ORNL/SPR-2020/1645

Oak Ridge National Laboratory Response to Versatile Test Reactor Environmental Impact Statement Data Request

Jeffrey J. Powers
Walt Doty

September 2020

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

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Versatile Test Reactor Project

OAK RIDGE NATIONAL LABORATORY RESPONSE TO VERSATILE TEST REACTOR ENVIRONMENTAL IMPACT STATEMENT DATA REQUEST

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Date Published: September 2020

Prepared by
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Oak Ridge, TN 37831-6283
managed by
UT-BATTELLE, LLC
for the
US DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

ACKNOWLEDGMENTS

Responding to the breadth and depth of data requests sent to Oak Ridge National Laboratory (ORNL) required a large, diverse team of contributors, listed below in alphabetical order, who were all essential in completing this work. The authors sincerely thank them all for their efforts and assistance and deeply apologize to any contributors inadvertently left off this list; their contributions were appreciated and every bit as important to making this happen. All individuals listed below are affiliated with ORNL unless stated otherwise.

Michele Baker	Elizabeth Krispin
Damen Belcher	Jessica Langstaff
Kevin Birdwell	Phil Lawlor
Drew Bryson	Melisa Madgett
Jeremy Busby	Bill Manuel
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Evin Carter	William McCarter
Sara Darling	Morgan McCorkle
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Wes Goddard	Matt Powell
Jason Harp	John Powell
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Lindsey Hayter	Ernest Ryan
Jamie Herold	Jim Serafin
Jane Holly	Jeff Shelton
Alex Huning	David Skipper
Alan Icenhour	Mike Stafford
David Keim	Gina Stone
Dick Ketelle (UCOR-RSI)	Patrick Thomas
Sharon Kohler	Bryce Wade

In addition to those listed above, the authors wish to thank Terry Matthews for her help getting researchers back onsite to conduct important field surveys at ORNL during a sustained reduction of operations due to the novel coronavirus (COVID-19) pandemic of 2020, Anita Benn for her administrative and editing support throughout this process, and Rose Raney for her assistance with technical editing of this report. Finally, the authors wish to thank all ORNL staff involved in providing tours during the February 2020 Versatile Test Reactor (VTR) Environmental Impact Statement (EIS) team visit to ORNL, especially Chad Parish and Rose Montgomery, and all ORNL Site Office (OSO) staff involved in that same visit, especially Chad Huffman, Martha Kass, and Johnny Moore.

This work was funded by the US Department of Energy Office of Nuclear Energy (DOE-NE) VTR project. Some of the information reported in this document is the result of studies supporting a VTR conceptual design, cost, and schedule estimate for DOE-NE to make a decision on procurement. As such, it is preliminary.

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1. INTRODUCTION

The Versatile Test Reactor (VTR) is a fast-spectrum test reactor being developed in the United States under the direction of the US Department of Energy Office of Nuclear Energy (DOE-NE). The VTR mission is to enable accelerated testing of advanced reactor fuels and materials required for advanced reactor technologies. The conceptual design of the 300 MWth sodium-cooled metallic-fueled pool-type fast reactor has been led by the US National Laboratories in collaboration with General Electric–Hitachi and Bechtel National, Inc.

In support of the VTR project, DOE issued a Notice of Intent (NOI) in the Federal Register on August 5, 2019, announcing the intent to prepare an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) and its implementing regulations. The EIS will evaluate alternatives for a versatile reactor–based fast-neutron source facility and associated facilities for the preparation, irradiation, and post-irradiation examination (PIE) of test/experimental fuels and materials. Specifically, the NOI identified two siting alternatives for the VTR reactor facility: Idaho National Laboratory (INL) or Oak Ridge National Laboratory (ORNL). In addition, the NOI also specified two siting alternatives for VTR fuel fabrication: INL and the Savannah River Site (SRS).

This report provides information in response to data requests made to ORNL to fill in site-specific knowledge gaps to develop a high-quality EIS. The responses provided are not required to provide full details in every aspect; instead, they adequately bound possible environmental impacts or provide sufficient information to adequately assess likely environmental impacts. This work is being performed under a subcontract from INL to ORNL using DOE-NE funds and is directed by DOE-NE and DOE-ID. Leidos has been contracted by DOE-NE to write the VTR EIS, so most data requests have come from Leidos but were often routed through INL or DOE-ID. DOE-ID is overseeing the NEPA and EIS processes for the VTR project. Leidos will use the information provided in this report to inform the VTR EIS and will also cite this document to establish a clear, publicly available source of the information.

Section 2 of this report briefly describes the proposed ORNL VTR Alternative and illustrates the location of the proposed site for the ORNL VTR Alternative. Sections 3 through 7 provide direct responses to data requests received by ORNL. These sections use a tabular format in which data requests are divided into separate items to be addressed; the items are numbered, the data requests are restated with more topical information included, and then the responses are provided. Initial data requests and follow-on requests for additional information (RAIs) are combined under the original data request fields. Finally, Section 8 presents summarized conclusions and describes future work.

2. PROPOSED ORNL VTR ALTERNATIVE

Under the ORNL VTR Alternative, the VTR would be sited at ORNL, about a mile east of the ORNL main campus, and a little less than a mile northeast of the High Flux Isotope Reactor (HFIR), southeast of the intersection of Melton Valley Access Road and Ramsey Drive. A recent study by Leidos [1] provided detailed information on selection of a specific proposed site location for VTR at ORNL. Figure 1, based on some updates to that study and reproduced with permission of Leidos, provides a map showing the proposed ORNL VTR Alternative site. Figure 2 [1] shows sites included in this area that were previously evaluated for the Advanced Neutron Source in the 1990s and as part of the Global Nuclear Energy Partnership (GNEP) in 2007. Initial ORNL efforts established a bounding area of interest covering about 2,500 acres, indicated by the gray rectangular box in Figure 2. Leidos focused in on the current proposed site shown in Figure 1, establishing a 50-acre Operations Area for long-term use, surrounded by a 100-acre Construction Area that would only be used during construction.

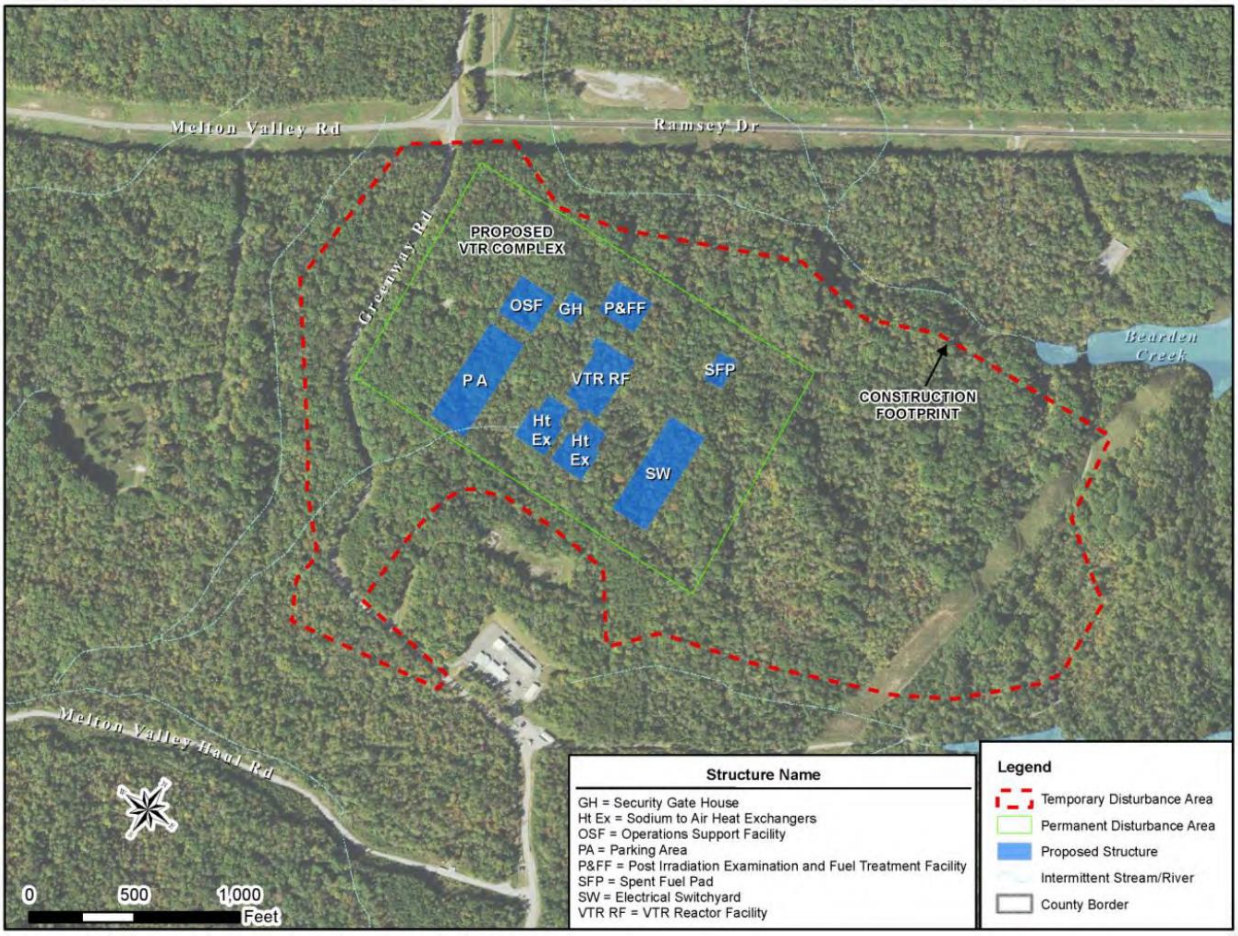

Figure 1. Map of the proposed siting location for the ORNL VTR Alternative.

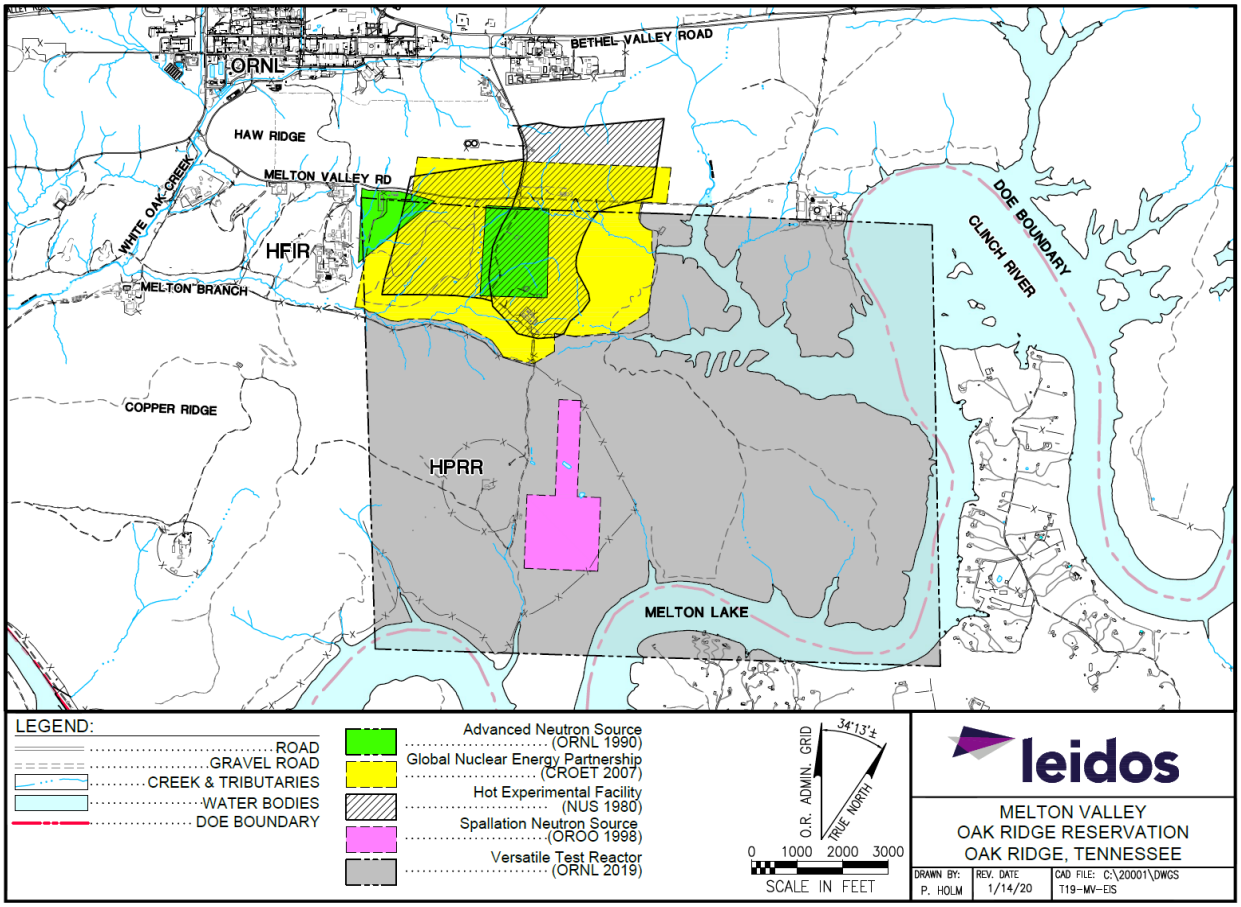

Figure 2. Map of proposed ORNL VTR Alternative site location and past projects that considered building a facility in this area (e.g., Advanced Neutron Source 1990s; Global Nuclear Energy Partnership 2007). [1]

To the best of our knowledge, the proposed site for the ORNL VTR Alternative is a greenfield site. There are no known radiological or hazardous wastes on the proposed site. However, environmental sampling/monitoring would likely still be done before and during disturbing the ground for construction.

The initial data request sent to ORNL assumed that there would be one facility to handle test assembly examination, which would primarily be PIE in hot cells, and then spent fuel treatment and storage would either be handled in a single facility or in two additional facilities. However, as described in Section 5 and in much further detail in a Leidos study covering construction and the hot cell facility for the ORNL VTR Alternative [2], a new hot cell facility collocated with the VTR reactor would be constructed as part of the ORNL VTR Alternative to support test assembly examination (PIE) and spent fuel treatment. This new hot cell facility would provide inert gas environment hot cell capabilities for handling pyrophoric materials and sodium, both of which could be likely to come from the VTR. Several existing ORNL facilities could also be used and/or modified to provide operational support and additional PIE capabilities. Hot cell facilities in the Irradiated Fuels Examination Laboratory (IFEL, Building 3525) and the Irradiated Materials Examination and Testing (IMET, Building 3025E) would be used to support PIE and material testing. IFEL is a Category 2 nuclear facility and contains hot cells which are currently used to examine a wide variety of fuels. IMET is a Category 3 nuclear facility and contains hot cells which are used for mechanical testing and examination of highly irradiated structural alloys and ceramics. The existing Radiochemical Engineering Development Center (REDC) could also help support VTR operations. REDC consists of two hot-cell facilities and operates in conjunction with ORNL's High Flux Isotope Reactor (HFIR) for remote and hands-on fabrication of targets for irradiation and subsequent

processing and recovery of valuable radioisotopes. Existing glovebox laboratories in Building 7920, which is currently used for chemical extraction and processing, could be used for fuel and/or test item fabrication if needed. Building 7930 houses heavily shielded hot cells and analytical laboratories that could be used for remote examination of irradiated fuels and test items.

