear material, under the provisions of 10 CFR 70, that would allow TRISO-X to possess and use special nuclear material in the TRISO-X FFF to produce TRISO-based coated particles and final fuel forms using uranium enriched to less than 20 weight percent ^{235}U. The TRISO uranium fuel produced is used for nuclear reactor developers and by the energy, aerospace, industrial, and defense sectors. The applicant for this license and owner of the nuclear FFF is TRISO-X.

TRISO-X has the necessary authority, control, and rights related to the construction and operation of the nuclear fuel fabrication facility once the license is approved.

2.1.2.1.1 Facility Description

2.1.2.1.1.1 Site Location

The HCS is located within the city limits of Oak Ridge, Roane County, Tennessee. The HCS boundary is approximately 7 mi. (11 km) southwest of the approximate city center of Oak Ridge. The TRISO-X FFF is centered at the following geographic coordinates.

State Plane Coordinate System
Zone TN-4100
Northing 596,650.000 US Survey Feet
Easting 2,450,750.000 US Survey Feet

Universal Traverse Mercator (UTM)/USNG coordinates
Northing 3,982,867.000 Meters
Easting 737,142.857 Meters

National Geodetic Survey (NGS) coordinates
Latitude 35° 57’ 41.13171” N
Longitude 84° 22’ 13.36646” W

As discussed in Section 1.3.1.2, bounding limits are defined by the circle with a radius of 0.38 mi. (0.61 km) measured from the center point and encompasses all the property within the HCS. A map of the TRISO-X FFF bounding limits is provided in Figure 2.1-1.

The sensitive populations (e.g., schools, daycare facilities, hospitals), nearest resident, and landmarks (including highways, transportation facilities, and rivers and other bodies of water) within the Region of Influence (ROI), which includes Roane, Anderson, Knox, Loudon, and Morgan counties, are discussed within Section 3.10.

2.1.2.1.1.2 Site Layout

Figure 2.1-1 shows the overall site layout depicting major structures and the site boundary. As discussed in Section 1.3, the TRISO-X FFF encompasses approximately 110 acres (ac.) (44.6 hectares (ha)). The following structures are located on the site:

- Process Building.
- Administration Building.
- Graphite Matrix Power (GMP) Building.
- Security/Emergency Operations Center Building.
- Electrical and mechanical equipment yards.
- Process building exhaust stack.
- Roadways.
- Detention basin and drainage ditches.

- Permanent parking areas.
- Shipping and receiving docks.
- Temporary construction laydown/parking.
- Temporary sediment basin and drainage ditches.

2.1.2.1.1.3 Underground Features

A natural gas pipeline provides commercial natural gas to the TRISO-X FFF. Municipal water is supplied with a new line connected to the City of Oak Ridge water main. Similarly, a connection to the city sanitary sewer line is provided to the sanitary sewer system. Within the project site, additional underground utilities are provided for various mechanical distribution piping and electrical conduits and duct banks. Underground tanks are located on site storing various liquid chemicals (See Table 2.1-1a). There are no underground electric lines, as off-site power is brought to the facility from overhead distribution lines. Some of the stormwater features are located underground as discussed in Section 2.1.2.1.1.4.

2.1.2.1.1.4 Stormwater and Sewage Features

2.1.2.1.1.4.1 Site Drainage Description

Stormwater runoff collected within the HCS property is discharged at two outlets located at west and southeast periphery of the site. There is also a temporary outlet from the temporary sediment pond which is in place during construction (TSP outlet).

The west outlet is located on the southwest side of the property and directly discharges the runoff collected from the western half of the undeveloped area of the site, with some minor natural ponding in depressed areas. This natural depression collects runoff from a major portion of the pre-developed and post-developed site areas, excluding the construction laydown and craft parking. The pre-developed runoff includes the off-site run-on from the north via two 24-inch culverts. The run-on and the site accumulated runoff follow natural drainage patterns and accumulates in the low areas of the site. The low depressed areas of the site provide a brief detention and the overflow from these areas discharges to the natural channel on the west side and flow continues through the DOE greenbelt zone to a natural depression located within the DOE greenway area west of the site.

The post-developed runoff from the plant areas and the off-site run-on from the north is collected in stormwater ditches. The flow from these ditches gets drained to the detention pond located near the western boundary of the site. This detention pond consists of a forebay to collect the first wash and provide ample amount of detention time for sedimentation to occur and also to provide retention for a portion of the Water Quality Volume (WQV) required to be retained in the pond per Tennessee Department of Environment and Conservation (TDEC) and the City of Oak Ridge requirements. The main detention pond is sized to provide the required retention for the WQV, in addition to detaining the maximum runoff generated by the design rainfall event. Effluent from the detention pond is controlled to keep the flow rate at or below the pre-developed site condition. An emergency spillway is provided to discharge flows due to above 100-year rainfall events.

The southeast outlet is a natural channel located at the southeast side of the site. This natural channel collects stormwater runoff from the eastern undeveloped area of the site and discharges to an off-site stream located along the Renovare Blvd. No modifications are anticipated for this channel; however, runoff from a portion of the contributory area to this stream is diverted to the west outlet and slightly reduces the post-developed runoff to southeast outlet.

The TSP outlet is a new temporary outlet from the sediment pond located south of the temporary construction laydown and craft parking area. Pre-developed runoff from this area flows to the existing ditch along Renovare Blvd. Post-developed runoff from the temporary areas is collected in the temporary drainage ditches and discharged to the sediment pond. The outlet structure in the sediment pond discharges the effluent at a controlled rate to the existing ditch along Renovare Blvd. The sediment pond is designed to ensure settlement of sediments from the collected runoff and discharge water meeting water quality requirements of TDEC and the City of Oak Ridge.

2.1.2.1.1.4.2 Sanitary System

The sanitary sewer system consists of a network of underground gravity pipes collecting sanitary waste from the building facilities and discharging to a City of Oak Ridge sanitary line. The new sanitary system is designed to handle the flow generated by the anticipated number of staff personnel and other sanitary waste (non-radiological) that is discharged from the facility.

2.1.2.1.1.5 Monitoring Stations

The need for monitoring stations is discussed in Chapter 6.

In addition, monitoring plans for the TRISO-X FFF are discussed in Chapter 6.

2.1.2.1.1.6 Water Consumption and Treatment

2.1.2.1.1.6.1 Water Consumption

The City of Oak Ridge municipal water system supplies the water needs of the TRISO-X FFF. Water uses for the facility include the following:

- Process Heat Removal System (Evaporation, Drift, Blowdown).
- Heating, ventilation, and air conditioning (HVAC) Chiller Cooling Tower System (Evaporation, Drift, Blowdown).
- Domestic Water (Water Closet, Lavatory, Sink, Shower, Drinking Fountain, Landscaping,).
- Demineralizer Skid Makeup (Demineralized Water Makeup).
- Fire Protection Water (fire hydrants, sprinkler systems, hose stations).
- Mechanical System Fill.
- Humidification.

Ultimate heat rejection from process equipment (i.e., process heat rejection) is steady and continuous via mechanical draft cooling towers as part of the Process Heat Removal System (PHRS).

Sensible and latent heat is rejected from process equipment (via vent ducts) and workspaces within the production facility to HVAC systems. The heat load from these sources varies seasonally. A portion of this heat is rejected to the ambient environment by dedicated mechanical draft towers via evaporative cooling. Cooling towers for both services require makeup water to allow for evaporation, drift, and blowdown.

The Administration Building demand of domestic water involves the water consumption by the expected number of fixtures (e.g., showers, toilets, sinks) and water required for landscaping. The demand is developed in accordance with International Plumbing Code, 2018 Edition.

For fuel production and other miscellaneous processes (e.g., Hydrogen electrolysis units), demineralized water is required in relatively small quantities. Demineralized water is produced on-site, with input from the municipal water system. In addition to consumed quantities, an allowance is included for concentrate rejection from reverse osmosis equipment.

The fire protection water demand includes water consumption for testing of fire hydrants and sprinkler systems throughout the facility.

The makeup water requirements for mechanical system fill, humidification, and other services are small relative to the total demand.

A water use diagram for the facility and quantities for various streams described above is provided per Figure 2.1-2. Note that wastewater disposal from water entering liquid radwaste processing per the diagram is addressed in Section 4.13.

2.1.2.1.1.6.2 Water Treatment

The TRISO-X FFF includes the water treatment for the following systems:

- Demineralized Water System (i.e., deionization).
- Closed Cooling System (CCS).
- Process Heat Removal System (PHRS).
- HVAC Chilled Water System.
- HVAC Cooling Tower System.

2.1.2.1.1.6.2.1 Water Demineralization

Within the TRISO-X FFF, demineralized water of various types (e.g., Type III and Type IV) is used for a number of process steps as part of the fuel fabrication process. Using potable water as feed, demineralized and deionized water is produced and distributed within the facility.

2.1.2.1.1.6.2.2 Cooling Water Treatment

Water for use in the closed-loop cooling water systems (process closed loop and HVAC chilled water) is treated prior to system start-up, and then treated periodically. The treatment is determined by regular grab sample testing.

Water for use in the mechanical draft cooling tower systems (process heat rejection and HVAC heat rejection) is treated.

The types of chemicals considered in water treatment include:

- Biocides – added to inhibit microbial growth in the water to control the potential for pathogens and fouling.
- Corrosion inhibitors – added to inhibit corrosion of piping and components the cooling water flows through. Often corrosion is inhibited by halogen-based biocides.
- Scale inhibitors – added to reduce scale formation, particularly within heat exchangers and cooling towers.

The specific inhibitor(s) is (are) selected based on the chemistry of the makeup water for the cooling water system.

2.1.2.1.1.7 Cooling and Heating Dissipation Systems

2.1.2.1.1.7.1 Cooling Systems

2.1.2.1.1.7.1.1 Process Cooling

TRISO-X process cooling is provided by the CCS. Hot return water from the process equipment is collected and pumped through refrigerant based chillers. Chilled water is then distributed to various process equipment for heat removal.

Heat is rejected from the CCS to the PHRS via the chiller condensers. The PHRS in turn rejects heat to the atmosphere via mechanical draft cooling towers.

In addition to heat received from the CCS, the PHRS removes heat from supporting equipment (e.g., chiller compressor shaft power, air compressor inter- and aftercoolers, CCS pump shaft power). The total heat rejection from the PHRS is estimated as 22.5×10^6 Btu/hr per process line, or 45×10^6 BTU/hr for both process lines, including applied margin.

For estimating consumptive water use (see Figure 2.1-2), the PHRS heat loads are estimated to be present 24 hours per day, seven days per week.

2.1.2.1.1.7.1.2 HVAC

Chilled water is used in the facility for HVAC cooling and humidity control. A chilled water supply temperature of 40°F (4.4°C) with 60°F (15.6°C) return temperature is assumed. The water-cooled chillers operate year-round, rejecting heat directly to the atmosphere through cooling towers. Water lost due to evaporation, drift, and blowdown for HVAC chillers is included in Section 2.1.2.1.1.6.1. The total estimated heat rejection witnessed by the chillers is as follows:

- Estimated peak HVAC load: 28.8 x 10^6 Btu/hr.
- Estimated heat of compression HVAC load: 7.2 x 10^6 Btu/hr.
- Estimated total heat rejection HVAC load: 36.0 x 10^6 Btu/hr.

For bounding purposes, the units are considered to run continuously (i.e., 24 hr. per day, 7 days per week).

Being a closed loop system, makeup water is periodic and minimal. The makeup water is treated with a standard chemical treatment system.

The chillers for both the CCS and HVAC chilled water systems operate using a non-chlorofluorocarbon refrigerant (R-514A).

2.1.2.1.1.7.2 Heating System

Natural gas is used to provide building heat and is piped directly to the heating coils in the Air Handling Units. The peak heating load is 15.3 x 10^6 Btu/hr, with a total annual natural gas consumption of 6.5 x 10^7 standard cubic feet (scf) (1.84 x 10^6 m^3).

For bounding purposes, the heating system is considered to run continuously (i.e., 24 hr. per day, seven days per week) for six months (4380 hours). Gas consumption is based on a heat content of natural gas of 1037 Btu/scf.

2.1.2.1.1.8 Waste Systems

Each waste stream at the TRISO-X FFF falls into one of many possible waste categories such as, municipal solid waste (MSW), nonhazardous industrial waste, hazardous waste, or radioactive waste. Waste containing a combination of radioactive and hazardous material is referred to as mixed waste. The Resource Conservation and Recovery Act (RCRA) and the Atomic Energy Act (AEA) govern mixed waste. (USEPA, 2021a) The U.S. Nuclear Regulatory Commission (NRC) implements the AEA to regulate mixed waste. Sections 2.1.2.1.1.8.1 and 2.1.2.1.1.8.2 discuss management, storage, and disposal of radioactive mixed waste. Hazardous waste is discussed in Section 2.1.2.1.1.9. The sources of radioactive liquid, solid, and gaseous waste generated by the operation of the TRISO-X FFF are summarized as follows:

- Liquid and gaseous effluents associated with process streams (e.g., wet chemistry material recovery process, gelation process, TRISO particle washing, High Temperature Carbonization furnace process).
- Solid waste associated with receipt of feedstock material (e.g., empty containers that contained HALEU); dry active waste including personal protective equipment (PPE), rags, cleaning supplies; waste from consumables used in the production process; and material that gets carried over into the ventilation system (e.g., U_3O_8 powder, Graphite Matrix Powder (GMP), and abraded material from mechanical handling; HEPA filters).
- Quality Control laboratory wastes.
- Routine waste from maintenance activities (e.g., trash generation from decontamination, filter replacement).

Facilities that handle and store radioactive materials in the area of the TRISO-X FFF are discussed in Section 3.11.1.

The type and quantity of radionuclides and hazardous materials is provided in Table 2.1-2.

2.1.2.1.1.8.1 Solid Radioactive Waste Handing System

The Class A waste is consolidated and compacted as necessary before being stored in 55-gallon drums. Drums are then shipped off-site for disposal. There is no solid radioactive waste disposal at the TRISO-X FFF.

2.1.2.1.1.8.2 Liquid Radioactive Waste System

The primary liquid waste which potentially could have radioactive contamination to be encountered in the TRISO-X FFF is the liquid waste coming from the liquid processing operations:

- Triuranium octoxide (U_3O_8) dissolution to Acid Deficient Uranyl Nitrate (ADUN), storage of the process solution, the formation of gel-sphere kernels, the subsequent aging, washing, and drying of the gel-spheres.
- The high viscosity substance which comes off of the High Temperature Carbonization furnace.
- Effluents from operation of the Quality Control Laboratory analytical equipment.
- Effluents from uranium recovery.

These liquid waste streams are collected, sampled, and chemically adjusted as necessary to recycle/reuse in the process or to prepare and package for off-site disposal.

2.1.2.1.1.8.3 Gaseous Effluents

High-efficiency particulate air (HEPA) filtration is installed on systems with the potential to discharge radioactive materials. Filters are disposed of as solid waste. Each radiological stack is planned to be continuously sampled to ensure air effluent discharge concentrations to the environment are less than action levels that are established to ensure that the 10 CFR 20, Appendix B, Table 2, Column 1, limits are not exceeded.

2.1.2.1.1.9 Hazardous Material Handling

The U.S. Environmental Protection Agency (USEPA) regulates nonhazardous and hazardous solid waste under RCRA. The regulations governing hazardous waste identification, classification, generation, management and disposal are found in Title 40 of the Code of Federal Regulations (CFR) Parts 260 through 273. Title 40 CFR Parts 239 through 259 contain the regulations for nonhazardous solid waste. (USEPA, 2021b)

Waste not categorized as MSW, radioactive, or mixed waste is examined to determine if it is nonhazardous or hazardous. Uncategorized waste is managed as hazardous until sufficient information is available to show the waste does not warrant hazardous classification.

2.1.2.1.1.9.1 Hazardous Waste Classification

Hazardous waste is classified as either listed waste or characteristic waste. Listed wastes are generated from common manufacturing and industrial processes, specific industries, or discarded pure commercial grade chemicals (USEPA, 2022). TRISO-X FFF's manufacturing and industrial process, as well as the raw materials used, are not listed in 40 CFR Part 261, Sections 31 through 34. Listed hazardous waste is not generated at the TRISO-X FFF.

Characteristic wastes have one or more property of toxicity, corrosivity, reactivity, or ignitability which qualify the waste as hazardous. Samples of uncategorized wastes are analyzed per USEPA approved Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium to determine if the waste exhibits any hazardous waste characteristics (USEPA, 2021c). Spent process chemicals (e.g., activated carbon and crystallizer bottoms containing formaldehyde) from the TRISO-FFF require additional analysis to determine if classifications as hazardous waste due to characteristics of the waste are appropriate.

2.1.2.1.1.9.2 Hazardous Waste Disposal

When the waste is not mixed with radioactive material, not MSW, and does not meet the listed or characteristic classification of a hazardous waste, the waste is then treated as a nonhazardous industrial waste and disposed off-site at an appropriate treatment, storage, or disposal facility (TSDF) accordingly.

In the event analytical results show the waste to exhibit one or more of the hazardous characteristics, the material is stored temporally on-site. Hazardous waste is consolidated as necessary and properly packaged then shipped off-site to an approved hazardous waste TSDF. There is no hazardous waste disposal at the HCS.

Section 4.13.4 provides details of the TRISO-X FFF waste minimization plan.

2.1.2.1.1.10 Direct Radiation Sources Stored On-Site or near the TRISO-X FFF

2.1.2.1.1.10.1 Direct Radiation Sources Stored On-Site

The solid wastes listed in Table 2.1-2 are stored on-site for a period before they are shipped off-site. The frequency of shipment of each type of waste is provided in Table 2.1-2. See also Section 4.13.3.

2.1.2.1.1.10.2 Direct Radiation Sources Stored near the TRISO-X FFF

Facilities that handle and store radioactive materials in the area of the TRISO-X FFF are discussed in Section 3.11.1.2.4.

2.1.2.1.1.11 Pollution Prevention and Waste Minimization

Pollution prevention and waste minimization planning provides the framework for promoting environmental stewardship and educating employees in the environmental aspects of activities occurring in the workplace, the community, and homes. The TRISO-X FFF has a program for pollution prevention and waste minimization that includes the following:

- Waste minimization and recycling for the various phases of the TRISO-X FFF construction and operation.