Under the proposed ORNL VTR Alternative, fuel fabrication would not be performed at the ORNL VTR site: the VTR EIS proposes INL and the SRS as two VTR Fuel Production Alternatives.

3. DATA REQUEST RESPONSES FOR EXISTING AFFECTED ENVIRONMENT

Item No.	Topic	Information Needed for EIS
1	**Geographic Information System (GIS)**	GIS layers appropriate for use in identifying site and relevant area boundaries, roads, facilities, surface water, and other features are needed. Please provide files appropriate for use in a public document or a contact person with whom our GIS analyst can interface to acquire needed files.

Response

The natural resources map shown in APPENDIX A depicts wetland delineations, streams, springs and sinks. For further details, the narrative in APPENDIX B describes and defines sensitive resources shown on the map associated with the defined natural areas, along with some information from some additional data sources, including an associated map.

GIS data files have been directly provided to Leidos for use in the VTR EIS.

Item No.	Topic	Information Needed for EIS
2	**Infrastructure**	

2.1		Please provide system capacities and current usage for the following site infrastructure systems. If the areas in which the facilities would be located (assumed to be [the Materials and Fuels Complex] MFC at INL and near HFIR at ORNL) have independent systems or limited capacity (e.g., an area electrical capacity limited by a dedicated substation or an independent sewage treatment/disposal system), the area capacity should also be provided.
		• Electricity
		  ○ Peak demand (MW)
		  ○ Energy (MW-hours/yr)
		• Water (potable and non-potable if applicable)
		• Sewage
		• Fuel (e.g., natural gas) if applicable

Response

Resource	Site usage	Site capacity
Electricity		
- Energy consumption (megawatt-hours per year)	583,000	n/a (see notes)
- Peak load (megawatts)	68.5	140
- Steam (pounds per hour)	May need both site-wide and local data. Please see comments.	May need both site-wide and local data. Please see comments.
Fuel		
- Natural gas (cubic feet per year)	600,000,000	3,214,200,000
Water (million gallons per year)	730	1,460

- **Electricity**

  There are two 13.8 kV feeders near the proposed VTR siting area. The maximum capacity of each feeder is approximately 12 MW. Peak loading on feeder 294 is approximately 4 MW. Peak loading on feeder 216 is approximately 7 MW. These numbers are calculated because direct metering is not available from that area. There is not enough capacity to support a load of the size stated as required for VTR. A new overhead feeder would need to be constructed from the nearby substation. It is possible that load could be shifted off feeder 216 when the new feeders to building 5600 are complete. Energy usage (MW-hr/yr) is only available for the whole site; there is no existing breakdown for each feeder.

  Site usage is specified in the table above for energy consumption. It is unclear that defining a site capacity for energy consumption would be applicable. If the peak site power capacity were maintained 24 hours a day for every day in the year, then peak site capacity would theoretically be ~1,227,000 MWh/year. However, it is unclear if that is a reasonable or useful number. The peak site load over a recent 13-week period is 68.5 MW. The site capacity at unity power factor is 140 MW. 30 MW of capacity is reserved for High Performance Computing.

  The Melton Valley Steam Plant would be the closest steam option for the proposed VTR site, so it would likely be the local steam source. However, it has limited capacity; maximum output of the plant is ~13,000 lb/hr, and its average peak site usage is between ~12,000 to ~13,000 lb/hr. If all processes are in operation at HFIR, REDC, and the Molten Salt Reactor Experiment (MSRE), then the demand can jump above 13,000 lb/hr.

Item No.	Topic	Information Needed for EIS
2	**Infrastructure**	

2.1		Please provide system capacities and current usage for the following site infrastructure systems. If the areas in which the facilities would be located (assumed to be the Materials and Fuels Complex [MFC] at INL and near HFIR at ORNL) have independent systems or limited capacity (e.g., an area electrical capacity limited by a dedicated substation or an independent sewage treatment/disposal system), the area capacity should also be provided.
		• Electricity
		  ○ Peak demand (MW)
		  ○ Energy (MW-hours/yr)
		• Water (potable and non-potable if applicable)
		• Sewage
		• Fuel (e.g., natural gas) if applicable

Response (continued)

- **Electricity (continued)**
  The main campus steam plant has a maximum output of 190,000 lb/hr, peak demand is ~150,000 lb/hr. When either plant is operating at maximum capacity, there is no longer any available redundancy. Trying to pull from remaining capacity at the main steam plant if the Melton Valley Steam Plant is at maximum capacity could create risks for ORNL.

  A capacity increase at Melton Valley Steam Plant may be needed. This issue would need to be investigated further to better understand the specifics, if this approach is desired.

- **Water**
  There are 16-inch supply pipes to Melton Valley (HFIR) that can support significant potable/process water load. Some additional work will be needed to connect to those supply pipes.

  Site capacity for water is 1,460 million gallons per year (mgy). However, this is limited by the local water provider; the current pipe can provide additional flow.

  Reports from DOE, UT-Battelle (UTB), and the City of Oak Ridge document site usage of potable water as 765 mgy in 2017, 722 mgy in 2018, and 589 mgy in 2019. The 2019 number was low due to HFIR not operating. Based upon this data, ORNL recommends using a value of about 730 mgy for site usage. This estimate falls between the 2017 and 2018 site usage numbers and therefore includes HFIR running. Alternatively, if Leidos wants to continue using the number they previously suggested (701 mgy) because they think it has a better basis, this would be acceptable if they state the basis for its use.

- **Sewage**
  Lift stations would be needed at the proposed VTR site to send waste to the east end of Bethel Valley. More details may be found in the utilities map in APPENDIX C.

Item No.	Topic	Information Needed for EIS
2	**Infrastructure**	

2.1		Please provide system capacities and current usage for the following site infrastructure systems. If the areas in which the facilities would be located (assumed to be [the Materials and Fuels Complex] MFC at INL and near HFIR at ORNL) have independent systems or limited capacity (e.g., an area electrical capacity limited by a dedicated substation or an independent sewage treatment/disposal system), the area capacity should also be provided.
		• Electricity
		  ○ Peak demand (MW)
		  ○ Energy (MW-hours/yr)
		• Water (potable and non-potable if applicable)
		• Sewage
		• Fuel (e.g., natural gas) if applicable

Response (continued)

- **Fuel**
  No large storage area or pipeline exists for any of these fuel types at the proposed site.

  There is natural gas in the area, but not in the immediate proximity. The natural gas line map in APPENDIX D shows the location of a 6-inch 100 psi natural gas line on the north side of Haw Ridge that could be used to supply natural gas to the VTR site area. Currently, the line goes to the Melton Valley Steam Plant at the intersection of Melton Valley Drive and HFIR Access Road. The current natural gas pressure reducing station will likely have capacity issues if VTR connects to it; the station was sized specifically for the steam plant. A new natural gas line would likely be installed along the Melton Valley Access Road to connect to the 100 psi line at Bethel Valley Road.

  Site gas usage for FY19 was ~6,000,000 centum cubic feet (CCF). This number includes all natural gas users in Bethel Valley and Spallation Neutron Source (SNS), and it has been converted to the specified units of cubic feet per year.

  Maximum flow at the site regulator station is 8,800 thousand cubic feet per day (MCFD). This number has been converted to the specified units of cubic feet per year.

  There is a small fuel oil storage tank at Melton Valley Steam Plant used as a backup fuel source for the steam plant.

Item No.	Topic	Information Needed for EIS
2	**Infrastructure**	
2.2		1. Would data be available for annual generation of industrial wastewater at ORNL (million gallons)? Does [National Pollutant Discharge Elimination System [NPDES] Permit TN0002941 specify permitted flows for ORNL or [Oak Ridge Reservation] ORR in total? How/where would the proposed VTR most likely be connected to the existing industrial wastewater system? 2. Would data be available for ORNL for average daily flow (gallons per day) and sanitary wastewater treatment plant current system capacity? How/where would the proposed VTR most likely be connected to the existing sanitary wastewater system? 3. ORNL's draft initial data response (received 16-Jan-2020) implied that the most likely connection point for water to the proposed VTR site would be 16" supply pipes to/from Melton Valley. Is this correct and is there data about capacity and current usage from those lines and their source?

Response (continued)

1. ORNL's existing industrial wastewater system is not allowing new piping system connections; therefore, the proposed VTR site would need to be put on a new industrial wastewater system. Data are available for annual generation of industrial wastewater at ORNL but may not be applicable given the limitation noted above about not connecting to the existing system. NPDES Permit TN0002941 specifies the permitted flows for ORNL.

2. ORNL's average daily flow is 186,1000 gpd. The current system capacity of the sanitary wastewater treatment plant at ORNL is 300,000 gpd. The proposed VTR site location would most likely be connected to the existing sanitary wastewater system using a new pump station and pipe along Melton Valley Access Road connecting to the existing pipe near the corner of White Oak Avenue.

3. Yes, the 16-inch supply pipes to/from Melton Valley would be the most likely connection point for water to the proposed VTR site. The current usage is a maximum of 1.1 million gallons per day (MGD). The capacity of the line will be limited by the current customer requirements instead of the physical pipe capacity. Additional information would be required before further response can be provided.

Item No.	Topic	Information Needed for EIS
3	**Noise**	
3.1		For each potential location, provide any recent noise measurements or surveys? (The 2016 EIS for Naval Spent Nuclear Fuel Handling mentions noise measurements from 2011 at INL and the 2007 GNEP Site Characterization Report mentions noise measurements from 2001 at ORNL.)
3.2		For each potential location, provide a list of the existing noise sources, locations, and noise levels, to include: • Noise-generating equipment • Noise-generating facilities/operations • Duration/frequency of noise

Response

Due to the remote nature of the Oak Ridge option site, noise measurements for the site reveal rural background noise levels estimated in the 30 dB range. If specific or improved values are needed, notify ORNL and an actual survey can be performed.

Currently there are no noise-generating facilities/operations or equipment associated with the Oak Ridge site option. The only existing noise source would be vehicle traffic noises along Melton Valley Drive, which is located approximately 1,000–1,500 feet from the Oak Ridge option site. All other potential sources of noise (e.g., HFIR) are located about 2,000 feet to the west of the Oak Ridge option site. Based on the distances from noise sources to the Oak Ridge option site, there would be no noise impact from existing sources.

Item No.	Topic	Information Needed for EIS

4	**Traffic**	• Current daily traffic into/out of facility
		• Current number of employees (total)
		• No. of commuters
		• % of those who carpool
		• Average commute distance for employees
		• Peak travel times for employees arriving/departing from facility
		• Are there any time(s) when traffic congestion onsite (entering, exiting, or within) occurs?
		• Number of primary entrances and exits
		• If there's a chance rail could be used for transportation during the Proposed Action, it would be good to get information on existing conditions for rails onsite:
		  o Total length
		  o Current usage (frequency, volume, type)
		• Existing volumes of waste and numbers of shipments offsite (daily/monthly/annually)
		• Existing volumes of materials and numbers of shipments offsite (daily/monthly/annually)
		• Existing volumes of materials and numbers of shipments received (daily/monthly/annually)
		• Current methods of offsite shipments (ground/rail/air) of materials and waste
		• Please describe protocols for movement of heavy equipment or escorted shipments
		• Have any traffic studies been conducted for the location?

Response

During 2019, an average of about 4,750 vehicles came into the site each day. There are currently about 4,750 total employees with 11 carpool permits currently issued. Peak travel times are 0630–0930 for the morning commute and 1530–1730 for the evening commute, with most congestion occurring at the east and west portals during morning/evening commute times. There are two primary entrances/exits: Bethel Valley Road eastbound toward TN-162, and Bethel Valley Road westbound toward TN-95. Traffic studies have been conducted for select intersections on site. A study for the entire site has not been completed.

Based on FY19 data for incoming material shipments, there are about 175,000 packages/containers received per fiscal year; no daily or monthly numbers are available for shipments received. FY19 annual waste shipment data indicates 631 landfill loads of sanitary waste (9,866 cubic yards), 45 loads of recycled cardboard (162 tons), and 114 loads of recycled scrap metal (666 tons) during the year.

There is currently no rail onsite.

Heavy equipment is processed in accordance with ORNL's access protocols, which include all vehicles being subject to search. Loads must be configured so that security personnel can perform a visual inspection of both the vehicle and the load. Searches are conducted randomly. Bills of lading are verified, government forms of identification are verified, and preplanning and notification are required for oversized or unusual shipments.

Item No.	Topic	Information Needed for EIS
5	**Surface Water and Groundwater**	• Available site-specific plans ([stormwater pollution prevention plan] SWPPP, Water Quality Protection Plan, etc.) • NPDES permit information • Identification of site/facility water source • Is groundwater at the proposed site location likely contaminated, based on experience at surrounding areas?

Response

Several documents providing the information requested in this item are available either as publicly accessible referenced documents, or they are included as appendices to this document for convenience:

- ORNL NPDES Permit, available online at the Tennessee Department of Environment and Conservation (TDEC) website [3]
- ORNL NPDES Water Quality Protection Plan (WQPP) 2016 Monitoring Strategy update, available online at the TDEC website [4]
- ORNL WQPP, partially embedded in the 2016 Monitoring Strategy update [4]; a copy of the original ORNL WQPP was also provided directly to Leidos as background information.
- ORNL Spill Prevention, Control, and Countermeasures (SPCC) Plan (internal ORNL plan); a copy of the ORNL SPCC Plan was provided directly to Leidos as background information but it is not a public document and therefore will not be shared directly as part of this report or the VTR EIS.

The natural resources map in APPENDIX A contains wetland delineations, streams, springs, and sinks. For further details, please see APPENDIX B for a narrative describing and defining sensitive resources on the map associated with ORNL's defined natural areas, along with information from some additional databases.

There is no expectation of contaminated groundwater in this area.

Item No.	Topic	Information Needed for EIS
6	**Socioeconomics and EJ**	Please confirm if the data contained in the following report has the most current economic information for Oak Ridge or provide more current reports if available. Alternatively, please provide average employee salary and total number of workers employed at all sites to help estimate tax revenues. • Oak Ridge: https://eteconline.org/wp-content/uploads/2018/05/DOE-EIS-FY17-Report.pdf

Response

Yes, the East Tennessee Economic Council (ETEC) report cited is the most recent and best report to our knowledge for the data requested.

Item No.	Topic	Information Needed for EIS
7	**Cultural**	
7.1		Has the area proposed for construction of the VTR been included in a recent cultural survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the possibility for cultural artifacts in the area is requested.
7.2		Confirm that the findings and recommendations in the 1994 Archeological Reconnaissance and Evaluation of the ORNL, Oak Ridge Reservation, Anderson and Roane Counties, Tennessee report are accepted at the [State Historic Preservation Office] SHPO (Tennessee Historical Commission) and that there are no other, more recent, archaeological reports or Section 106 agreements that would figure into the analysis for the area selected for the VTR.