- Employee training and education on general environmental activities and hazards regarding the facility, operations and the pollution prevention program, as well as waste minimization requirements, goals, and accomplishments.

- Employee training and education on specific environmental requirements and issues.

- Responsibilities for pollution prevention and waste minimization.

- Recognition of employees for efforts to improve environmental conditions.

- Requirements for employees to consider pollution prevention and waste minimization in day-to-day activities and engineering.

2.1.2.1.2 Construction Activities

The construction phase of this project requires a monthly average of 94 workers (134 peak monthly workers) and a monthly average of 240 truck deliveries and 48 off-site waste shipments. Materials consumed are shown in Table 2.1-3 and also include approximately 28,931 gallons of diesel fuel (as a bounding assumption fuel is assumed to be diesel) on an average monthly basis. The different types of construction equipment used during the construction phase are shown in Table 2.1-4.

Based on the preliminary grading analysis of the site, approximately 560,243 yd^3 (428,337 m^3) of topsoil and subsoil are excavated during the first six months of construction and replaced with approximately 362,661 yd^3 (277,274 m^3) of clean, earthen material for backfill. It is conservatively assumed that all of the excavated material is unsuitable for backfill and is disposed of at an off-site landfill location, and that all backfill material is obtained from off-site borrow areas. Additional geotechnical investigation work during construction will determine if some or much of the excavated material is suitable for backfill after lime treatment for expansive clay. Re-use of excavated materials as backfill reduces the volume of off-site disposal and borrow activities. It is also conservatively assumed that all of the off-site material is transported during the first six months of construction. Based on these conservative assumptions, the project requires a monthly average of 15,729 truckloads of excavated materials and backfill during the first six months of the project.

Off-site disposal and borrow areas comply with all applicable local, state and federal environmental requirements. The City of Oak Ridge approves off-site landfill and borrow areas as part of the local zoning, land use, and building permits process. The specific locations are not yet identified, but they are expected to be located near the major truck transportation routes in and out of the HCS and within the HCS Region to minimize hauling distances and costs.

Required permits and other regulatory approvals discussed in Section 1.4 of this report (Applicable Regulatory Requirements, Permits, and Required Consultations) would be obtained prior to construction activities.

2.1.2.1.3 Operation Activities

Operational activities require a peak workforce of 820 workers and an annual average of 24 truck deliveries and 48 off-site waste shipments (radiological and non-radiological waste).

Operations at the TRISO-X FFF are described in detail below.

2.1.2.1.3.1 Dissolution

U_3O_8 powder enriched to less than 20 weight percent ^{235}U is manually transferred from a portable container into a hopper in a glovebox. The U_3O_8 powder is then metered into a nitric acid and water solution in a column where it is mixed until the required amount of U_3O_8 is dissolved resulting in a uranyl nitrate solution. The uranyl nitrate solution is then transferred to storage columns until it is ready to be used in the Gelation process.

2.1.2.1.3.2 Gelation

The uranyl nitrate solution is mixed with organic additives, and liquid droplets are formed that react with heated silicone oil to produce gel spheres. The gel spheres are aged in silicone oil, washed and rinsed to remove the silicone and additives, and dried. The resulting dried microspheres are combined by mass to form the input batches to the Kernel Conversion process.

2.1.2.1.3.3 Kernel Conversion

The dried microspheres are converted in a high temperature furnace to fuel kernels of uranium compounds, such as uranium dioxide and uranium dicarbide, based on the fuel design being fabricated. The fuel kernels undergo quality checks, and non-conforming products are rejected and sent to the Uranium Recovery process. The fuel kernels that pass the quality checks are combined by mass to form the input batches to the Coating process.

2.1.2.1.3.4 Coating

The fuel kernels are coated with several carbonous layers using a fluidized bed chemical vapor deposition system, resulting in coated particle fuel. When four carbonous layers are used, the resulting uranium-bearing microspheres are known as TRISO particles. The coated particles undergo quality checks and non-conforming products are rejected and sent to the Uranium Recovery process. The coated particles that pass the quality checks are combined by mass to form the input batches to the Overcoating process.

2.1.2.1.3.5 Overcoating

The coated particles are overcoated with a layer of graphite matrix powder, based on the fuel design being fabricated and the packing fraction required in the fuel element. The overcoated particles (OCPs) undergo quality checks and non-conforming products are rejected and sent to a washing station to remove the overcoating layer before being reintroduced into the Overcoating process. The OCPs that pass the quality checks are batched and sent to the Fuel Form Preparation process.

2.1.2.1.3.6 Fuel Form Preparation

OCPs are poured into molds or tooling and compressed or compacted into green fuel forms of the desired geometry, such as compacts or pebbles, based on the fuel design being fabricated. Some fuel designs require encapsulating OCPs in additional GMP and/or shaping. The green fuel forms undergo dimensional checks, and non-conforming products are rejected and sent to the Uranium Recovery process. The green fuel forms that pass the quality checks are batched and sent to the High Temperature Carbonization process.

2.1.2.1.3.7 High Temperature Carbonization

The green fuel forms are processed through a high temperature furnace to convert the green body into a strong carbonized fuel form capable of withstanding handling and reactor service conditions. The final fuel forms undergo quality checks and those that pass are loaded into shipping containers. Non-conforming products are rejected and sent to the Uranium Recovery process.

2.1.2.1.3.8 Uranium Recovery

Uranium is recovered from damaged, degraded, or otherwise non-conforming product materials through a variety of batch operations. The batch operations size reduce, deconsolidate, oxidize, and/or convert the non-conforming product materials to U_3O_8 powder so that it can be used as feedstock for the Dissolution process.

2.1.2.1.3.9 Ventilation, Waste Processing, And Effluent Handling

Ventilation systems are designed and operated to assure adequate control of radioactive dust and particulate. Solid wastes are collected in the areas of generation and transferred to the Waste Handling area for assay and processing; wastes may be compressed and/or size reduced to allow containerization into 55-gallon drums, and those that meet free release criteria may be disposed of as non-contaminated. Liquid waste streams are collected, sampled, and chemically adjusted as necessary to recycle/reuse in the process or to prepare and package for off-site disposal. Compliance with regulatory limits is verified through periodic sampling of the waste streams.

2.1.2.1.3.10 Quality Laboratory

Product quality is verified by analyzing samples taken at various stages of the process. Destructive and non-destructive tests are performed to confirm the chemical composition, physical attributes, and material properties.

2.1.2.1.3.11 Chemical Receipt, Storage, And Handling

The TRISO-X FFF takes delivery and consumes a number of chemicals in the production of TRISO fuel. Those which are stored in bulk quantities are addressed here. These can be divided into chemicals stored outdoors and those stored indoors.

The storage configuration (e.g., design standards for vessels, valves, and piping, or separation requirements) for each chemical addresses and meets requirements from various codes, standards, and guidelines including certain applicable publications from the American Society of Mechanical Engineers (ASME), Compressed Gas Association, International Building Code,

International Fire Code, National Fire Protection Association (NFPA), Occupational Safety and Health Administration (OSHA), and the NRC.

The liquid and gaseous chemicals stored in bulk quantities and consumed in the production of TRISO fuel (See Tables 2.1-1a through 2.1-1e) are received by truck. For these chemicals, provisions for: (i) on-site receipt and (ii) return of empty containers are included to prevent spills, releases, and accidents. These provisions follow accepted engineering practice, and adhere to applicable laws, regulations, codes, and standards.

For outdoor storage of certain liquids, deliveries are by transfer from a delivery vehicle (tanker truck) to the fixed on-site storage tank(s). Provisions for on-site chemical transfer operations are included to prevent spills and accidents. These provisions follow accepted engineering practice, and adhere to applicable laws, regulations, codes, and standards.

Table 2.1-1a summarizes the design for underground outdoor storage. Table 2.1-1b summarizes the design for above ground outdoor storage of hazardous chemicals. Table 2.1-1c summarizes the design for (non-pressurized) indoor storage of certain liquids used and consumed in the various production processes. Tables 2.1-1d and 2.1-1e summarize design provisions for solids stored in bulk quantities in the Main Facility and the GMP Building, respectively.

2.1.2.1.3.12 Shipping and Transportation

All shipments of nuclear materials and wastes are conducted in conformance with NRC, U.S. Department of Transportation, and State of Tennessee requirements. Incoming U_3O_8 feedstock arrives by truck in approved containers licensed by the NRC. Final fuel forms are shipped out to customers by truck in approved containers licensed by the NRC. Low level waste shipments are appropriately packaged and analyzed for uranium content prior to shipment to licensed low-level waste disposal sites.

2.1.2.1.3.13 Research and Development

Product research and development activities for planned and future fuel products and processes occur in this section of the facility. Small scale production process testing, as well as destructive and non-destructive tests, are performed which can include radiological materials of various chemical compositions, physical attributes, and material properties.

2.1.2.1.4 Decommissioning Activities

At the end of useful plant life, the TRISO-X FFF would be decontaminated and decommissioned in accordance with applicable NRC license termination requirements. Decontamination and decommissioning of the TRISO-X FFF would be funded in accordance with the Decommissioning Funding Plan (DFP) for the TRISO-X FFF. The DFP, prepared by TRISO-X in accordance with 10 CFR 70.25(a), provides information required by 10 CFR 70.25(e) regarding TRISO-X's plans for funding the decommissioning of the TRISO-X FFF and the disposal of radioactive waste generated as a result of plant operations. Funding would be provided by

TRISO-X in accordance with NRC regulations in 10 CFR Part 70 and guidance in NUREG-1757.

Any radioactive equipment and materials are disposed of during decommissioning according to local and Federal laws and regulations. Post-operational decommissioning activities require up to 150 workers. It is expected that the average number of truck shipments from the site during decommissioning are bounded by the average daily truck traffic during the construction phase. Building materials, such as wood, concrete, and steel, and process equipment would be removed from the site. The different types of construction equipment used during the decommissioning phase are shown in Table 2.1-4.

Before decommissioning activities begin, a Decommissioning Plan is prepared and submitted to the NRC pursuant to 10 CFR 70.38 (Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas). The Decommissioning Plan provides information concerning the TRISO-X FFF, the types of items to be decontaminated, the disposition of facilities used for hazardous materials, the assumptions upon which the cost of decommissioning is derived, and an estimated schedule for decommissioning and closing the facility. It is the intent of TRISO-X to decommission and close the TRISO-X FFF so as to reduce the level of radioactivity remaining in the facility to residual levels acceptable for release of the facility site for unrestricted use and for NRC license termination pursuant to 10 CFR 20.1401 (General provisions and scope) and 10 CFR 20.1402 (Radiological criteria for unrestricted use).

Prior to decommissioning, an assessment of the radiological status of the TRISO-X FFF is made. Decommissioning and closure activities include the cleaning and removal of radioactive and hazardous waste contamination that may be present on materials, equipment, and structures. General guidelines that would apply to the decommissioning and closure effort are discussed in Section 3.12.

2.1.2.2 Impacts from Performing the Proposed Action and Mitigation Measures

Reasonably foreseeable environmental impacts and the extent of those impacts from the Proposed Action, potential mitigation measures, and restoration actions, if applicable, are described in detail in Chapter 4 of this Report (Environmental Impacts).

Potential mitigation measures of those impacts and associated potential restoration actions, if applicable, are further described in Chapter 5 of this Report (Mitigation Measures). Mitigation measures are those actions or processes that would be implemented to avoid or minimize the magnitude of the impact of the Proposed Action on the affected environment; rectify (i.e., repair, rehabilitate, or restore) the affected environment; or compensate for the impact by providing substitute resources or environments (40 CFR 1508.20, Mitigation). Chapter 4 also summarizes environmental impacts that result from the construction, operation, and decommissioning of the TRISO-X FFF.

A summary of adverse impacts from the Proposed Action are provided in Table 2.1-5. The extent of impacts considering all lifecycle phases from the Proposed Action is briefly summarized by the environmental resource that is impacted. As referenced in NUREG 1748 (Environmental Review Guidance for Licensing Actions Associated with NMSS [Nuclear Material Safety and Safeguards]) Programs), the standard of significance (i.e., SMALL, MODERATE, LARGE) established by the NRC in NUREG-1437, Revision 1 (Generic Environmental Impact Statement for License Renewal of Nuclear Plants), was used to define

the extent of impacts from the Proposed Action (see also Section 2.3). Overall, adverse impacts from the Proposed Action are SMALL. Implementation of mitigation measures further reduce the severity of these impacts.

2.1.3 REASONABLE ALTERNATIVES

Modern TRISO particle fuel technology is the product of particle fuel development activities spanning many countries during a half-century period. The U.S. Department of Energy (DOE) launched the Advanced Gas Reactor (AGR) Fuel Development and Qualification Program in 2002 to establish the ability to manufacture high-quality TRISO fuel in the United States and to demonstrate its performance (EPRI, 2019). The results of the AGR program have been successful to date and support current safety design and analysis assumptions about fuel performance and radionuclide retention required for advanced reactor designs. Fabrication of high-quality low-defect fuel is achievable at an industrial scale (INL, 2017).

Subsequent work by TRISO-X under a DOE cooperative agreement and industry partnership, DE-NE0008472 Advanced Reactor Concept 2015 (ARC15), established high throughput, high-yield commercial scale equipment, and advanced characterization techniques in the TRISO-X Pilot Facility inside the Oak Ridge National Laboratory. TRISO-X's Pilot Facility produced qualification test articles for TRISO-based reactors, developed operational processes and procedures that comply with ASME Nuclear Quality Assurance (NQA-1) requirements, and demonstrated the technologies developed under the AGR Fuel Program to produce TRISO fuel forms is mature and ready for commercialization.

Alternatives to TRISO particle fuel technology would require decades to develop to maturity. Therefore, there are currently no reasonable alternatives to TRISO particle fuel.

2.1.3.1 Design Alternatives

Since the beginning of conceptual design work for the TRISO-X FFF in 2018, the energy landscape has been evolving rapidly, in part due to increasing global attention on climate change and the relationship to carbon emissions. Business model forecasts for deployments of Xe-100 reactor modules and the required quantities of TRISO pebble fuel went through several updates to reflect influences like those summarized below:

- As the largest source of carbon-free electricity in the U.S., nuclear reactors provide carbon-free, resilient and reliable energy, and enable the replacement of retiring coal facilities and nuclear plants, as utilities that have pledged to decarbonize are now investing in license renewals to keep zero carbon generators online to 2050 and beyond (NEI, 2020a).

- Nuclear energy, an essential part of the United States' clean energy portfolio which generates nearly 20 percent of U.S. electricity and nearly 55 percent of our emission-free generation, along with wind, solar, hydro and other zero-carbon power generation sources, is critical to achieving a 100 percent carbon-free energy system (NEI, 2020b).

- On November 15, 2021, the bipartisan "Infrastructure Investment and Jobs Act", a 1.2 trillion dollar package containing a total of more than 62 billion dollars for the DOE to deliver a more equitable clean energy future, including the premature retirement of existing nuclear plants and investing in advanced nuclear projects, was signed into law. The deal earmarks 2.5 billion dollars for advanced nuclear through the DOE's Advanced Reactor Demonstration Program (ADRP), which was launched by DOE in 2020 to speed the demonstration of advanced reactors through cost-shared partnerships with the US industry. In October 2020, Terrapower and X-energy were the two companies selected

by DOE to demonstrate their advanced nuclear reactors by the end of the decade (WNN, 2021).

- On December 8, 2021, Executive Order 14057, "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability," a policy set to achieve a carbon pollution-free electricity sector, including nuclear energy, by 2035 and a net zero emissions economy-wide by no later than 2050, was signed (Exec. Order No. 14057, 2021).

- A June 2022 study by Vibrant Clean Energy, on behalf of NEI, concluded nuclear generation can play an important role in decarbonizing the electricity sector by providing over 40 percent of total generation in 2050, requiring more than 300 GW of new nuclear (VCN, 2022).

- On August 16, 2022, the Inflation Reduction Act (IRA) was signed into law by President Biden. The IRA provides tax credits for both production and investment for advanced reactors generating electricity. Advanced reactor facilities that qualify for production or investment tax credits may only benefit from one, the production credit or the investment credit, but not both. The IRA also puts forth $700 Million to support research of HALEU fuel, as well as its development and use in advanced reactors. There is $100 Million to make HALEU fuel available for research, development, demonstration, and commercial use; $500 Million to make HALEU available for the first advanced reactors from the U.S.'s uranium stockpile that is currently being formed, determine HALEU amounts needed for commercial HALEU markets in the U.S., and create a group to support the availability of HALEU for commercial use; and $100 Million to assist commercial entities in the licensing and regulation of special nuclear material fuel (such as HALEU) fabrication, enrichment facilities, and transportation packages.

As a result of influences on the energy landscape such as the examples above, the capacity of the TRISO-X FFF was increased from the 2018 projected need of 1.5 metric tons of uranium (MTU) per year, to a 5-6 MTU per year modular concept that could be used to right-size the size of factories at multiple locations. The 5-6 MTU per year modular concept was further increased to an 8-MTU per year module. In 2021, the projected need was further defined as two 8-MTU modules providing a factory capacity of 16 MTU per year.

Table 2.1-1a
Yard Storage – Underground Tanks

See the TRISO-X Fuel Fabrication Facility Site Emergency Plan
and/or
TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary

Table 2.1-1b
Yard Storage – Above Ground

See the TRISO-X Fuel Fabrication Facility Site Emergency Plan
and/or
TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary

Table 2.1-1c
Indoor Storage – Liquids

See the TRISO-X Fuel Fabrication Facility Site Emergency Plan
and/or
TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary

Table 2.1-1d
Indoor Storage – Solids in Main Facility

See the TRISO-X Fuel Fabrication Facility Site Emergency Plan
and/or
TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary

Table 2.1-1e
Indoor Storage – Solids in GMP Building

See the TRISO-X Fuel Fabrication Facility Site Emergency Plan
and/or
TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary

Table 2.1-2
Estimated Type and Quantity of Radioactive Wastes

Description	Matrix	Class as Generated	Contents	Mass (kg/yr)	Volume as shipped (ft^3)	55-gallon drum equivalent as shipped	Shipment Type	Destination[b]
Waste Drums	Solid	A	Local and central system high efficiency particulate air (HEPA) filters, consumables, dry active waste (DAW)	919,138	26,182	3562	LSA[a]	EnergySolutions Clive, UT
Waste Drums	Liquid	A	Unrecoverable water from crystallizer, silicone oil trough refill waste	34,551	984	134	LSA[a]	EnergySolutions Clive, UT
Quality Control (QC) Lab Waste	Mixed	A	Unrecoverable uranium samples	12,350	352	48	LSA[a]	EnergySolutions Clive, UT

a) Low Specific Activity
b) There are approximately 39 shipments per year and each shipment consists of 96 55-gallon drums.