Response

- An ORNL Site Wide Historic Preservation Plan and Programmatic Agreement was completed and approved in 2004. No major archeological resources were identified in these areas per that documentation. The natural resources map in APPENDIX A contains locations of pre-war historic homesites and cemeteries. For further details, please see APPENDIX B for a narrative that describes and defines sensitive resources on the map associated with ORNL's defined natural areas, along with some information taken from some additional databases.

  Although no cultural resources have been identified within the proposed construction and operations site at ORNL, the archeologic remains of multiple pre-Manhattan Project dwellings and other structures are located within and just beyond the 0.25 mile distance "Area of Interest" buffer area surrounding the VTR construction zone suggested by Leidos. Efforts were performed in 2020 to assess these resources within or just beyond the Area of Interest, including field surveys. Please see APPENDIX E for full details of these recent activities. In summary, no adverse impacts on these remains are expected if the VTR were to be constructed in the proposed location.

- The findings and recommendations in the 1994 Archeological Reconnaissance and Evaluation of the ORNL, Oak Ridge Reservation, Anderson and Roane Counties, Tennessee report are accepted at the SHPO (Tennessee Historical Commission), and there are no other more recent archaeological reports or Section 106 agreements that would figure into the analysis for the area selected for the VTR beyond the details provided in APPENDIX E of this report. The natural resources map presented in APPENDIX A contains locations of pre-war historic homesites and cemeteries, and Figure E-4 in APPENDIX E shows a map of pre-1942 structure locations around the proposed VTR ORNL Alternative site.

  The 2001 Cultural Resource Management Plan (CRMP) remains the most recent report.

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.1		Has the area proposed for construction of the VTR been included in a recent biological survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the threatened and endangered species in the area is requested.

Response

Past surveys have found multiple threatened and endangered (T&E) species and special habitats. More surveys will be required and will need to be conducted at specific times of the year for various species. Many of these surveys could require consultation with US Fish and Wildlife Service (USFWS), Army Corp of Engineers (ACOE), and/or TDEC prior to work. Mitigation for T&E species, aquatic features, and sensitive habitats may also be required. Some species, such as bats and migratory birds, will require tree removal and other activities to be avoided during certain times of the year. The Natural Resources Map provided contains locations of the sensitive resources detailed below.

Biological surveys have been performed in the proposed VTR site area at ORNL during 2020. [5] The findings of those surveys have been integrated into this report, provided to Leidos directly, and are publicly accessible in their own report. [5] If the ORNL VTR Alternative is selected, then further consultation with USFWS would be required and additional species-specific surveys would be warranted. Consultation with the USFWS will determine the level of effort required for surveys and whether a Biological Assessment will be required. In addition, if the ORNL VTR Alternative is selected, wetland determinations and stream delineations would be necessary via TDEC before starting any construction activities.

MAMMALS

Federal and State Listed Threatened and Endangered Species

The proposed project area includes suitable bat foraging and roosting habitat. Previous bat acoustic surveys identified the presence of five T&E bat species in the proposed VTR location (Natural Resources Map). Further acoustic monitoring and/or mist netting surveys will be required. Formal consultation may be necessary between USFWS and the project to develop a mitigation plan for federally listed threatened and endangered bat species. Tree removal and disturbance to bat habitat can only occur at certain times of the year and with consent from USFWS. White oaks, shagbark hickories, and standing snags on the site provide potential roosting habitat. Bat species of concern include:

- Indiana bat (*Myotis sodalis*) (federally listed as Endangered)
- Gray bat (*Myotis grisescens*) (federally listed as Endangered)
- Northern long-eared bat (*Myotis septentrionalis*) (federally listed as Threatened)
- Little brown bat (*Myotis lucifugus*) (active petition for federal listing and state-listed as Threatened)
- Tricolored bat (*Perimyotis subflavus*) (active petition for federal listing and state-listed as Threatened)
- Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) (state-listed as In Need of Management)
- Eastern small-footed bat (*Myotis leibii*) (state-listed as In Need of Management)

Other mammal records for the area include:

- Southern bog lemming (*Synaptomys cooperi*) (state-listed as In Need of Management)
- Allegheny woodrat (*Neotoma magister*) (state-listed as In Need of Management)
- Multiple shrew species (*Sorex* spp) (rare, of regional importance, or state-listed as In Need of Management)

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.1		Has the area proposed for construction of the VTR been included in a recent biological survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the threatened and endangered species in the area is requested.

Response (continued)

BIRDS

Migratory Bird Treaty Act requirements and Federally Listed Management Concern Species

The expectation is that this would include Neotropical forest birds, some of which may be sensitive to further forest fragmentation. Two areas within Natural Area (NA) 14 and Reference Area (RA) 11 (see Natural Resources Map provided) have been surveyed by ORNL Natural Resources Program staff as part of the international Partners in Flight (PIF) breeding bird survey program. The following bird list was compiled from formal PIF surveys, informal surveys, and other databases. Area-sensitive forest birds known to be in the area include red-shouldered hawk, barred owl, pileated woodpecker, Acadian flycatcher, whip-poor-will, blue-gray gnatcatcher, wood thrush, red-eyed vireo, yellow-throated vireo, ovenbird, northern parula, worm-eating warbler, Kentucky warbler, black-and-white warbler, yellow-throated warbler, hooded warbler, summer tanager, and scarlet tanager. Other bird species records for the area include great blue heron, black-crowned night-heron, belted kingfisher, Canada goose, bald eagle (breeding habitat present), Cooper's hawk, sharp-shinned hawk, black vulture, wild turkey, mourning dove, yellow-bellied sapsucker, red-headed woodpecker, red-bellied woodpecker, hairy woodpecker, downy woodpecker, northern flicker, chuck-will's-widow, American crow, blue jay, yellow-billed cuckoo, great crested flycatcher, eastern phoebe, barn swallow, northern rough-winged swallow, tufted titmouse, Carolina chickadee, white-breasted nuthatch, Carolina wren, pine warbler, prairie warbler, common yellowthroat, yellow-breasted chat, American goldfinch, chipping sparrow, field sparrow, indigo bunting, gray catbird, northern cardinal, eastern towhee, common grackle, brown-headed cowbird, and European starling. The value of the area to forest birds and other forest wildlife species is increased by the presence of larger interior forest areas. Of the bird species noted above, the following have some listed status:

- Black-crowned night-heron (state-listed "In Need of Management")
- Bald eagle (USFWS Bird of Conservation Concern, USFWS Bird of Management Concern, Bald and Golden Eagle Protection Act, and state-listed as In Need of Management)
- Sharp-shinned hawk (considered uncommon in the state)
- Whip-poor-will (USFWS Bird of Conservation Concern and PIF – Yellow Watch List = moderate risk of extinction)
- Chuck-will's-widow (PIF – common bird in steep decline)
- Yellow-bellied sapsucker (USFWS Bird of Conservation Concern, USFWS Bird of Management Concern, considered regionally rare in the state)
- Yellow-billed cuckoo (PIF – common bird in steep decline)
- Wood thrush (USFWS Bird of Conservation Concern, state-listed as In Need of Management, and PIF – Yellow Watch List = moderate risk of extinction)
- Kentucky warbler (USFWS Bird of Conservation Concern and PIF – Yellow Watch List = moderate risk of extinction)
- Prairie warbler (PIF – Yellow Watch List = moderate risk of extinction)
- Field sparrow (PIF – common bird in steep decline)
- Common grackle (PIF – common bird in steep decline)
- Worm-eating warbler (USFWS Bird of Conservation Concern and USFWS Bird of Management Concern)

AMPHIBIANS/REPTILES

This area contains habitat conducive to T&E species and supports high diversity of sensitive amphibian species. Ephemeral shallow water-filled depressions in stream bottomlands are important amphibian breeding sites, including the only mud salamander (*Pseudotriton montanus*) occurrence records for Anderson and Roane counties.

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.1		Has the area proposed for construction of the VTR been included in a recent biological survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the threatened and endangered species in the area is requested.

Response (continued)

The site supports ~33% of all known four-toed salamanders (*Hemidactylium scutatum*, state-listed as In Need of Management) on the ORR. This area contains habitat for the northern pine snake (*Pituophis melanoleucus*, state-listed as Threatened). Of the amphibian and reptile species noted above, the following have some listed status:

- Four-toed salamander (*Hemidactylium scutatum*) (state-listed as In Need of Management and Priority Species for the National Environmental Research Park)
- Northern pine snake (*Pituophis melanoleucus*) (state-listed as Threatened)
- Mud salamander (*Pseudotrion montanus*) (Priority Species for the National Environmental Research Park)

CAVES

The numerous caves in the area are expected to be important for bats.

Most caves in the area have not been bio inventoried but are expected to harbor high biodiversity of cave-obligate taxa. Species considered rare by TDEC such as the Mountain Disc Snail (*Anguispira jessica*, NatureServe rank G3 Vulnerable) and *Pseudanophthalmus* cave beetles (NatureServe G3 Vulnerable to G1 Critically Imperiled) are known from rock outcrops and/or cave entrances in the area.

Other species that are assumed to be present but currently lack occurrence records include the Allegheny Woodrat (*Neotoma magister*, state-listed as In Need of Management and NatureServe rank G3 Vulnerable), numerous cave obligate amphipod and isopod species (NatureServe G3 Vulnerable to G1 Critically Imperiled), and the Cave Thorn Snail (*Carychium stygium*, NatureServe rank G3 Vulnerable).

Cave surveys are needed to determine the presence of berry cave salamanders (*Gyrinophilus gulolineatus*, state-listed as Threatened and NatureServe rank G1 Critically Imperiled), which are known from several nearby caves in Knox County, as well as southern Roane County.

FISH AND OTHER AQUATIC SPECIES

Surveys may be required. No T&E fish species are known in this area, but stream surveys may be needed for fish and invertebrate species.

PLANTS

Plants of special value to the ORR and future scientific studies

Orchids of the genus *Platanthera* occur within the VTR project area. Individuals were identified as either White fringeless orchid (*P. integrilabia*, federally-listed Threatened) or Tubercled rein orchid (*P. flava* var. *herbiola*, state-listed Threatened) but could not be distinguished at the time of surveys. Hemlocks are a tree species that is plagued by the hemlock woolly adelgid (HWA). Populations are decreasing on the ORR, the state, and nationally. This location contains 164 hemlocks. Some of these are among the largest hemlocks on the ORR and are being treated for HWA (largest hemlocks shown on Natural Resources Map provided). This site also contains a study site of 100 hemlocks planted in 1958 that includes hemlocks from throughout its native range. This study site has the potential to provide future information about the effect of HWA on hemlocks from various ecosystems. There are multiple locations that contain plants of conservation concern that are monitored by ORNL Natural Resources

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.1		Has the area proposed for construction of the VTR been included in a recent biological survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the threatened and endangered species in the area is requested.

Response (continued)

Program staff. Plants of concern associated with the VTR study area include the following:

- *Platanthera* sp (state and/or federal-listed Threatened)
- Spreading False-foxglove (*Aureolaria patula*) (state-listed – Special Concern)
- Pink Lady's-slipper (*Cypripedium acaule*) (state-listed – Special Concern - Commercially Exploited)
- Appalachian Bugbane (*Cimicifuga rubifolia*) (considered as rare in the state)
- Canada Lily (*Lilium canadense*) (monitored as rare for the Oak Ridge Reservation)
- Goldenseal (*Hydrastis canadensis*) (state-listed – Special Concern - Commercially Exploited)
- Ginseng (*Panax quinquefolius*) (state-listed – Special Concern - Commercially Exploited)
- Carey's Saxifrage (*Saxifraga careyana*) (of regional importance)
- October Ladies' tresses (*Spiranthes ovalis*) (sensitive)
- Northern Bush honeysuckle (*Diervilla lonicera*) (state-listed - Threatened)
- Northern White Cedar (*Thuja occidentalis*) (state-listed – Special Concern / rare)
- Butternut (*Juglans cinerea*) (state-listed – Threatened)

Rare plant communities present:

- Northern White Cedar Woodland
- Ridge and Valley Calcareous Mixed Mesophytic Forest

AQUATIC RESOURCES

Multiple aquatic resources requiring surveys and potential mitigation

This area includes a substantial stream system, including Melton Branch and its tributaries, which feed into White Oak Creek, White Oak Lake, and ultimately the Clinch River. Multiple wetlands have been delineated in this area. Some ephemeral depressional ponds exist in forested headwater stream bottom wetlands. At certain times of year, there are ephemeral shallow water-filled depressions in one headwater stream bottom. Wetland and stream disturbance could require approval by TDEC and ACOE and require mitigation. Encroachment into riparian zones may also require mitigation.

- 7,428 feet (2,264 meters) of mapped stream
- 8,209 feet (2,502 meters) of additional wet weather conveyances and to-be-classified aquatic channels
- > 10.5 acres (4.25 hectares) of mapped wetland, likely to be classified as Exceptional Tennessee Waters via TDEC
- > 30 active springs and seep wetlands

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.1		Has the area proposed for construction of the VTR been included in a recent biological survey? If so, provide the results of that survey. If not, a survey of the area or an alternative assessment of the threatened and endangered species in the area is requested.

Response (continued)

ECOLOGICAL COMMUNITIES

DOE has made the commitment to preserve biological diversity through the protection of special habitats on the Reservation that host rare plants or animals, exemplary plant communities representative of the Southern Appalachians, and natural communities uncommon in this area. These areas are seen on the Natural Resources Map as "Natural and Reference Areas" (NAs and RAs) and "Aquatic Natural and Reference Areas" (ANAs and ARAs). These areas contain and protect sensitive species and that have been traditionally defined as containing state and federally listed species, species under consideration for such listing, or species considered globally imperiled or rare by NatureServe, an international network of natural heritage programs. They also recognize special habitats (e.g., cedar barrens, wetlands, unique forests) or features (e.g., caves, sinks, springs); these areas may also serve as references or controls for biological monitoring, environmental remediation and characterization, and other ecological research activities. The NAs and ANAs may also serve as reference or control areas for the above-mentioned activities. Habitat Areas (HAs) are areas known to harbor commercially exploited state-listed species. The plants involved, though not rare, are listed by the state for special management because of their commercial exploitation.

For further details, please see APPENDIX B for a narrative that describes and defines sensitive resources on the map associated with our defined natural areas, along with information taken from some additional databases, including a map.

Item No.	Topic	Information Needed for EIS
8	**Biological / Natural Resources**	
8.2		Please review the list of species provided and, based on your internal data and site knowledge, assess whether suitable habitat is present for the target species within the proposed 150-acre VTR Construction Area. Also, based on the internal DOE species database, please amend the list if there are additional species or habitats of interest in or near the area that would be disturbed by the proposed action.

Response

An 8-member team at ORNL extensively reviewed and updated a draft table that Leidos compiled of Federal and State sensitive species, including Threatened and Endangered Species, that could reside near the proposed VTR site at ORNL. Additional on-site surveys have also been performed during 2020 to understand the natural and biological resources present at the proposed site. [5] The results from these surveys have been integrated into this report. Please see APPENDIX F for updated tables that reflect the current collective knowledge of resources within the proposed ORNL VTR Alternative site construction area footprint.