Table 2.1-3
Estimated Materials Consumed During Construction Phase

Material	Amount
Concrete	42,000 cubic yards
Structural Steel	5250 tons
Misc. Steel	3040 tons
Asphalt	8200 cubic yards
Stone Granular Material	41,800 cubic yards
Roofing	1500 tons
Diesel Fuel	28,931 gallons

Table 2.1-4
(Sheet 1 of 2)
Construction/Demolition Equipment Used in the Construction and Decommissioning Phases

Equipment	Present During Construction (Y or N)	Present During Decommissioning (Y or N)
37" Walk Behind Finisher – Concrete, 6.5 HP	Y	N
Air Compressor, 600 cfm	Y	Y
Asphalt Compactor, Cat CB434C, 107 Hp	Y	N
Asphalt Paver, Barber Greene AP-1000, 174 Hp	Y	N
Backhoe Cat 426, 1.3 CY 85 HP	Y	Y
Backhoe/Loader, Cat 430, 105 Hp	Y	Y
Boom Lift, JLG 800AJ, 65 Hp	Y	Y
Compactor Plate, 20 HP	Y	Y
Concrete Pump, 100 yph, 100 HP	Y	N
Concrete saw, hand, 13 HP	Y	Y
Crane Hydraulic 18 ton, 160 HP	Y	Y
Crane, Lattice Boom, Manitowoc 8000, 80t, 205 Hp	Y	N
Crane, Picker, Grove RT530E-2 30t, 160 Hp	Y	Y
Dozer - Cat D5, 90 HP	Y	Y
Excavator Cat 320, 24'-10" dig depth, 162 HP	Y	N
Excavator, Large, Cat 345D L, 380 Hp	Y	N
Extended Forklift, Lull 1044C-54, 115 Hp	Y	Y
Fuel Truck, Mack MP6, 150 Hp	Y	Y
Hydromulcher, 44 HP, Kubota Diesel	Y	N
Lift, boom JLG40, 40' telescoping, 67 HP	Y	Y
Lift, Fork 8000 lb, 97 HP	Y	Y

Table 2.1-4
(Sheet 2 of 2)
Construction/Demolition Equipment Used in the Construction and Decommissioning Phases

Equipment	Present During Construction (Y or N)	Present During Decommissioning (Y or N)
Lift, Scissor 24', 65 HP	Y	Y
Mechanic's Truck, 2½ ton, F-650, 270 Hp	Y	Y
Pickup Truck, F-250, 300 Hp	Y	Y
Portable Air Compressors, <50 HP	Y	Y
Portable Generators, <50 Hp	Y	Y
Skidsteer Loader, Case SR200, 75 Hp	Y	Y
Tracked Dozer, Cat D7, 235 Hp	Y	N
Tracked Loader, Cat 973C, 242 Hp	Y	N
Trencher, < 5' deep, 44 HP	Y	N
Truck, Dump 16 CY, 280 HP	Y	Y
Vibratory Soil Compactor, Cat CS74, 156 Hp	Y	Y
Walk Behind Compactor, <50 Hp	Y	Y
Water Truck, Mack MP6, 150 Hp	Y	Y
Welding Machine 400 amp, 20 HP	Y	N
Wheel Loader, Cat 950 4 CY, 202 HP	Y	Y

Table 2.1-5
Summary of Adverse Impacts from the Proposed Action

Category	ER Section	Extent of Impact
Land Use	4.1	SMALL
Transportation	4.2	SMALL
Geology and Soils	4.3	SMALL
Water Resources	4.4	SMALL
Ecology	4.5	SMALL
Air Quality	4.6	SMALL
Noise	4.7	SMALL
Historic and Cultural Resources	4.8	SMALL
Visual/Scenic	4.9	SMALL
Socioeconomics	4.10	SMALL to MODERATE
Environmental Justice	4.11	SMALL
Public and Occupational Health	4.12	SMALL
Waste Management	4.13	SMALL

2.2 ALTERNATIVES CONSIDERED BUT ELIMINATED

2.2.1 FACILITY LOCATION

A site study was performed to identify a site for the TRISO-X Fuel Fabrication Facility (TRISO-X FFF) . The goal of the site study was to recommend one or more suitable sites for the siting of the TRISO-X FFF from a nuclear licensing, environmental, engineering, and community acceptance standpoint. The site study identified and screened potential sites in order to identify candidate sites for the TRISO-X FFF. Those candidate sites were further evaluated to determine if there is an obviously superior site and ranked the candidate sites based on environmental, engineering, or nuclear licensing criteria. The results of the site study are detailed further within this section.

The site study identified 25 potential sites or site areas in the U.S. for the siting of the TRISO-X FFF. Eleven of the potential sites are fuel cycle facilities licensed by the U.S. Nuclear Regulatory Commission (NRC). Four of the sites have been previously studied by the NRC for reactors but were never built and remain greenfield sites. Two of the potential sites are other nuclear sites or facilities. Four of the sites are industrial properties formerly owned by General Motors Corporation (GMC) that have been remediated for potential redevelopment. The GMC sites are now owned by an entity known as the RACER Trust and are available for redevelopment. Four of the sites are brownfield power plant sites. Two of the brownfield sites are retired fossil fuel electric generating units (EGUs) located in urban areas and were identified from lists published by the Energy Information Administration (EIA). Two of the brownfield sites are decommissioned nuclear plants for which the owners have announced the availability of the sites for disposition.

The potential sites were evaluated using a ranking methodology consistent with the Electric Power Research Institute (EPRI) Siting Guide (EPRI, 2002). The site selection criteria included the following environmental, technical, and social factors:

- The proximity to a source of high assay low enriched uranium (HALEU) in the form of U_3O_8 powder.
- Potential local government and community support for a proposed NRC-licensed facility.
- Access to a skilled nuclear workforce.
- Proximity to the interstate highway system.
- Available municipal water, sewer, and electric power infrastructure.
- Access to a well-developed health and safety infrastructure.
- Sufficiently large (at least 75 ac. [30.4 ha]) site generally free of potential environmental constraints (e.g., wetlands, floodplains, natural habitats for protected species, steep terrain and known cultural resources).
- Acceptable seismic characteristics.
- Proximity of karst formations.

- Frequency of inclement weather (e.g., tornadoes, hurricanes, and winter storms).
- Proximity of hazardous industrial facilities and potentially contaminated properties (e.g., oil refineries, pipelines, liquified natural gas facilities).
- Local and State environmental siting and permitting processes.
- Proximity to airports. This criterion identifies sites with access to commercial air travel but avoids sites near public or private-use airports that could pose additional hazards to the facility.

Using the ranking methodology, the following five candidate sites for additional evaluation were identified:

- Centrus American Centrifuge Plant (ACP), Piketon, Ohio.
- Centrus Technology Manufacturing Center (TMC), Oak Ridge, Tennessee.
- Horizon Center site (HCS), Oak Ridge, Tennessee.
- General Electric/Global Nuclear Fuel-A Facility (GE/GNF-A), Wilmington, North Carolina.
- Savannah River Site (SRS) Energy Park, Aiken, South Carolina.

The five identified candidate sites were then examined in more detail to determine whether the candidate sites had any significant environmental, engineering, or nuclear licensing issues that would make them impractical or otherwise undesirable for development of the TRISO-X FFF. Based on the detailed examination, it was determined that all five of the candidate sites were suitable for the TRISO-X FFF and that there were no obviously superior alternative sites. The candidate sites were also ranked from highest to lowest as follows, based on the further evaluation results:

1. Centrus ACP, Piketon, Ohio
2. HCS, Oak Ridge Tennessee
3. Centrus TMC Site, Oak Ridge, Tennessee
4. GE/GNF-A Site, Wilmington, North Carolina
5. SRS Energy Park Site, Aiken, South Carolina

The HCS was selected over other evaluated sites because it provided the best opportunity to deploy the TRISO-X FFF, based on the criteria established in our site selection process. Specifically, the HCS was located in Oak Ridge, Tennessee, a community supportive of nuclear facilities, with close location to emergency resources such as fire and police. The site also offered no major environmental concerns, in terms of ground water quality, soil plasticity, karst, and archaeological artifacts. In addition, the Industrial Development Board of Oak Ridge offered the 110-acre (Lot 6a) site to TRISO-X at no cost and a 20-year payment in lieu of taxes

program. In summary, the physical location of the site, properties of the site itself, and real estate offer made the HCS the best option for the commercial fuel facility.

2.2.2 DESIGN ALTERNATIVES

The purpose of the facility is to produce TRISO-based coated particle fuel. As described in Section 2.1.3, modern TRISO particle fuel technology is the product of particle fuel development activities spanning many countries during a half-century period. Alternatives to TRISO particle fuel technology would require decades to develop to maturity. Therefore, there are currently no reasonable alternatives to TRISO particle fuel. However, TRISO-X anticipates that the entire design of the TRISO-X FFF would consider the potential for automation where possible to optimize production and minimize cost in an industrial setting. It is not anticipated that such automation improvements would influence the fundamental production process but would instead improve production efficiency.

2.3 CUMULATIVE EFFECTS

Cumulative impacts result when the effects of an action are added to or interact with other past,present, and reasonably foreseeable future effects on the same resources. This section describes actions within the region surrounding the Horizon Center site (HCS) that, together with the effects of the construction, operation, and decommissioning of the HCS, may contribute to cumulative impacts to environmental resources. A cumulative impact is defined in current Council on Environmental Quality (CEQ) regulations (40 CFR 1508.1) as “effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions.”

Table 2.3-1 identifies reasonably foreseeable future trends and planned actions that were identified to be in proximity to the HCS. Past and present actions inherently have environmental impacts that are integrated into the base condition for each of the resources as described in Chapter 3.

The geographic area of interest for consideration of cumulative effects is defined as the area where other actions occur that could potentially have impacts within the resource impact area. Because the construction, operation and decommissioning of the TRISO-X Fuel Fabrication Facility (TRISO-X FFF) occurs on the HCS, a previously disturbed area designated for industrial use, the potential cumulative effects to off-site resources in the vicinity of the HCS is also limited for a number of resources. In contrast, the effects to other resources may be expressed beyond the immediate area surrounding the HCS. As such, the geographic area of interest is different for each resource.

The following sections provide a description of past and planned actions at the Horizon Center Industrial Park and within the broader area surrounding the HCS.

2.3.1 ACTIONS AT THE HORIZON CENTER INDUSTRIAL PARK

The Horizon Center Industrial Park is a greenfield business park owned by the City of Oak Ridge Industrial Development Board, dedicated to industrial development. As shown in Figure 2.3-1, seven development areas are set amongst 500 acres of permanent natural area set aside for environmental preservation and protection. Development Area 6 has been identified as the preferred site for the TRISO-X FFF. The entirety of the land was owned by the U.S. Department of Energy (DOE) until 1996 when it was leased to the Community Reuse Organization of East Tennessee. The title was transferred to the current owner in 2003, with DOE retaining approximately half of the acreage for use as permanent greenspace. In 2020, the DOE expanded the available land uses for the seven development areas.

Among other small businesses, the Horizon Center Industrial Park is currently home to the DOE’s Carbon Fiber Technology Facility (Development Area 3A) and Philotechnics (Development Area 6A). The City of Oak Ridge has identified carbon fiber and composites as one of its three main growth industries. Given this fact and the availability of additional sites at the Horizon Center Industrial Park, the City expects substantial future expansion of carbon fiber manufacturing at the industrial park, however specific projects have not been identified. Philotechnics, a radiological services and mixed and radioactive waste brokerage provider, operates on the adjacent lot to the TRISO-X FFF.

The Oak Ridge Electric Department (ORED) plans to construct a 69-kV transmission line from the ORED substation on Blair Road to provide electricity to Horizon Center Industrial Park (DOE, 2014). The easement for the transmission line received a Finding of No Significant Impact determination from the DOE in 2014. In 2020, the DOE prepared an Addendum to the 2014 Environmental Report to address the proposed construction of the approximately 1.7 mi. (2.7 km) extension of the original 69 kV transmission line from the easement approved in 2014 to the Imperium entrance at the Horizon Center. The easement is needed to provide power distribution to undeveloped parcels of the Horizon Center. The DOE found no further NEPA analysis was necessary to support the extension of the transmission line (DOE 2020.)

Previously, a motorsports park selected Development Areas 5, 6, and 7 at the Horizon Center Industrial Park for development and estimated a $50 million investment. The original proposal included a 4.5-mile track where car enthusiasts could race luxury cars up to speeds of 160 mph. It was inspired by Barber Motorsports Park in Alabama. However, this proposal was withdrawn due to community opposition, zoning, and National Environmental Policy Act requirements, and has been relocated to another location in Cumberland County, Tennessee.

2.3.2 ACTIONS RELATED TO OTHER FACILITIES

This section describes the reasonably foreseeable future actions in the vicinity of the HCS which could result in cumulative impacts when considered in conjunction with the construction, operation and decommissioning of the TRISO-X FFF. Actions identified within the geographic area of interest as having the potential to, in the aggregate, result in larger and potentially significant adverse impacts to the resources of concern are listed in Table 2.3-1. The analysis of the potential cumulative impacts of these actions by resource area is presented in Chapter 4.

To identify past, present, or reasonably foreseeable future actions which may be considered as part of a cumulative effects analysis, TRISO-X considered:

- Information about current or planned local economic development programs or projects (e.g., commercial, industrial, and/or residential).
- Information about current or planned infrastructure improvements (e.g., transportation, electric, and water utility).
- Information about other current or planned projects at nearby Federal facilities and within the nuclear industry.

Actions related to environmental remediation of facilities that were used for nuclear research, including the Manhattan Project, are presently planned or expected to occur in the reasonably foreseeable future. These facilities include the Oak Ridge National Laboratory (ORNL), East Tennessee Technology Park (ETTP) and the Y-12 National Security Complex (Y-12).The actions include remediation and construction at Y-12 (Oak Ridge Office of Environmental Management, 2019; National Nuclear Security Administration, 2020); remediation at ORNL (Oak Ridge Office of Environmental Management, 2019); remediation at ETTP (Oak Ridge Office of Environmental Management, 2019); construction of the Environmental Management Disposal Facility (EMDF) (DOE, 2021); and continued operation of a transuranic waste processing facility (Northwind Solutions LLC, 2021).

Other present or reasonably foreseeable future actions include a development project in downtown Oak Ridge (Oak Ridge Chamber of Commerce, 2020); construction and operation of a new water treatment plant for the City of Oak Ridge (City of Oak Ridge, 2017); construction and operation of Small Modular Reactor (SMR) units at the Clinch River Nuclear site (NRC, 2019 and TVA, 2022); and construction and operation of an emergency response training facility (Roane Alliance, 2020). Additionally, several actions are planned to occur at the ETTP, including construction and operation of a demonstration reactor (Kairos Power, 2021); construction and operation of a proposed general aviation airport (City of Oak Ridge, 2021); and construction and operation of a medical isotope production facility (Coquí Pharma, 2019).

Table 2.3-1
(Sheet 1 of 4)
Actions at Other Facilities

Facility/Site	Approximate Location Relative to the HCS site	Description of Action	Status of Action	Comment
Additional Development of the Horizon Center Industrial Park	Adjacent	Development of lots within the Horizon Center Industrial Park	Potential	Timeframe uncertain. No definitive development plans.
69-kilovolt Transmission Line	Southwest, northwest, and northeast	Construction by the ORED of a 69-kV transmission line from the ORED substation on Blair Road to the intersection of Imperium Drive and TN 95. A portion would extend along the HCS, would require some additional tree clearing, and would cross the East Fork Poplar Creek and associated tributary streams.	Reasonably foreseeable	Approved. Overlapping construction activities
Oak Ridge Enhanced Technology and Training Center (ORETTC)	0.9 mi. (1.5 km) east	Operation of the ORETTC by DOE National Nuclear Security Administration to train first responders and other experts in nuclear operations, safeguards, and emergency response to support the National Security Enterprise.	Under construction expected to be complete in 2022	Operation would overlap with construction and operation of the TRISO-X FFF
ETTP	2.3 mi. (3.6 km) southwest	Continuing remediation activity and transfer of remediated facilities.	Past, present, future	Operation would overlap with construction and operation of the TRISO-X FFF

Table 2.3-1
(Sheet 2 of 4)
Actions at Other Facilities

Facility/Site	Approximate Location Relative to the HCS site	Description of Action	Status of Action	Comment
Kairos Reactor Demonstration at ETTP	2.3 mi. (3.6 km) southwest	Construction and operation of a low-power demonstration reactor to support development of their fluoride salt-cooled, high-temperature reactor technology.	Reasonably foreseeable	A construction permit application has been accepted by the NRC for review. Initial operations are planned by mid-2026
USNC Pilot Fuel Manufacturing Operation / ETTP	2.3 mi. (3.6 km) southwest	Ultra Safe Nuclear Corporation (USNC) to site new Pilot Fuel Manufacturing operation, located on the ETTP, site of Manhattan Project's K-25 gaseous diffusion plant.	Under development	Initial operations planned by Summer 2022
Medical Isotope Production Facility	2.3 mi. (3.6 km) southwest	Coquí Pharma construction of medical isotope facility.	Reasonably foreseeable. Operational by 2025.	May overlap with construction and operation of the TRISO-X FFF
Oak Ridge General Aviation Airport / ETTP	2.3 mi. (3.6 km) southwest	Construction and operation by the City of Oak Ridge of a general aviation airport with a single 5,000 ft runway. Approximately $22 million of the estimated $55 million project cost has been made available.	Reasonably foreseeable. Operational by 2025.	Planning phase.