Some resources were removed based on restricting the table to the specific footprint proposed for the ORNL VTR Alternative site location, whereas other resources were added based on a more detailed assessment. Knowledge gaps in the tables are indicated within the column labeled as "Notes".

Item No.	Topic	Information Needed for EIS
RAI-1	**Geology and Soils**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but a relevant RAI has come on it.)* Do you know where the bore hole was drilled at the proposed site during the site characterization efforts for Advanced Neutron Source back in the 90s? Any information on the results of that work could be of interest.

Response

Maps and documents both indicate that a bore hole was drilled at the proposed site as part of site characterization efforts for the Advanced Neutron Source (ANS) project in the 1990s. However, a significant search by several people at both ORNL and OSO did not find any further information about the results of this bore sampling; nor was the actual core sample itself found anywhere. An individual involved with the work at the time indicated that to his knowledge, any bore holes that had been drilled were plugged and abandoned.

A seismic refraction survey performed at the preferred ANS site, which largely overlaps with the proposed site for the ORNL VTR Alternative, may also provide additional geophysical information of interest. [6]

Item No.	Topic	Information Needed for EIS
RAI-2	**Emergency Preparedness**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but relevant RAIs have come on it.)* 1. Has ORNL made the transition from DOE Order 151.1C (DOE O 151.1C, Comprehensive Emergency Management System, 11/2/05) to DOE Order 151.1D? If not, when will the transition be completed.? 2. Is there a short report giving an overview of ORNL's current emergency management program? 3. Please provide the report of the latest annual emergency exercise and the reports of any internal or external audits of that exercise. 4. To what extent does ORNL rely on personnel and equipment at Y-12 in the event of an emergency at ORNL? 5. With which external organizations (local, state, and Federal) does ORNL have agreements concerning assistance that will be provided in the event of an emergency at ORNL?

Response

1. Yes, ORNL has made the transition to DOE Order 151.1D.

2 and 3. The best public document to provide information relevant to these Emergency Preparedness inquiries is a 2008 assessment report. [7] No new information was developed for this request; responses have been provided based upon the best and most complete information available at this time. Please contact ORNL and/or OSO if specific additional information is required.

4. For the initial response to an incident, ORNL does not rely on the Y-12 National Security Complex to provide personnel or equipment. However, there is a Mutual Aid Fire Protection Agreement between Consolidated Nuclear Security, LLC, and UT-Battelle, LLC, to provide fire protection assistance as needed.

5. There are a number of mutual aid agreements in place for support at ORNL. All of these agreements (with the exception of the one with CNS identified above) are signed by the DOE ORNL Site Office and maintained by DOE Consolidated Service Center. Please see APPENDIX G.

Item No.	Topic	Information Needed for EIS
RAI-3	**Waste Management**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but relevant RAIs have come on it.)*
RAI-3.1		1. Please provide ORNL's historic annual generated waste quantities in cubic meters for the LLW, MLLW, TRU Waste from 2015 through 2019. For those facilities used in common by ORNL and one or more of the other ORR Programs/entities/operations, we are requesting: i. The capacity of the facility, ii. The annual quantity of ORNL waste managed by the facility (over the last 5 years), and iii. The annual quantity of waste (collectively) from other Programs/entities/operations (over the last five (5) years).

Response

1. ANNUAL GENERATED WASTE QUANTITIES

Waste Volumes for ORNL vs. ORR, 2015–2017

Waste category	2015		2016		2017	
	ORNL	ORR	ORNL	ORR	ORNL	ORR
LLW[a] (m^3)	401.10	104,025.64	355.00	77,213.84	1,031.00	60,858.87
MLLW[b] (m^3)	36.01	462.84	64.65	454.35	61.20	529.08
TRU[c] (m^3)	12.70	0.00	20.00	0.00	17.00	25.83
Hazardous (m^3)	128.73	37.49	148.76	42.56	102.69	110.03
C&D[d] (m^3)	51.03	43,020.84	110.87	32,840.81	251.33	45,854.63

[a]LLW = low-level radioactive waste
[b]MLLW = mixed low-level waste
[c]TRU = transuranic waste
[d]C&D = construction and demolition debris

Notes:

- ORR waste volumes do not include the ORNL contribution.
- The C&D waste volumes provided are not purely the construction and demolition debris. Each entity rolls up its landfill numbers differently, and several combine industrial waste with C&D waste.
- URS-CH2M Oak Ridge LLC (UCOR) has provided LLW numbers that include their disposal into the Environmental Management Waste Management Facility (EMWMF), whereas the other entities dispose of LLW offsite.

Item No.	Topic	Information Needed for EIS
RAI-3	**Waste Management**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but relevant RAIs have come on it.)*
RAI-3.1		1. Please provide ORNL's historic annual generated waste quantities in cubic meters for the LLW, MLLW, TRU Waste from 2015 through 2019. For those facilities used in common by ORNL and one or more of the other ORR Programs/entities/operations, we are requesting: i. The capacity of the facility, ii. The annual quantity of ORNL waste managed by the facility (over the last 5 years), and iii. The annual quantity of waste (collectively) from other Programs/entities/operations (over the last five (5) years).

Response (continued)

1. ANNUAL GENERATED WASTE QUANTITIES (continued)

Waste Volumes for ORNL vs. ORR, 2018 and 2019

Waste category	2018		2019	
	ORNL	ORR	ORNL	ORR
LLW (m^3)	388.00	60,951.46	484.00	103,751.61
MLLW (m^3)	50.40	817.73	72.66	948.69
TRU (m^3)	6.00	372.54	7.76	247.38
Hazardous (m^3)	125.70	1,063.34	113.76	1,207.13
C&D (m^3)	79.56	34,019.09	86.49	74,397.06

Notes:

- ORR waste volumes do not include the ORNL contribution.
- The C&D waste volumes provided are not purely the construction and demolition debris. Each entity rolls up its landfill numbers differently, and several combine industrial waste with C&D waste.
- UCOR has provided LLW numbers that include their disposal into EMWMF, whereas the other entities dispose of LLW offsite.

Capacity of the Y-12 Landfills (not including EMWMF)

Landfill IV (Classified Waste):

1. Permitted airspace = 67,007 m^3 (87,642 yd^3)
2. Airspace consumed (as of December 2019) = 25,292 m^3 (33,081 yd^3)
3. Remaining permitted airspace (as of December 2019) = 41,715 m (54,561 yd^3)
4. Constructed airspace (there is one area in the permit not constructed yet) = 38,608 m^3 (50,497 yd^3)
5. Remaining constructed airspace (as of December 2019) = 13,315 m^3 (17,416 yd^3)
6. Annual airspace consumption rate (since February 2000) = 792 m^3 (1,036 yd^3)
7. Annual airspace consumption rate (past 3 years) = 3,453 m^3 (4,517 yd^3)
8. Estimated remaining permitted life = 12.2 to 158.5 years
9. Estimated remaining constructed life = 4.0 to 51.9 years

Item No.	Topic	Information Needed for EIS
RAI-3	**Waste Management**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but relevant RAIs have come on it.)*
RAI-3.1		1. Please provide ORNL's historic annual generated waste quantities in cubic meters for the LLW, MLLW, TRU Waste from 2015 through 2019. For those facilities used in common by ORNL and one or more of the other ORR Programs/entities/operations, we are requesting: i. The capacity of the facility, ii. The annual quantity of ORNL waste managed by the facility (over the last 5 years), and iii. The annual quantity of waste (collectively) from other Programs/entities/operations (over the last five (5) years).

Response (continued)

1. ANNUAL GENERATED WASTE QUANTITIES (continued)

Capacity of the Y-12 Landfills (not including EMWMF, continued)

Landfill V (Industrial):

1. Permitted airspace = 1,660,331 m^3 (2,171,631 yd^3)
2. Airspace consumed (as of December 2019) = 721,221 m^3 (943,322 yd^3)
3. Remaining permitted Airspace (as of December 2019) = 939,110 m^3 (1,228,309 yd^3)
4. Constructed airspace (there is one area in the permit not constructed yet) = 998,510 m^3 (1,306,002 yd^3)
5. Remaining constructed airspace (as of December 2019) = 277,289 m^3 (362,680 yd^3)
6. Annual airspace consumption rate (since beginning of operations) = 27,116 m^3 per year (35,466 yd^3)
7. Annual airspace consumption rate (past 3 years) = 32,653 m^3 per year (42,708 yd^3)
8. Estimated remaining permitted life = 29.9 to 36.0 years
9. Estimated remaining constructed life = 7.2 to 8.6 years

Landfill VII (C&D Debris):

1. Permitted airspace = 1,597,573 m^3 (2,089,547 yd^3)
2. Airspace consumed (as of June 2019) = 610,847 m^3 (798,958 yd^3)
3. Remaining permitted airspace (as of June 2019) = 986,726 m^3 (1,290,589 yd^3)
4. Constructed airspace (there is one area in the permit not constructed yet) 530,789 m^3 = (694,246 yd^3)
5. Remaining constructed airspace (as of June 2019) = 130,308 m^3 (170,436 yd^3)
6. Annual airspace consumption rate (since April 2001) = 22,882 m^3 per year (29,928 yd^3)
7. Annual airspace consumption rate (past 3 years) = 9,101 m^3 per year (11,904 yd^3) – this number is anticipated to increase based on waste projections
8. Estimated remaining permitted life = 51.6 to 129.7 years
9. Estimated remaining constructed life = 5.7 to 14.3 years (DOE EM is currently constructing Area 6, Phase II, so the remaining constructed life duration will change within the next year)

Item No.	Topic	Information Needed for EIS
RAI-3	**Waste Management**	*(This Topic was not included in Affected Environment in the original data request to ORNL, but relevant RAIs have come on it.)*
RAI-3.1		1. Please provide ORNL's historic annual generated waste quantities in cubic meters for the LLW, MLLW, TRU Waste from 2015 through 2019. For those facilities used in common by ORNL and one or more of the other ORR Programs/entities/operations, we are requesting: i. The capacity of the facility, ii. The annual quantity of ORNL waste managed by the facility (over the last 5 years), and iii. The annual quantity of waste (collectively) from other Programs/entities/operations (over the last five (5) years). 2. Does ORNL have a concrete recycling program?

Response (continued)

1. ANNUAL GENERATED WASTE QUANTITIES (continued)

TRU Waste Management at ORNL Summary

ORNL routinely generates both contact-handled (CH) and remote-handled (RH) transuranic (TRU) waste from activities that support isotope production, advanced fuels development, and other research and development missions. Until recently, the small volume of newly generated TRU waste from ORNL has been managed by the DOE Office of Environmental Management (EM) as part of the much larger legacy TRU waste inventory.

Beginning in 2015, responsibility for the management of ORNL's enduring TRU waste generation began to transition to ORNL in a phased approach. The first phase was to assume the financial responsibility for all costs associated with the newly generated TRU waste disposition. In addition to the financial responsibility, ORNL also began a formal relationship with the DOE Waste Isolation Pilot Plant (WIPP), which is the sole disposition site for TRU waste.

The second phase, which is currently underway, is establishing facility capabilities to package, store and ship TRU waste to WIPP. The first step being evaluated in the second phase is to assume ownership of two TRU waste storage facilities currently under the management of the DOE EM contractor. Currently, the EM contractor is storing ORNL's newly generated TRU waste pending ORNL establishing their own capability. If the evaluation concludes that ownership of the two EM facilities is the best approach, then ORNL will assume operational control of those facilities and will store the ORNL TRU waste in preparation for the future additional steps necessary to disposition the TRU waste at the WIPP.

The final transition phase will be implemented after ORNL has established the facility and program infrastructure to support TRU waste disposition operations into the future. At that point, ORNL will obtain approval to dispose of the newly generated TRU waste from WIPP through a rigorous approval process and will then begin to ship TRU waste offsite to WIPP for permanent disposition.

2. No, ORNL does not have a concrete recycling program.

4. DATA REQUEST RESPONSES FOR VTR FACILITY CONSTRUCTION AND OPERATION

Item No.	Topic	Information Needed for EIS
9	**General**	Construction schedule: duration, for individual resource areas. Where requested for a specific resource area, both annual and peak data (including the peak year data) are required. To assess potential overlap of impacts with construction activities for other VTR facilities, relative start and end dates for construction are required. This allows for an assessment of peak annual impacts from all VTR related construction.

Response

Please see Section 2 for additional details regarding the proposed schedule, site location, and facilities planned for the ORNL VTR Alternative, as well as a Leidos report on site selection [1] and a subsequent Leidos report with estimated construction details of VTR and supporting facilities at ORNL, as well as high-level details regarding a possible Hot Cell Facility design if construction of VTR is at ORNL [2].

All three facilities (VTR, the PIE facility, and the spent fuel storage facility) will require Category 1 security due to the attractiveness level of the fuel based on the current understanding of specifications. Furthermore, the PIE and spent fuel storage facilities will be designated and operated as hazard category 2 (HazCat 2) non-reactor nuclear facilities per DOE-STD-1027. The VTR, PIE, and spent fuel storage facilities will be located in close proximity to each other to take advantage of one security area, to minimize transportation activities, and to maximize the efficiency of operations personnel.

A comprehensive waste management plan would need to be developed, reviewed, and approved by signature of all the relevant parties for a new spent fuel facility for VTR. This present document is not binding for waste acceptance.

There is no additional Oak Ridge response planned to the questions regarding construction schedule and impacts beyond the details provided in the Leidos report [2], which is the best available information for those purposes and should be sufficient for EIS purposes.

With regarding to land clearing and leveling for construction activities, ORNL prefers to reduce the size of the cleared footprint for the construction area by using existing laydown areas in close proximity, such as:

- the 7600 Area (~1 mile to the east), where two new large gravel pads may be available, or
- an area originally planned (but never used) as Solid Waste Storage Area (SWSA) 7, just west of Access Road, where there is previously disturbed, relatively flat land, with dirt and/or gravel access roads already in place.

Actions like this should be possible and could avoid the need to clear some of the proposed VTR Construction Area if the ORNL VTR Alternative is chosen. However, assuming that the full 150 acres will be cleared for the purpose of this EIS should be bounding in terms of environmental impact.

Item No.	Topic	Information Needed for EIS
10	**Land and Visual Resources**	
10.1	Construction and Operation	Size of the area be used for construction of the VTR. The estimate should Include areas for final operational facilities (the VTR Building, switchyard, cooling system structures, parking areas, etc.) and temporary areas impacted by construction (laydown areas, temporary construction facilities, temporary parking, roads, etc.)
10.2	Construction and Operation	Quantities of soils/materials needed for activities such as backfill, landscaping Locations from which this material would be acquired
10.3	Construction and Operation	Quantities of materials to be excavated for construction Locations at which this material would be disposed
10.4	Construction and Operation	Physical dimensions of the completed structures. In particular, what are the heights of the buildings, cooling structures and stacks/towers?
10.5	Construction and Operation	Information (figure) showing the location of operational VTR facilities at the site Also provide figures showing areas for proposed construction activities (temporary structures, laydown areas, roads, etc.)
Response Please see Section 2 for additional details regarding the proposed site location and facilities for the ORNL VTR Alternative; also see the Leidos report on site selection [1] and the subsequent Leidos report with estimated construction details of VTR and supporting facilities at ORNL, as well as high-level details regarding a possible Hot Cell Facility design if construction of VTR occurs at ORNL [2].		