Table 2.3-1
(Sheet 3 of 4)
Actions at Other Facilities

Facility/Site	Approximate Location Relative to the HCS site	Description of Action	Status of Action	Comment
EMDF	3.4 mi. (5.4 km) east	Proposed Landfill facility for disposal of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) low-level hazardous waste.	Reasonably foreseeable	Planning phase. Timeframe uncertain
ORNL	4 mi. (6.4 km) southeast	Continuing remediation of radiologically and chemically contaminated facilities. ORNL occupies approximately 4,470 acres and includes facilities in two areas—Bethel Valley, which includes the central campus area of ORNL, includes reactor facilities, isotope production facilities, waste treatment facilities, and research facilities, and Melton Valley, which includes reactor facilities, research facilities, waste treatment facilities, and waste management areas.	Past, present, future	Continued operation would overlap with construction and operation of the TRISO-X FFF.
TRU Waste Processing Center (TWPC)	4.8 mi. (7.7 km) southeast	North Wind Solutions, LLC operates the Transuranic (TRU) Waste Processing Center for the DOE Oak Ridge Office of Environmental Management to process and repackage ORNL legacy TRU waste and ship it off-site.	Past, present, future	Continued operation would overlap with construction and operation of the TRISO-X FFF.

Table 2.3-1
(Sheet 4 of 4)
Actions at Other Facilities

Facility/Site	Approximate Location Relative to the HCS site	Description of Action	Status of Action	Comment
Clinch River Nuclear site	5 mi. (8.1 km) southwest	Construction and operation by Tennessee Valley Authority of an Advanced Nuclear Technology Park. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric for the site.	Reasonably foreseeable. Early Site Permit issued by NRC in 2019. Programmatic Environmental Impact Statement issued by TVA July 2022. Timing of construction/operation is unknown.	May overlap with construction and operation of the TRISO-X FFF
Y-12	6.6 mi. (10.5 km) east	Continuing remediation of contaminated facilities and mercury contamination in soil and groundwater. . The following projects are proposed: West End Protected Area Reduction Project; Lithium Processing Facility; Calciner Project; and Electrorefining Project.	Past present and future. Planning and installation of the Calciner Project began in 2014 and is ongoing. Installation of the Electrorefining Project is scheduled to be complete in 2023. The West End Protected Area reduction project is scheduled for completion in 2025.in 2025. The Lithium Processing Facility is scheduled for completion in 2031 and operation in 2034.	May overlap with construction and operation of the TRISO-X FFF
City of Oak Ridge water treatment plant	7.3 mi (11.7 km) east	New water treatment facility to be constructed at a location near the intake of the current water treatment plant.	Present, future. Project completion expected in 2022	Operation would support operation of the TRISO-X FFF.
Downtown Oak Ridge	7.3 mi. (11.7 km) northeast	Downtown Oak Ridge development project along the Wilson Street corridor. Project includes a mix of residential and retail development.	Reasonably foreseeable	Planning phase. Timeframe uncertain.

2.4 COMPARISON OF THE PREDICTED ENVIRONMENTAL IMPACTS

As described in Section 2.2, evaluations have been performed for alternatives to the Proposed Action regarding technology, facility design, and location. The results of these evaluations have eliminated these alternatives from further consideration. Therefore, the comparison presented in this Report is that of the Proposed Action, under which the TRISO-X Fuel Fabrication Facility (TRISO-X FFF) is constructed and would produce TRISO-X fuel while minimizing potential adverse environmental impacts, against the No-Action Alternative, under which the TRISO-X FFF is not constructed. Reasonably foreseeable environmental impacts and the extent of those impacts from the Proposed Action, potential mitigation measures, and restoration actions, if applicable, are described in detail in the resource-specific sections of Chapter 4 of this Report (Environmental Impacts), as well as summarized earlier in Section 2.1.2.2. Table 2.4-1 details the comparison between the potential foreseeable environmental impacts for the Proposed Action, Alternative Sites, and No-Action Alternative.

As described in Section 2.2, during Phase 2 of the TRISO-X FFF site study an evaluation of the five candidate sites against 35 categories/evaluation criteria was presented in Appendix C of the report. The weighted scores found in Appendix C of the Site Study of each candidate site for the impact categories listed in Table 2.4-1 were used to assign the foreseeable environmental impacts. SMALL, MODERATE, and LARGE environmental impacts were assigned to each of the impact categories of the Alternative Sites presented in Table 2.4-1. Sites that received a high weighted score in an impact category during the site study were listed as having SMALL potential impacts in Table 2.4-1, whereas sites that received a low weighted score in an impact category during the site study were listed as having of LARGE potential impacts in Table 2.4-1. Sites that received a moderate weighted score in an impact category during the site study were listed as having of MODERATE potential impacts in Table 2.4-1.

Table 2.4-1
(Sheet 1 of 2)
Comparison of the Predicted Environmental Impacts

Impact Category	Proposed Action	Alternative Sites				No-Action
	HCS Oak Ridge, TN	Centrus ACP Piketon, OH	Centrus TMC Oak Ridge, TN	GE/GNF-A Wilmington, NC	SRS Energy Park Aiken, SC	
Land Use	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL
Transportation	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL
Geology and Soils	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL
Water Resources	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL
Ecology	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Noise	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Visual/Scenic	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL
Socioeconomics	SMALL to MODERATE	SMALL	SMALL	SMALL	MODERATE	SMALL

Table 2.4-1
(Sheet 2 of 2)
Comparison of the Predicted Environmental Impacts

Impact Category	Proposed Action	Alternative Sites				No-Action
	HCS Oak Ridge, TN	Centrus ACP Piketon, OH	Centrus TMC Oak Ridge, TN	GE/GNF-A Wilmington, NC	SRS Energy Park Aiken, SC	
Environmental Justice	SMALL	MODERATE	SMALL	MODERATE	SMALL	SMALL
Public and Occupational Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

Figure 2.1-1
Overall Site Layout

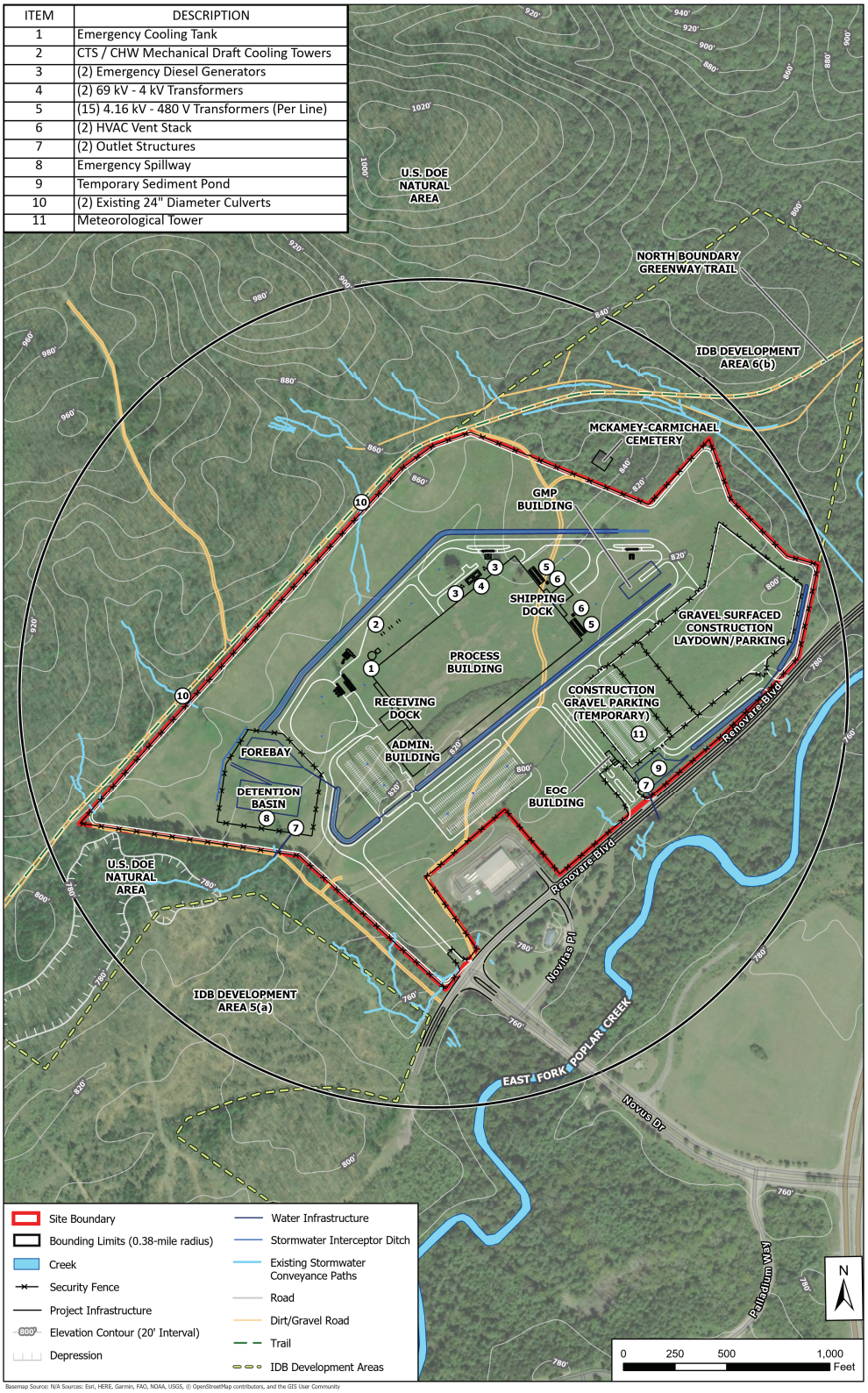


Figure 2.1-2
Water Balance Diagram

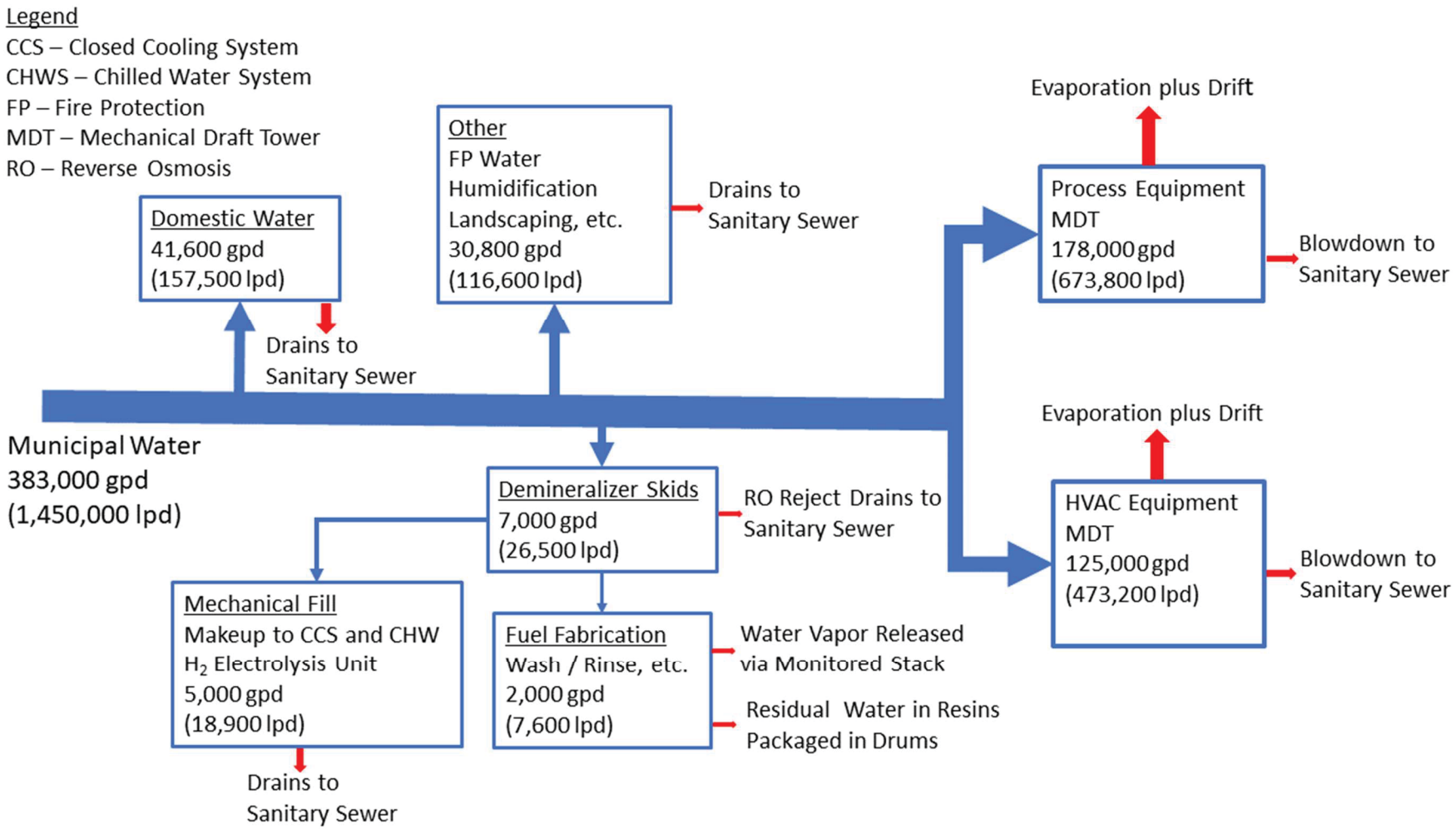
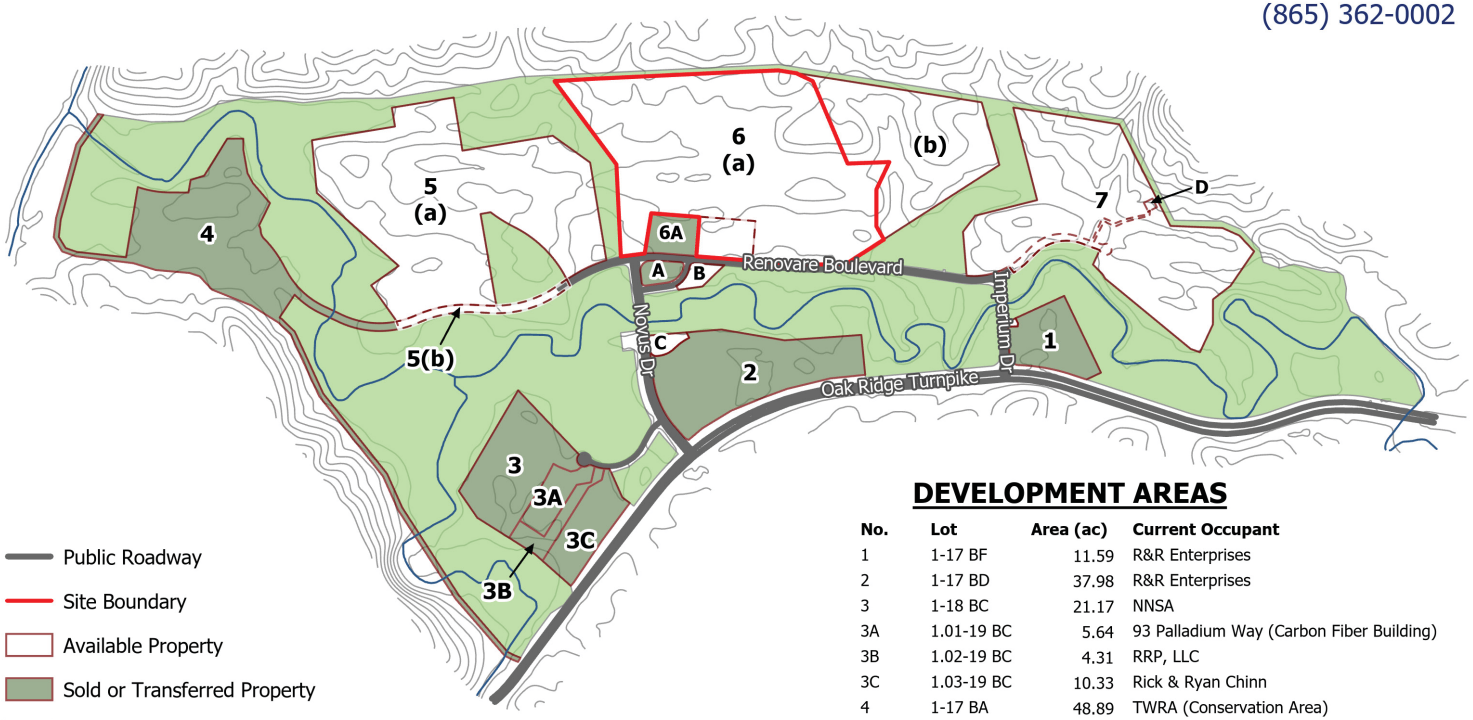


Figure 2.3-1
City of Oak Ridge Industrial Development Board Development Areas

Horizon Center
Oak Ridge, Tennessee

The Industrial Development Board of the City of Oak Ridge (IDB)
(865) 362-0002



Public Roadway
Site Boundary
Available Property
Sold or Transferred Property
Permanent Natural Area
Stream
Elevation Contour (20-Foot Interval)

0 1,000 2,000 4,000 Feet

N

7/22 Rev. 9

DEVELOPMENT AREAS

No.	Lot	Area (ac)	Current Occupant
1	1-17 BF	11.59	R&R Enterprises
2	1-17 BD	37.98	R&R Enterprises
3	1-18 BC	21.17	NNSA
3A	1.01-19 BC	5.64	93 Palladium Way (Carbon Fiber Building)
3B	1.02-19 BC	4.31	RRP, LLC
3C	1.03-19 BC	10.33	Rick & Ryan Chinn
4	1-17 BA	48.89	TWRA (Conservation Area)
5	1-16 BB (a)	94.18	IDB Available
	1-16 BB (b)	3.75	Renovare Blvd Extension
6	1-16 BD (a)	110.16	TRISO-X
	1-16 BD (b)	40.94	IDB Available
6A	1.01-16 BD	4.90	Philotechnics
7	1-15 BF	73.59	IDB Available
A	2-16 BD	2.12	CROET
B	3-16 BD	1.68	IDB Available
C	2-17 BD	1.55	IDB (Sculpture Area)
D	1.01-15 BF	0.90	CROET (Cell Tower and Utility Easement)
Total Acres 473.68			