Item No.	Topic	Information Needed for EIS
11	**Soil and Geology**	What would the depths of excavations be during construction of the VTR?
Response The excavation depth would likely be similar to that used for VTR construction at the INL VTR Alternative site. Please see the Leidos report with the estimated construction details of VTR and supporting facilities at ORNL for additional information. [2]		

Item No.	Topic	Information Needed for EIS
12	**Water**	
12.1	Construction	What is the source of water?
12.2	Construction	Which outfalls would be impacted?
12.3	Operation	What is the source of water?
12.4	Operation	Which outfalls would be impacted?

Response

The source of water for construction and operation would be Melton Hill Lake, coming through potable water lines from the City of Oak Ridge.

There are no existing outfalls near the proposed site. Industrial stormwater from the proposed site would need to be permitted if it is managed through any new outfalls. ORNL has an internal policy to avoid adding new outfalls where practicable, preferring that stormwater runoff be handled through non-point source features. Since no on-site wastewater treatment is proposed, no new treatment plant outfalls would need to be approved.

Item No.	Topic	Information Needed for EIS
13	**Human Health**	
13.1	Accidents	- Site meteorology (preferably 5 years of data) in a format compatible with MACCS input files and FRAMES (GENII) input files (5-year average) - Site-specific atmospheric mixing level - Atmospheric stability class and wind speed if site-specific meteorological data are not available - Site-specific natural phenomena events (severity, frequency)

Response

Meteorology and atmospheric mixing: Information from ORNL Tower A near HFIR has been used to generate the requested information. APPENDIX H provides wind roses with information on wind direction and speed. Additional meteorological data were provided in electronic form (an Excel file) directly to Leidos with all parameters in the requested format. This file contains Tower A hourly data for 2015 through 2019 for 15 m wind speed, 15 m from wind direction, precipitation in inches, precipitation in millimeters, stability (A=1, G=7), and mixing height meters. The Excel file is not replicated in this report due to the large quantity of data.

Raw meteorological data from a publicly accessible ORNL website [8] was extracted, processed, entered into Excel, and formatted to meet the Leidos request.

The VTR conceptual safety design report (CSDR) treatment of accidents is expected to be consistent regardless of site selection. While there would be different site boundary distances between the INL VTR Alternative site and the ORNL VTR Alternative and these would affect consequences, accidents should be treated sufficiently in the VTR CSDR.

Site-specific natural phenomena events

Wildfires: The wildfire map provided in APPENDIX I shows locations of documented wildfires in the vicinity, as well as fire fuel type.

Seismic: Based on discussions with Leidos, DOE, and INL, no additional site-specific response appears to be needed at this time given the bounding provided by the VTR CSDR.

Floods: Engineered approaches would be used to mitigate flood concerns.

Item No.	Topic	Information Needed for EIS
14	**Biological Resources**	For the land disturbed as identified in the response to Land and Visual Resources, provide an estimate of the land to be disturbed that can be categorized as previously disturbed land and that which would be newly disturbed.

Response

Other than HFIR, the Dosimetry Applications Research Facility (DOSAR), the Experimental Gas-Cooled Reactor (EGCR) and a few access roads and corridors, most of the land identified will be newly disturbed. The only timber removal has been pine that was infested with the southern pine beetle in 1965 and 1966; however, these areas have revegetated over the past half-century.

The forest cover map in APPENDIX J shows forest cover for the initial 2,240-acre VTR study area. 1941 forest cover shown in light green was 1,247 acres, or 55% of the land area. By 2012, forest cover (light and dark green) was 2,045 acres, or 91% of the land area. An increase of 798 acres, or a 64% gain from 1941. Interior forest (calculated using a 200-meter buffer from edges) amounts to 307.3 acres, or 15% of the present forest.

Item No.	Topic	Information Needed for EIS
15	**Transportation**	
15.1	Operations	Method(s) of shipment for each waste stream: • Truck • Rail • Water • Combination

Response
The only anticipated transportation method is by road in commerce.

Item No.	Topic	Information Needed for EIS
16	**Noise**	
16.1	Operations	Identify any activities that would result in noise levels exceeding the noise level associated with activities in currently operating facilities near the location of the VTR?

Response

No significant differences are expected in noise levels for the ORNL VTR Alternative site compared to the INL VTR Alternative site.

Item No.	Topic	Information Needed for EIS
17	**Waste Management**	
17.1	Operations	What are the candidate sites for disposal of each of these materials? Which, if any, existing site facilities would be used for waste management (TSD)? What is the current capacity of the above site waste management facilities? If new facilities are required or existing facilities are to be augmented, describe their location, size, significant physical features.

Response

New disposal sites would be created at Oak Ridge for VTR use; no existing disposal sites or disposal facilities would be used for VTR operations. No specific details regarding the location, size, and physical features for these disposal sites are currently available beyond the description of the VTR spent fuel storage facility, summarized in Section 2 and described in more detail in Reference 2.

5. DATA REQUEST RESPONSES FOR TEST ASSEMBLY EXAMINATION FACILITY CONSTRUCTION AND OPERATION

Item No.	Topic	Information Needed for EIS
18	**General**	
18.1		It is anticipated that no new structures (buildings) would be built in support of post irradiation examination. Data requests for construction are divided into two groups if needed. The first assumes no new structures. Additional requests are identified should new structures be required. Also note that parameter data provided should be those at the facility in support of VTR construction or operation, only. Parameters may or may not be a portion of those from existing operations. The answer may not be the same for all resource areas. For example, due to differences in materials being handled, it is possible that air emissions from VTR support activities may be bounded by current operations, but waste generation may not. Caveat: if existing activities do not have NEPA coverage we may need to address full impact. At Oak Ridge, post irradiation examination and material testing may occur at the Irradiated Fuels Examination Laboratory (IFEL) Building 3525 and the Irradiated Materials Examination and Testing (IMET) Building 3025E hot cell facility.
18.2		Identify which facilities would be used for test assembly examination
18.3		Provide a description of the proposed modifications to existing facilities required for VTR support.

Response

18.1. Inerted hot cells are likely required for VTR PIE work, and ORNL does not currently have any inerted hot cell facilities. Two main options have been identified and discussed as possible ways to remedy this situation if siting VTR at Oak Ridge. The first option would be to modify existing hot cell facilities such as Building 3525. The second option would be to build a new PIE facility for VTR. Modifying Building 3525 to have inerted hot cells would likely be expensive, involve radiation dose, and would significantly impact existing work being performed. Therefore, building a new PIE facility co-located with VTR is strongly preferred as the path forward if siting VTR at Oak Ridge. This would also benefit VTR operations and research, because the PIE facility could be integrated into the VTR site, minimizing transportation complications and delays, allowing streamlined operations, and consolidating the necessary security around the fuel and experiments.
Please see Section 2 and the response to Item #9 in this report, as well as References 1 and 2, regarding structures for this work.

18.2. The first and primary facility used for test assembly examination would be a new PIE facility with integrated fuel treatment (sodium removal) co-located with VTR. This building can be conceptually envisioned as a hybrid of the Hot Fuel Examination Facility (HFEF) and Fuel Cycle Facility (FCF) at INL's MFC because it would have inert hot cells, the capability to flush sodium off the external surfaces of fuel assemblies/pins, and the capability to remove sodium bond material from within fuel pins. The full facility could perhaps be HFEF-sized. In addition to this new PIE facility, existing facilities at ORNL, including Building 3525, Building 3025E, and the Low Activation and Materials Development and Analysis (LAMDA) facility, would be used for supplemental and/or advanced PIE for materials that do not require an inert environment.
Please see Section 2 and the response to Item #9 in this report, as well as References 1 and 2.

18.3. No major modifications to existing facilities are proposed at this time; new construction is assumed.

Item No.	Topic	Information Needed for EIS
18	**General**	
18.4		Provide a description of the proposed configuration and operation of the facility.
18.5		Construction schedule: duration, for individual resource areas. Where requested for a specific resource area both annual and peak data (including the peak year data) are required. To assess potential overlap of impacts with construction activities for other VTR facilities relative start and end dates for construction are required. This allows for an assessment of peak annual impacts from all VTR related construction.

Response

18.4. Please see Section 2 and the response to Item #9 in this report, as well as References 1 and 2, for a description of the proposed configuration and operation of the facility. Reference 2 has reasonably detailed information about a notional concept for a possible hot cell facility to be co-located with the VTR reactor facility if constructed at ORNL.

18.5. The best data for construction schedule information is in Reference 2 and in the construction studies for the INL VTR Alternative.

Item No.	Topic	Information Needed for EIS
19	**Land and Visual Resources**	
19.1	Construction and Operation of a New Facility	Size of the area to be used for construction of the new facility. Include areas for final operational facilities and temporary areas impacted by construction (laydown areas, temporary construction facilities, temporary parking, roads, etc.)
19.2	Construction and Operation of a New Facility	Quantities of soils/materials needed for activities such as backfill, landscaping Locations from which this material would be acquired
19.3	Construction and Operation of a New Facility	Quantities of materials to be excavated for construction Locations at which this material would be disposed
19.4	Construction and Operation of a New Facility	Physical dimensions of the completed structures. In particular, what are the heights of the buildings and towers?
19.5	Construction and Operation of a New Facility	Provide information (figure) showing the location of operational PIE facilities at the site Also provide figures showing areas for proposed construction activities (temporary structures, laydown areas, roads, etc.)

Response

Please see Section 2 and the response to Item 9 in this report, as well as References 1 and 2.

The primary PIE facility for VTR use at ORNL would be a newly constructed PIE facility constructed co-located with VTR.

Item No.	Topic	Information Needed for EIS
20	**Soil and Geology**	
20.1	Construction and Operation	If a new facility is constructed, provide the depth of excavation during construction. Otherwise, no additional information requests beyond the Information requests from other areas

Response

The excavation depth would likely be about the same as for HFEF or similar inerted hot cell facilities. Please see Reference 2 for further relevant information.

Item No.	Topic	Information Needed for EIS
21	**Water**	
21.1	Construction	What are the water requirements during construction, annual consumption and total? Water uses include potable water (drinking water for construction workforce), sanitary water, and if there are new facilities: water used for construction (such as dust control). What is the source of water?
21.2	Construction	What water discharges to the surface water would be expected during construction, which outfalls would be impacted
21.3	Operation	What are the water requirements during operation, annual consumption and total for activities associated with VTR support that are in excess of the currently anticipated requirements? Water uses include potable water (drinking water for operational workforce), sanitary water, and water used for operation (such as any cooling water for facility operation). What is the source of water?
21.4	Operation	How much water would be discharged to surface water during operation and what outfalls would be impacted?

Response

Please see Reference 2 for information on water, as well as the response to Item 12 for details about the water source and outfalls.

Item No.	Topic	Information Needed for EIS
22	**Air**	
22.1	Construction – Internal Modifications	To estimate air emissions from construction, what types and numbers of nonroad equipment (e.g. generators) would be used for construction? What are the anticipated annual and total hours of operation for each type of equipment? To estimate a period of peak construction activity, provide a schedule of proposed activities.
22.2	Construction-New Facility	To estimate air emissions from construction, what types and numbers of nonroad equipment would be used for construction (excavators, cranes, soil compactors, backhoes, concrete delivery and pump trucks, generators, etc.)? What are the anticipated annual and total hours of operation for each type of equipment? What area of ground would construction disturb and what would be the duration of this activity? To estimate a period of peak construction activity, provide a schedule of proposed activities.
22.3	Operations	What sources of non-radiological emissions would be required for PIE operations in support of VTR operations? What annual levels of non-radiological emissions would occur from these sources? Include criteria pollutants (carbon monoxide, nitrogen oxides [NO_x], particulate matter less than 10 and 2.5 microns in diameter, sulfur oxides [SO_x], and volatile organic compounds [VOCs]).

Response

22.1 The primary option for VTR siting at ORNL is construction of a new PIE facility; existing facilities would not be modified for this effort.

22.2 The best relevant information regarding air emissions is provided in Reference 2.

22.3 This information is mostly facility dependent rather than site specific. Therefore, any emissions during PIE facility operations at Oak Ridge would likely be very similar to those discussed for the INL VTR Alternative site. Please see Reference 2 for additional information.

Item No.	Topic	Information Needed for EIS
23	**Human Health**	
23.1	Construction	How many construction workers (annual and for how long) would be exposed to a radiation environment?
23.2	Operations	The number of workers needed to operate the PIE facility in support of the VTR. How many are in excess of the current workforce. How many would be considered radiation workers and how many would not.
23.3	Operations	What are the anticipated annual radiological emissions from the PIE facility in support of the VTR that would be in excess of the current emissions? Include quantity by radioisotope.
23.4	Operations	What are the anticipated characteristics of the releases: elevation above ground, air flow rate, stack diameter or exit velocity, temperature?
23.5	Operations	What chemical hazards are workers in the PIE facility exposed to?
23.6	Accidents	Severe operational and natural phenomena accidents to be considered, release source terms, frequency Please provide the safety analyses (Documented Safety Analyses (DSAs), hazards analyses, etc.) that establish the safety basis for the facilities and area where the PIE activities in support of VTR might occur. What we need are the bounding accident descriptions and source terms. For radiological accidents, we will ultimately need to generate for the EIS: - Accident description (include release pathways and mitigating factors) - Accident frequency - Material at risk including assumptions and methods used in determining MAR - Material characteristics - Source term released to environment (curies by isotope) - Values for damage ratio, airborne release fraction, respirable fraction, and leak path factor used to determine source term - Release parameters: release fractions, release timing, location, release height, release duration, and heat of release - Filtration (specify efficiency) - Types and quantities of hazardous materials that may be released during accidents Accidents to be considered include severe/extremely unlikely operational accidents, natural phenomena initiated (principally severe seismic seismic), and external events (aircraft, range fire, etc.).

Response

23.1 No exposure of construction workers to a radiation environment is expected since this will be new construction.

23.2–6. No detailed responses are available at this time for Items 23.2 through 23.5. Estimated quantities are included in Reference 2 and in the INL Data Response document. The chemical hazards to which workers in the PIE facility would be exposed (Item 23.5) are expected to be similar to those mentioned for HFEF at the INL VTR Alternative site, given the similarities in work being performed and the materials being handled. Please see Reference 2 for additional relevant information, as well as the response to Item 13.1 for information regarding Accidents (Item 23.6).

Item No.	Topic	Information Needed for EIS
24	**Biological/Natural Resources**	
24.1	Construction -New Facility	For the land disturbed as identified in the response to Land and Visual Resources provide an estimate of the land to be disturbed that can be categorized as previously disturbed land and that which would be undisturbed.

Response

Please see the response to Item 14.

Item No.	Topic	Information Needed for EIS
25	**Transportation**	
25.1	Construction	Quantity of construction material to be delivered to the site and number of shipments
25.2	Construction	Quantity and number of shipments for construction waste (hazardous and non-hazardous)
25.3	Operations	Method(s) of shipment for each waste stream: • Truck • Rail • Combination

Response

25.1 Please see Reference 2 for details on the quantity of construction material to be delivered and the number of shipments.

25.2 Since this would be new construction, no radioactive or hazardous waste shipments should be needed. Please see Reference 2 for additional relevant information on nonhazardous waste shipments.

25.3 The only anticipated transportation method is by road in commerce.

Item No.	Topic	Information Needed for EIS
26	**Noise**	
26.1	Construction – Internal Modifications	Identify any activities that would result in noise levels exceeding the noise level associated with activities currently being performed in the facilities in which the PIE would be performed
26.2	Construction-New Facility	Identify the construction equipment expected to be used during construction a new facility for PIE: examples include • backhoes • excavators • cranes • soil compactors • work trucks, • four-wheel drive • concrete delivery trucks • concrete pump trucks • water truck • generators • flatbed • telescoping forklifts • welder • dump trucks • skid steer • fuel truck • mini excavator • front end loader
26.3	Operations	Identify any activities that would result in noise levels exceeding the noise level associated with activities currently being performed in the facilities in which the PIE would be performed

Response

26.1 No planned response regarding construction noise levels exceeding that associated with current activities; construction of a new PIE facility is the primary option for VTR siting at Oak Ridge; existing facilities would not be modified for the VTR.

26.2 Please see Reference 2 for additional relevant information on new facility construction. The types of equipment expected to be used for construction of a new PIE facility would mostly overlap with the types of construction equipment used during construction of the VTR at the INL VTR Alternative site or the ORNL VTR Alternative site.

26.3 No detailed response is available regarding operations noise levels for the Oak Ridge site. However, relevant typical operational noise is expected to be contained within the confines of the PIE facility.

Item No.	Topic	Information Needed for EIS
27	**Waste Management**	
27.1	Construction	Quantities of waste generated per year (peak and average) during construction to include: non-radiological waste (hazardous and non-hazardous)
27.2	Construction	Quantities of radiological waste to include form (LLW, MLLW, HLW)
27.3	Operations	Quantities of waste generated per year during operation to include: • non-radiological waste (hazardous and non-hazardous), • LLW (solid and liquid) • MLLW • HLW
27.4		How are each of these materials to be disposed? If this material is to be handled at existing facilities at the site, what are they? Is there sufficient existing capacity to handle the waste streams? If new facilities are required or existing facilities are to be augmented, describe their location, size, significant physical features. Does the site have a preferred location for the ultimate disposal of these materials (excluding spent fuel)?

Response

27.1 and 27.2 Given that new construction would be planned for the VTR PIE facility at Oak Ridge, annual waste generation during construction is expected to be normal for new construction. Please see Reference 2 for additional relevant information. No hazardous or radiological waste generation is expected during construction. Please see Reference 2 for additional relevant information on quantities of radiological waste by type.

27.3 Response information for waste generation during operations at the INL VTR Alternative PIE facility (HFEF) should also be similar to that anticipated for a new PIE facility at Oak Ridge.

27.4 Disposal techniques and locations, along with corresponding impacts, would vary depending upon the characteristics of any waste. Existing locations should be available for disposal during construction if waste generation is minimal and nonhazardous. New facilities would likely be needed during operations, depending upon the waste generation characteristics.

Item No.	Topic	Information Needed for EIS
28	**Socioeconomic**	
28.1	Construction	Workforce: How many workers would be required during construction, provide annual estimates (average and peak) for the full duration of construction? What year would the peak workforce be employed? Please provide percentage estimates for each phase as to which percent of workers would be employed locally vs. workers expected to relocate. Please provide estimates on length (months or years) for project phase.
28.2	Operations	Workforce: How many workers would be required in addition to the current workforce in the facilities where PIE would occur during operations Please provide percentage estimates of percent of workers would be employed locally vs. workers expected to relocate.

Response

This information is not available at this time. Please contact ORNL if specific information is required; otherwise it is assumed that Leidos will obtain relevant information from other documents or create their own estimates for this information based upon available information and their own workforce estimation methods.

Item No.	Topic	Information Needed for EIS
29	**Infrastructure**	
29.1	Construction	Electricity: Electrical consumption - provide annual estimates (average and peak) for the full duration of construction.
29.2	Construction	Fuels: oil, natural gas, diesel fuel, gasoline - provide annual estimates (average and peak) for the full duration of construction
29.3	Construction	Water: water consumption - provide annual estimates for the full duration of construction (average and peak) (expected to be the same as identified for water)
29.4	Construction	Sewage: estimated sewage treatment demand generated during construction on an annual basis (average and peak)
29.5	Operations	Electricity: Electrical consumption requirements beyond current requirements, provide annual average and peak estimates
29.6	Operations	Fuels: oil, natural gas, diesel fuel, gasoline beyond current requirements, provide annual average and peak estimates
29.7	Operations	Water: water consumption beyond current requirements, provide annual average and peak estimates
29.8	Operations	Sewage: estimated sewage treatment demand generated beyond current requirements,

Response

Please see Reference 2 for additional relevant information. Requirements during operations of the new PIE facility should be similar to PIE operations at HFEF at the INL VTR Alternative site.

Item No.	Topic	Information Needed for EIS
30	**Irretrievable and Irreplaceable materials**	
30.1	Construction	Identify materials used for construction whether for a new facility or for internal modifications to an existing facility, for example Concrete Asphalt Steel (structural and reactor vessel) Lumber Piping Conduit Cable Gases (acetylene, oxygen, etc.) Any chemicals that are either relatively rare, not easily replaced, or used in large quantities
30.2	Operations	Annual quantities of any chemicals that are either relatively rare, not easily replaced, or used in large quantities
Response Please see Reference 2 for additional relevant information. Chemicals needed during operations of the PIE facility if sited at Oak Ridge should be similar to those at the INL VTR Alternative site.		

6. DATA REQUEST RESPONSES FOR SPENT FUEL STORAGE AND TREATMENT FACILITY CONSTRUCTION AND OPERATION

Item No.	Topic	Information Needed for EIS
31	**General**	
31.1		Identify which facilities would be used for spent fuel storage and treatment.
31.2		Provide a description of the proposed modifications to existing facilities required for VTR support.

Response

Please see Section 2 and the Response to Item 9 in this report, as well as References 1 and 2. No existing facilities at Oak Ridge would be used for spent fuel storage and treatment. New facilities would be constructed. Existing spent fuel storage locations and facilities would not be able to handle metallic fuel coming from VTR.

Capabilities for spent fuel treatment—which is understood to focus on cleaning sodium off of the exterior of fuel and experiments and removing bond sodium from driver fuel—would be integrated into the new PIE facility to be co-located with VTR at Oak Ridge. Therefore, unless otherwise stated, all responses below pertain solely to the spent fuel storage facility needed at Oak Ridge for VTR; spent fuel treatment capabilities, requirements, and impacts (construction impacts, noise, air, water, etc.) are included in the PIE facility requirements and impacts.

Item No.	Topic	Information Needed for EIS
32	**Land and Visual Resources**	
32.1	Construction and Operation of a New Facility	How large of an area will be used for construction of the new facility? Include areas for final operational facilities and temporary areas impacted by construction (laydown areas, temporary construction facilities, temporary parking, roads, etc.)
32.2	Construction and Operation of a New Facility	Quantities of soils/materials needed for activities such as backfill, landscaping Locations from which this material would be acquired
32.3	Construction and Operation of a New Facility	Quantities of materials to be excavated for construction Locations at which this material would be disposed
32.4	Construction and Operation of a New Facility	What are the physical dimensions of the completed structures? In particular, what are the heights of the buildings and towers?
32.5	Construction and Operation of a New Facility	Provide information (figure) showing the location of operational spent fuel storage and treatment facilities at the site Also provide figures showing areas for proposed construction activities (temporary structures, laydown areas, roads, etc.)

Response

32.1 Please see Section 2 and the response to Item 9 in this report, as well as References 1 and 2.

32.2– 32.5 Some of the information requested on quantities of soils and materials is not available at this time or should be similar to data found in the INL Data Response document. No map is currently available showing the locations of existing operational spent fuel facilities at the site. However, the two main existing spent fuel storage locations at ORNL are at HFIR and REDC. Neither of these locations would be able to accept VTR driver fuel, and they likely would not be able to accept fueled experiments, either.

It is assumed that fuel treatment would be integrated into the new PIE facility that would be constructed for VTR if sited at Oak Ridge.

Item No.	Topic	Information Needed for EIS
33	**Water**	
33.1	Construction	What are the water requirements during construction, annual consumption and total? Water uses include potable water (drinking water for construction workforce), sanitary water, and if there are new facilities: water used for construction (such as dust control). What is the source of water?
33.2	Construction	What water discharges to the surface water would be expected during construction, which outfalls would be impacted
33.3	Operation	What are the water requirements during operation, annual consumption and total for activities associated with VTR support that are in excess of the currently anticipated requirements? Water uses include potable water (drinking water for operational workforce), sanitary water, and water used for operation (such as any cooling water for facility operation). What is the source of water?
33.4	Operation	How much water would be discharged to surface water during operation and what outfalls would be impacted?

Response

Please see Section 2 and the response to Item 9 in this report, as well as References 1 and 2, regarding water requirements during construction and operation. Some of this information is not available at this time or should be similar to data found in the INL Data Response document. Please see the response for Item 12 for details about the water source and outfalls.

Item No.	Topic	Information Needed for EIS
34	**Air**	
34.1	Construction – Internal Modifications	To estimate air emissions from construction, what types and numbers of nonroad equipment (e.g. generators) would be used for construction? What are the anticipated annual and total hours of operation for each type of equipment? To estimate a period of peak construction activity, provide a schedule of proposed activities.
34.2	Construction-New Facility	To estimate air emissions from construction, what types and numbers of nonroad equipment would be used for construction (excavators, cranes, soil compactors, backhoes, concrete delivery and pump trucks, generators, etc.)? What are the anticipated annual and total hours of operation for each type of equipment? What area of ground would construction disturb and what would be the duration of this activity? To estimate a period of peak construction activity, provide a schedule of proposed activities.
34.3	Operations	What sources of non-radiological emissions would be required for spent fuel storage and treatment operations in support of VTR operations? What annual levels of non-radiological emissions would occur from these sources? Include criteria pollutants (carbon monoxide, nitrogen oxides [NO_x], particulate matter less than 10 and 2.5 microns in diameter, sulfur oxides [SO_x], and volatile organic compounds [VOCs]).

Response

34.1. Internal modifications to existing plants are not applicable for this response; the primary option for VTR siting at ORNL is construction of a new spent fuel storage facility.

34.2. Some of this information is not available at this time or should be similar to data found in the INL Data Response document.

34.3. This information is mostly facility dependent rather than site specific. Therefore, any emissions during operations at Oak Ridge would likely be very similar to those discussed for the INL VTR Alternative site, assuming the new spent fuel facility at ORNL would be similar to the spent fuel facility at the INL VTR Alternative site.

Item No.	Topic	Information Needed for EIS
35	**Human Health**	
35.1	Construction	How many construction workers (annual and for how long) would be exposed to a radiation environment?
35.2	Operations	The number of workers needed to operate the spent fuel storage and treatment facility in support of the VTR spent fuel storage and treatment. How many are in excess of the current workforce. How many would be considered radiation workers and how many would not.
35.3	Operations	What are the anticipated annual radiological emissions from the spent fuel storage and treatment facility in support of the VTR spent fuel storage and treatment that would be in excess of the current emissions? Include quantity by radioisotope.
35.4	Operations	What are the anticipated characteristics of the releases: elevation above ground, air flow rate, stack diameter or exit velocity, temperature
35.5	Operations	What chemical hazards are workers in the spent fuel storage and treatment exposed to?
35.6	Accidents	Severe operational and natural phenomena accidents to be considered, release source terms, frequency Please provide the safety analyses (Documented Safety Analyses (DSAs), hazards analyses, etc.) that establish the safety basis for the facilities and area where the spent fuel storage and treatment activities in support of VTR might occur. What we need are the bounding accident descriptions and source terms. We can develop VTR-specific accidents based on the existing information. For radiological accidents, we will ultimately need to generate for the EIS: - Accident description (include release pathways and mitigating factors) - Accident frequency - Material at risk including assumptions and methods used in determining MAR - Material characteristics - Source term released to environment (curies by isotope) - Values for damage ratio, airborne release fraction, respirable fraction, and leak path factor used to determine source term - Release parameters: release fractions, release timing, location, release height, release duration, and heat of release - Filtration (specify efficiency) - Types and quantities of hazardous materials that may be released during accidents Accidents to be considered include severe/extremely unlikely operational accidents, natural phenomena initiated (principally severe seismic seismic), and external events (aircraft, range fire, etc.).

Response

35.1–35.4 No exposure of construction workers to a radiation environment is expected since this effort would only comprise new construction. Some of this information is not available at this time or should be similar to data found in the INL Data Response document.

35.5 The chemical hazards to which workers would be exposed to (Item 35.5) are expected to be similar to those at the INL VTR Alternative site given the similarities in work performed and materials handled.

35.6 Please see the response to Item 13.1 for information requested regarding Accidents (Item 35.6).

Item No.	Topic	Information Needed for EIS
36	**Biological/Natural Resources**	
36.1	Construction -New Facility	For the land disturbed as identified in the response to Land and Visual Resources provide an estimate of the land to be disturbed that can be categorized as previously disturbed land and that which would be undisturbed.

Response

Please see response to Item 14.

Item No.	Topic	Information Needed for EIS
37	**Transportation**	
37.1	Construction	Quantity of construction material to be delivered to the site and number of shipments
37.2	Construction	Quantity and number of shipments for construction waste (hazardous and non-hazardous)
37.3	Operations	Anticipated number of shipments (annual) in support of VTR spent fuel storage and treatment operations of the following materials • LLW • MLLW • High level waste • Hazardous and non-hazardous waste Method(s) of shipment for each waste stream: • Truck • Rail • Combination

Response

37.1 Some of this information is not available at this time or should be similar to data found in the INL Data Response document.

37.2 Given that this would be new construction, no radioactive or hazardous waste shipments should be needed. No response is available at this time for nonhazardous waste shipments.

37.3 The only anticipated transportation method is by road in commerce.

Item No.	Topic	Information Needed for EIS
38	**Noise**	
38.1	Construction – Internal Modifications	Identify any activities that would result in noise levels exceeding the noise level associated with activities currently being performed in the facilities in which the spent fuel storage and treatment operations would be performed.
38.2	Construction-New Facility	Identify the construction equipment expected to be used during construction a new facility for spent fuel storage and treatment: examples include • backhoes • excavators • cranes • soil compactors • work trucks, • four-wheel drive • concrete delivery trucks • concrete pump trucks • water truck • generators • flatbed • telescoping forklifts • welder • dump trucks • skid steer • fuel truck • mini excavator • front end loader
38.3	Operations	Identify any activities that would result in noise levels exceeding the noise level associated with activities currently being performed in the facilities in which the spent fuel storage and treatment would be performed

Response

38.1 No planned response; construction of a new spent fuel storage facility is the primary option for VTR siting at Oak Ridge, not modifying existing facilities.

38.2 No detailed response is available at this time. However, the types of construction equipment expected to be used during construction of a new spent fuel storage facility would mostly overlap with the types of construction equipment used during construction of the VTR itself at the INL VTR Alternative site or at Oak Ridge. In addition, this information should be similar to data found in the INL Data Response document.

38.3 No detailed response is available for the Oak Ridge site. However, relevant typical operational noise is expected to be located within the confines of the spent fuel storage facility.

Item No.	Topic	Information Needed for EIS
39	**Waste Management**	
39.1	Construction	Quantities of waste generated per year (peak and average) during construction to include: non-radiological waste (hazardous and non-hazardous)
39.2	Construction	Quantities of radiological waste to include form (LLW, MLLW, HLW)
39.3	Operations	Quantities of waste generated per year during operation to include: • non-radiological waste (hazardous and non-hazardous), • LLW (solid and liquid) • MLLW • HLW
39.4		How are each of these materials to be disposed? If this material is to be handled at existing facilities at the site, what are they? Is there sufficient existing capacity to handle the waste streams? If new facilities are required or existing facilities are to be augmented, describe their location, size, significant physical features. Does the site have a preferred location for the ultimate disposal of these materials (excluding spent fuel)?

Response

39.1 Given that new construction is planned for the VTR spent fuel storage facility at Oak Ridge, waste generation during construction is expected to be normal for new construction. No hazardous or radiological waste generation is expected during construction.

39.2 and 39.3 No detailed estimates are currently available for quantities of waste generation; however, response information for waste generation during operations at the INL VTR Alternative site spent fuel storage facility should be similar to that for a new spent fuel storage facility at Oak Ridge.

39.4 Disposal techniques and locations during operations, along with corresponding impacts, would vary depending upon the characteristics of any waste. Existing locations should be available for disposal during construction if waste generation is minimal and non-hazardous. New facilities would likely be needed during operations, depending upon the waste generation characteristics.

Item No.	Topic	Information Needed for EIS
40	**Socioeconomic**	
40.1	Construction	Workforce: How many workers would be required during construction, provide annual estimates (average and peak) for the full duration of construction? What year would the peak workforce be employed? Please provide percentage estimates for each phase as to which percent of workers would be employed locally vs. workers expected to relocate. Please provide estimates on length (months or years) for project phase.
40.2	Operations	Workforce: How many workers would be required in addition to the current workforce in the facilities where spent fuel storage and treatment would occur during operations Please provide percentage estimates of percent of workers would be employed locally vs. workers expected to relocate.

Response

This information is not available at this time. Please contact ORNL if specific information is required; otherwise it is assumed that Leidos will obtain relevant information from other documents or create their own estimates for this information based upon available information and their own workforce estimation methods.

Item No.	Topic	Information Needed for EIS
41	**Infrastructure**	
41.1	Construction	Electricity: Electrical consumption - provide annual estimates (average and peak) for the full duration of construction.
41.2	Construction	Fuels: oil, natural gas, diesel fuel, gasoline requirements, provide annual estimates (average and peak) for the full duration of construction
41.3	Construction	Water: water consumption - provide annual estimates for the full duration of construction (average and peak) (expected to be the same as identified for water)
41.4	Construction	Sewage: estimated sewage treatment demand generated during construction on an annual basis (average and peak)
41.5	Operations	Electricity: Electrical consumption requirements beyond current requirements, provide annual average and peak estimates
41.6	Operations	Fuels: oil, natural gas, diesel fuel, gasoline beyond current requirements, provide annual average and peak estimates
41.7	Operations	Water: water consumption beyond current requirements, provide annual average and peak estimates
41.8	Operations	Sewage: estimated sewage treatment demand generated beyond current requirements,

Response

This information is not available at this time but should be similar to information for the INL VTR Alternative site.

Item No.	Topic	Information Needed for EIS
42	**Irretrievable and Irreplaceable materials**	
42.1	Construction	Identify materials used for construction whether for a new facility or for internal modifications to an existing facility, for example Concrete Asphalt Steel (structural and reactor vessel) Lumber Piping Conduit Cable Gases (acetylene, oxygen, etc.) Any chemicals that are either relatively rare, not easily replaced, or used in large quantities
42.2	Operations	Annual quantities of any chemicals that are either relatively rare, not easily replaced, or used in large quantities

Response

42.1 No detailed response is available at this time. Information should be similar to data provided for the INL VTR Alternative.

42.2 Chemicals needed during operations of the spent fuel storage facility if sited at Oak Ridge should be to those at the INL VTR Alternative site.

7. DATA REQUEST RESPONSES FOR CUMULATIVE IMPACTS

Item No.	Topic	Information Needed for EIS
43	**Cumulative Impacts**	Provide a list of existing and any reasonably foreseeable other actions that may occur in the Region of Influence (consider a radius of approximately 10 miles from the site). These would include actions by DOE, other Federal State and local agencies, and commercial ventures. Please review the preliminary draft list compiled by Leidos of other reasonably foreseeable actions in the region of influence (ROI) for ORR, and consider the following: - Is the Status correct? - Are there proposed activities at the site that are missing? - Are there activities proposed or operating near the site (offsite) that you have heard of? - Have any of the listed projects been officially cancelled or dropped (an official announcement made)? - Are any of the projects fully completed (all activities are complete and they would not add to ongoing or future impacts). - Have projects with a Status of Ongoing been in an operational mode for at least the last 5 years (we would expect that the impacts of such projects to be captured in the Affected Environment section).

Response

The status is correct for all the projects.

Yes, proposed site activities are missing. ORNL has a number of environmental assessment (EA) determination that have been made which will likely be nearing completion or will be completed by the time the final EIS is issued. Determinations have been sent to Leidos for the following:

- The Stable Isotope Production and Research Center
- The Transformational Challenge Reactor
- Supplement Analysis for Construction of the Second Target Station at the Spallation Neutron Source (Note that the original SNS EIS that was developed included plans for the Second Target Station and operation, which may also be used as a reference.)
- Also, ORNL is listed as an alternate site for the proposed US Department of Defense (DoD) Pele Reactor. It is unclear if being an alternate site meets the criteria of "sufficiently likely to occur" but this is included for completeness.

No additional activities are proposed or operating near the site at this time information on any new initiatives will be provided if they occur.

None of the listed projects has been officially cancelled or dropped.

All of the projects are still active; none have been completed.

The last request regarding projects with "Status of Ongoing" seems unclear, so no specific response is provided. Section 5.2 states that "past, present, and reasonably foreseeable projects at INL, ORR, and SRS are listed in Table 5–1." However, the wording in this request suggests that past projects should not be incorporated in this section of the EIS. Please contact ORNL if additional information is needed.

8. CONCLUSIONS AND FUTURE WORK

This report provides responses to specific data requests sent to ORNL and contains sufficient information on a multitude of topics to support Leidos in completion of the VTR EIS. Knowledge gaps are addressed, and a comprehensive picture of the ORNL site as a whole, as well as the proposed ORNL VTR Alternative site in particular, is pieced together herein by drawing from a large number of subject matter experts and a range of relevant documents. Significant efforts were made to complete surveys and assessments for biological/natural resources as well as historical/cultural resources, all of which are integrated into this report; these efforts significantly improved the understanding of the proposed ORNL VTR Alternative site and surrounds land at ORNL.

No specific future work actions are planned at this time. If actions arise from informal consultation with USFWS on the outcome from the biological survey work, they will be addressed in an appropriate manner at that time.

REFERENCES

1. Leidos, *Site Evaluation for a Versatile Test Reactor at the Oak Ridge Reservation*, Leidos, January 14, 2020 **(DRAFT, OUO).**
2. C. Crabtree, D. Gallagher, M. Kidder, D. Outlaw, K. Owens, G. Santee, *Information for Construction and Operation of the Versatile Test Reactor Complex at the Oak Ridge National Laboratory*, VTR-RPT-01, Leidos, August 2020 **(FINAL DRAFT, LEIDOS PROPRIETARY).**
3. *NPDES Permit No. TN0002941*, Issued to DOE for the ORNL site by State of Tennessee Department of Environment and Conservation Division of Water Resources, issued May 2019 and valid through December 2023. http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9034:34308:::NO:RIR:IREQ_PERMIT_NUMBER,IREQ_FILE_TYPE:TN0002941,Permit [Accessed August 14, 2020].
4. *ORNL National Pollutant Discharge Elimination System (NPDES) Permit Number TN0002941, Water Quality Protection Plan (WQPP) 2016 Monitoring Strategy Update for NPDES*, issued September 2018. http://environment-online.state.tn.us:8080/pls/enf_reports/apex_util.count_click?p_url=BGWPC.GET_WPC_DOCUMENTS?p_file=596377778274527135&p_cat=DOCS&p_id=596377778274527135&p_user=APEX_PUBLIC_USER&p_workspace=19833722515258996 [Accessed August 14, 2020].
5. E.T. Carter, G. Byrd, J. Herold, S. Darling, K. McCracken, L. Hayter, B. Wade, N.R. Giffen, *Sensitive Resources Assessment and Forest Analysis for the Proposed Versatile Test Reactor, Oak Ridge, Tennessee*, ORNL/TM-2020/1703, Oak Ridge National Laboratory, September 2020.
6. R.K. Davis, R.A. Hopkins, W.E. Doll, *Seismic Refraction Survey of the ANS Preferred Site*, ORNL/TM-11998, Oak Ridge National Laboratory, February 1992. https://www.osti.gov/servlets/purl/5642671
7. US Department of Energy, *Independent Oversight Inspection of Emergency Management at the Oak Ridge National Laboratory*, October 2008, https://www.energy.gov/ea/downloads/independent-oversight-inspection-oak-ridge-national-laboratory-october-2008-0, accessed September 3, 2020.
8. Oak Ridge National Laboratory Meteorology Hourly Data, https://metweb.ornl.gov/~krbirdwell/met/Data/hour/ORNL/TOWA/, accessed August 27, 2020.

APPENDIX A. NATURAL RESOURCES MAP

APPENDIX A. ORR NATURAL RESOURCES MAP

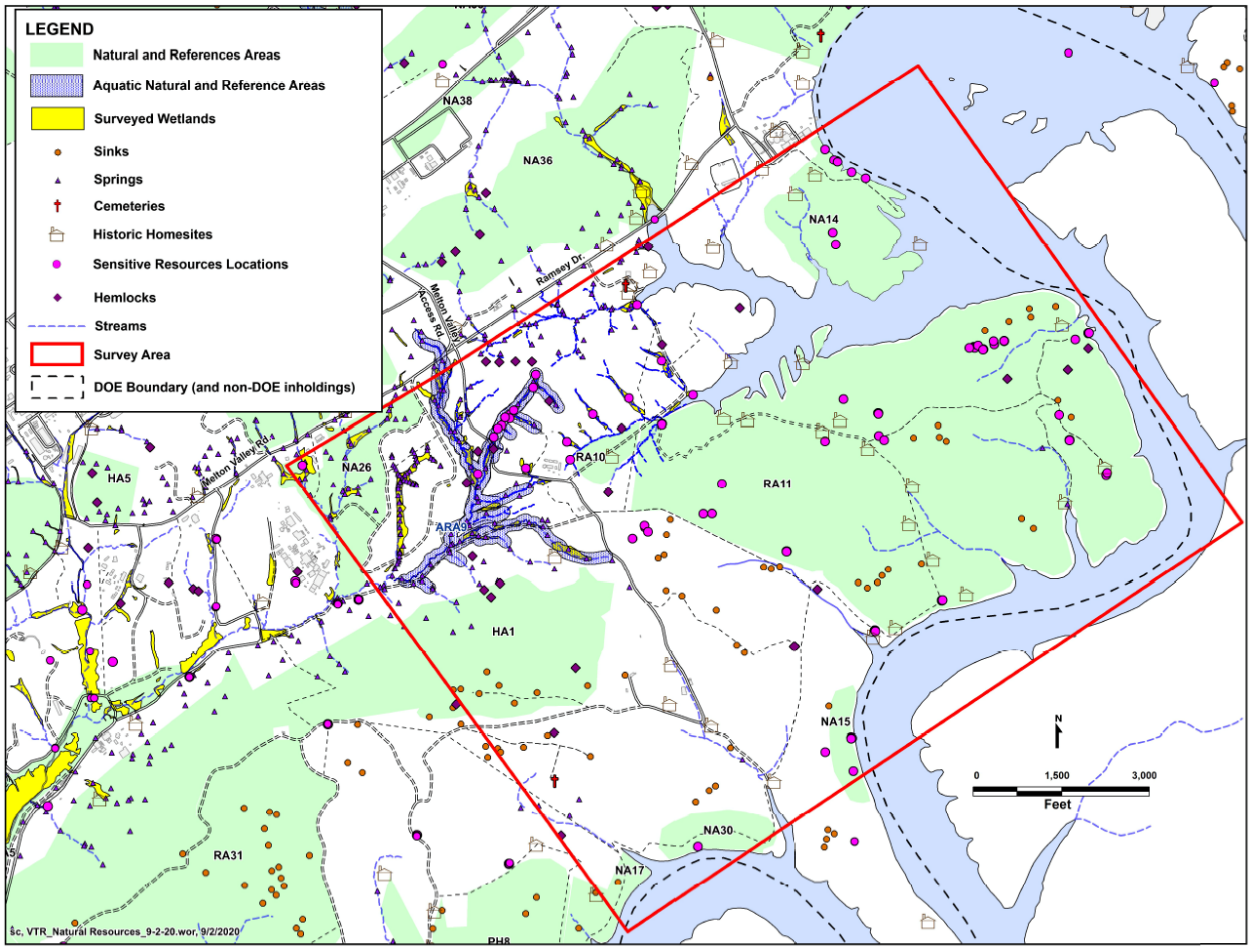

Figure A-1. Natural Resources in general area of proposed ORNL VTR Alternative site.

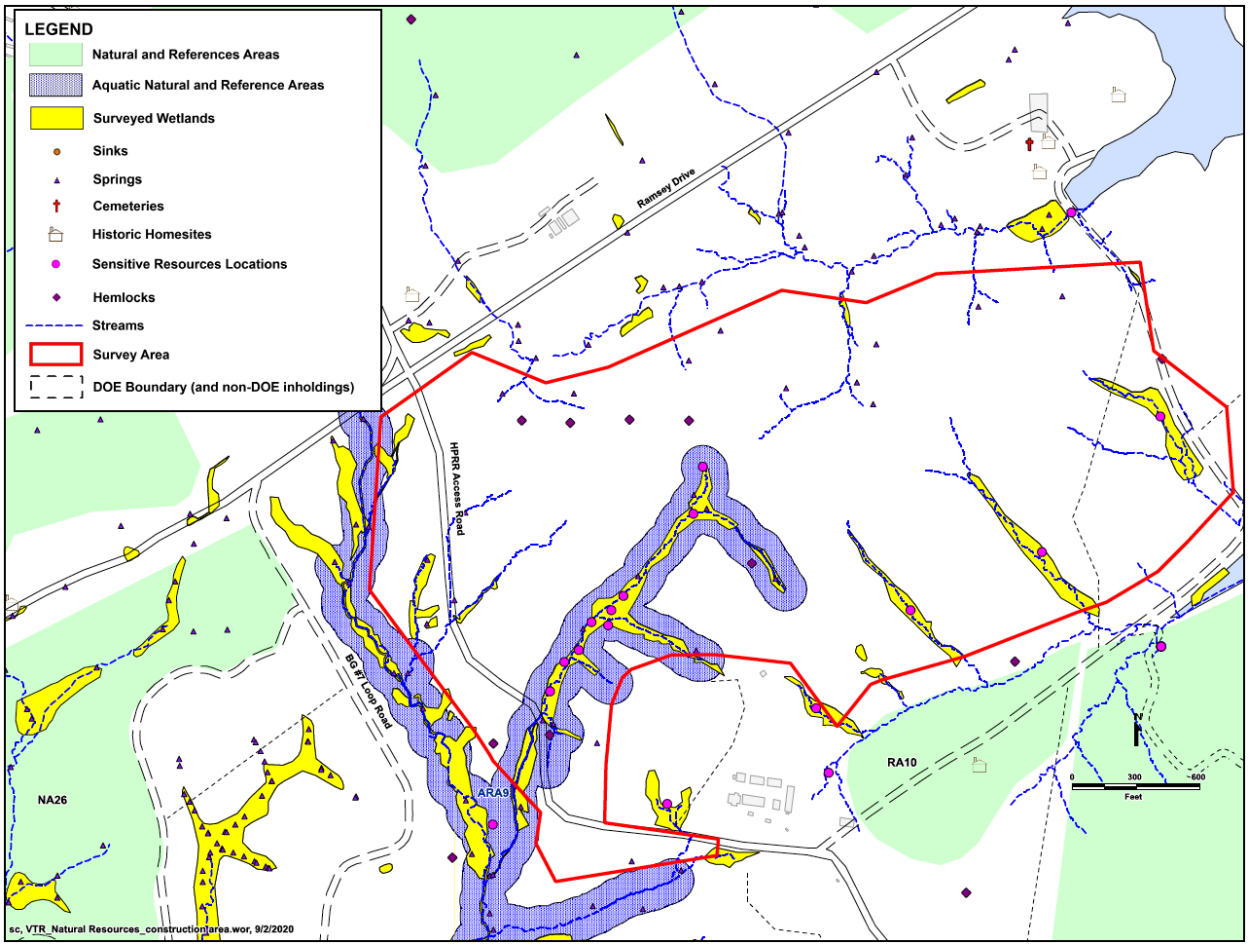

Figure A-2. Natural Resources within VTR project footprint and vicinity.

APPENDIX B. NATURAL AREAS OF THE OAK RIDGE RESERVATION – VTR STUDY AREA

APPENDIX B. NATURAL AREAS OF THE OAK RIDGE RESERVATION – VTR STUDY AREA

DEFINITIONS FOR NATURAL AREA DESIGNATIONS

Natural Area (NA): an area that contains and protects sensitive species and that has traditionally been defined as containing state-listed and federally listed species, species under consideration for such listing, or species considered globally imperiled or rare by NatureServe, an international network of natural heritage programs. NAs are primarily terrestrial but may include aquatic aspects.

Reference Area (RA) and Aquatic Reference Area (ARA): areas that recognize special habitats (e.g., cedar barrens, wetlands) or features (e.g., caves) and that may also serve as references or controls for biological monitoring, environmental remediation and characterization, and other ecological research activities.

Habitat Area (HA): an area known to harbor commercially exploited state-listed species. The plants involved, though not rare, are listed by the state for special management because of their commercial exploitation.

SPECIFIC NATURAL AREAS WITHIN THE VTR STUDY AREA (AS DEFINED IN DECEMBER 2019)

NA14 WHITE CEDAR AREA

Location: Below Melton Hill Lake southeast of the X-10 Robotics Facility.

Size: 88.3 acres (35.7 ha)

General description: Ridges dissected by deep ravines with steep slopes and shaley cliffs dropping into Melton Hill Lake. Old second-growth mixed mesic hardwood forest in spots, especially in deep ravines and steep slopes; uplands are generally younger second-growth hardwood; dry to mesic oak–hickory forest with some mature beech forest, particularly in ravines. Area includes a significant amount of forested lakeshore, some small quality wetlands, and some remnant bottomland forest. Four state-listed and two federal-listed species have been identified for this NA.

Wetlands: No wetland surveys have been conducted in this NA. The site topography precludes the development of large wetlands, but some small quality wetlands are present in some upper stream reaches. Others, if determined to be present, likely would be confined to the Melton Hill Lake shoreline and a small stream inlet.

Other factors: The NA was about evenly divided between open and forested areas in 1935. Interesting topography with high aesthetic value, but a primitive forest road runs the length of the eastern side, detracting from the value. Clinch River Cabin, a conference center, is adjacent at the north end.

Disturbances and external effects: Recent construction of a conference facility on the north side resulted in additional human activity, including lights and noise. An unimproved road runs down the length of the eastern side. A developed area lies just to the north. Disturbance impacts = Intermediate.

Previous recognitions: The eastern portion includes an area previously given a biodiversity significance ranking (BSR) by The Natural Conservancy (1995). The area was assigned BSR 2-21 = very high significance for existence of small, shaley cliff that slopes steeply into Melton Hill Lake that supports sensitive resources.

Comments: This area was reconfigured in 2014 (Parr et al. 2014**)** following the 2010 construction of Clinch River Cabin at the north end of the original NA, which removed a section of mature second- growth forest. Exclusion of the area directly impacted by facility construction and the addition of adjacent ecologically significant areas increased the size of the NA from the original 26.3 acres (10.6 ha) to 88.3 acres (35.7 ha). Further description of the area may be found in Cornwell et al. (2011).

NA15 NORTH HICKORY CREEK BEND BLUFFS/Hickory Creek Bend Bluffs

Location: Along Melton Hill Lake on an east-facing slope on Hickory Creek Bend southeast of the X-10 Robotics Facility.

Size: 17.4 acres (7.0 ha)

General description: Steep, forested southeast-facing slope overlooking Melton Hill Lake. The overstory is mixed hardwood and pine. One state-listed and two federal-listed species have been identified for this NA.

Wetlands: No wetland field surveys have been conducted in this NA; however, the absence of wetlands may be inferred from the steep topography.

Other factors: Most of the area consisted of intact forest in 1935.

Disturbances and external effects: None evident. Disturbance impacts = Low.

Previous recognitions: Area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 3-46 = high significance due to presence of sensitive resources.

NA17 TOWER SHIELDING BLUFFS

Location: Along the shore of Melton Hill Lake southeast of the Tower Shielding Facility.

Size: 292.7 acres (118.4 ha)

General description: Steep east-facing slope overlooking Melton Hill Lake. The overstory consists primarily of oaks and hickories with some mesic species such as Sugar Maple (*Acer saccharum*). One state-listed species has been identified for this NA.

Wetlands: No field wetland surveys have been conducted in this NA; however, the absence of wetlands can be inferred from the steep topography. Small wetland areas may be present in the riparian zone of the small stream located along the northwestern edge of the NA.

Other factors: The area consisted of a mosaic of open and forested areas in 1935.

Disturbances and external effects: Power line corridor along most of western edge and through southern part. Unimproved road through most of long axis. Disturbance impacts = Low to Intermediate.

Previous recognitions: Includes an area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 3-49 = high significance due to presence of one sensitive resource and a tuliptree-mixed hardwood forest with pine.

NA26 MELTON VALLEY LILY AREA

Location: South of Melton Valley Drive, east of the High Flux Isotope Reactor, including portions of Solid Waste Storage Area 7 (uncontaminated area).

Size: 76.7 acres (31.0 ha)

General description: The NA includes a substantial stream system with forested headwater stream bottomlands of Melton Branch, steep ridges, and older forest, including large bottomland oaks and huge White Pines (*Pinus strobus*). Some regionally uncommon tree species are also present. At certain times of the year, ephemeral shallow water-filled depressions in one headwater stream bottom form that may serve as important amphibian breeding sites. Sensitive resources have been identified for this NA, including two federal-listed species.

Wetlands: Several small surveyed wetlands occur within the NA. Ephemeral depressional ponds occur in the forested headwater stream bottom wetland. Additional information on wetlands in the Melton Branch watershed can be found in Rosensteel and Trettin (1993).

Other factors: Most of the NA consisted of intact forest in 1935.

Disturbances and external effects: Impacts from peripheral roads and built-up areas; waterline crossings. Disturbance impacts = Intermediate.

Previous recognitions: Includes area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 2-27 = very high significance due to presence of sensitive resources and east facing rocky slope.

Comment: The original NA constituted only 3.0 acres (1.2 ha). Construction of the Melton Valley maintenance facility resulted in disturbance and elimination of some sensitive resources. Deletion of the construction-affected area from the NA and thorough study of the immediate vicinity, with discovery of important natural resources, resulted in the addition of new acreage and a significantly new entity in 2014 (Parr et al., 2014).

NA30 HEALTH PHYSICS RESEARCH REACTOR (HPRR) LAKE BLUFFS

Location: Along the shore of Melton Hill Lake south of the Health Physics Research Reactor (HPPR) facility on Copper Ridge.

Size: 22.8 acres (9.2 ha)

General description: This area of steep rocky limestone bluffs runs along the shoreline of Melton Hill Lake south of HPRR. Sensitive resources have been identified for this NA, including one state-listed species.

Wetlands: No wetland surveys have been conducted in this NA; however, the absence of wetlands can be inferred from the steep topography.

Other factors: The area consisted of intact forest in 1935.

Disturbances and external effects: Unimproved road through long axis. Disturbance impacts = Low to Intermediate.

Previous recognitions: Area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 3-48 = high significance due to presence of sensitive resources.

RA10 MOSS AND LICHEN PINE COMMUNITY

Location: Small RA east of intersection of HPRR Access Road and Bearden Creek Road.

Size: 14.6 acres (5.9 ha)

General description: This area provides a good illustration of plant community succession following serious soil erosion damage. Mosses and lichens are abundant under pines, which is typical of early successional stages in this region. The dominant ground cover is the lichen Reindeer Moss (*Cladonia subtenuis*).

Other factors: The area consisted of a mosaic of open and forested areas in 1935.

Disturbances and external effects: TVA electric transmission line [Fort Loudon/Elza (161)] over eastern edge. Improved gravel road through long axis. Disturbance impacts = High to Intermediate.

RA11 COPPER RIDGE AREA

Location: Large RA encompassing a peninsula bordered on east and south by Clinch River/Melton Hill Lake, north by Bearden Creek Cove and west by HPRR East Fence Access Trail.

Size: 478.5 acres (193.6 ha)

General description: This large and relatively undisturbed area includes communities in various stages of succession. Some of the major community types include oak–hickory, pine, and cedar forests. The ridge section is extremely rocky, and there are numerous limestone rocky sinks and several caves. A number of sensitive resources have been identified for this RA, which include three state and federal-listed species.

Other factors: Approximately half of this area is interior forest. This RA contained no intact forest in 1935. It supports nesting interior forest Neotropical migrant birds.

Disturbances and external effects: TVA electric transmission line [Fort Loudon/Elza (161)] lies adjacent to the narrow western edge. An improved gravel road and some unimproved roads traverse the area. Disturbance impacts = Low.

Previous recognitions: Includes most of area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 3-37 = high significance due to presence of sensitive resources and a White Oak-Tuliptree-Hickory Forest.

ARA9 MELTON BRANCH

Location: Large ARA north of HA1 and east of NA26, adjacent to SWSA 7 Loop Road.

Size: 47 acres (19 ha); 1.9 stream mi (3.1 km)

General description: This ARA consists of the uppermost first- and second-order reaches of Melton Branch and lies completely within the ORR. Melton Branch becomes a third-order stream that is a major tributary of the main stem of White Oak Creek, all within the ORR. Some sections in the ARA naturally dewater, and flow is intermittent for parts of the year. The vegetation is primarily young forest, from mesic alluvial flats to drier uplands. The entire watershed lies within the ORR, and 38% of the watershed within the ORR is protected. A number of sensitive resources have been recently identified for this ARA, which include state and federal-listed plant and animal species and ORNL Priority Focal Species for Research and Management (Carter et al 2020).

Wetlands: Forested, scrub–shrub, and emergent wetlands have been identified and mapped along Melton Branch and its many headwater tributaries (Rosensteel 1996). More recent data for this area was acquired during a 2020 sensitive resources survey (Carter et al 2020).

Other factors: Reference sites (MEK 1.8 and 2.1) for periphyton, benthics, and the fish community tasks for the Biological Monitoring and Abatement Program (BMAP) are present in the ARA.

Disturbances and external effects: TVA power line [Fort Loudon/Elza (161)] at northern tip of ARA. Some water line crossings. Two secondary paved road crossings. Two improved gravel road crossings with a short section of parallel road. Nearby parallel roads. Disturbance impacts = High to Intermediate.

Previous recognitions: Area previously given a BSR by The Natural Conservancy (1995). The area was assigned BSR 4-6 = moderate significance due to presence of Red-shouldered Hawk (not currently state-listed).

HA1 WEST COPPER RIDGE/Holland Road Forest

Location: South of ARA9 (Melton Branch) and west of HPRR Access Road.

Size: 353.4 acres (143.0 ha)

General description: Largely consists of interior forest. Sensitive resources have been identified for this HA.

ADDITIONAL SENSITIVE RESOURCES DATA FOR VTR STUDY AREA

STATUS SPECIES OCCURRENCES FROM OTHER DATABASES:

Table B-1. Additional occurrences of status species noted for the VTR study area from other available sources (state databases, prior assessments, incidental observations).

List includes federal listing status under the US Endangered Species Act (ESA), Tennessee Wildlife Resources Agency status for wildlife species, Tennessee Department of Environment and Conservation for plant species, and additional status remarks. (**Note: List overlaps species records noted in the Oak Ridge Reservation Natural Areas database, as well as containing some additional species listings.)**

Species	Common name	Federal	State	Other
Myotis grisescens	Gray bat	Endangered, ESA	E	Caves in review area
Myotis lucifugus	Little brown bat		T	Caves in review area
Myotis septentrionalis	Northern long-eared bat	Threatened, ESA	T	Caves in review area
Myotis sodalis	Indiana bat	Endangered, ESA	E	Caves in review area
Perimyotis subflavus	Tri-colored bat	Active ESA petition	T	Caves in review area
Accipiter striatus	Sharp-shinned hawk			Uncommon
Haliaeetus leucocephalus	Bald eagle	16 U.S.C. 668-668d	D	Breeding habitat present
Sphyrapicus varius	Yellow-bellied sapsucker		P-D	Breeding - rare in state
Sorex spp	multiple shrew species		P-D?	Of regional importance
Synaptomys cooperi	Southern bog lemming		D	
Aureolaria patula	Spreading false-foxglove		S	
Cimicifuga rubifolia	Appalachian bugbane		P-T	
Cypripedium acaule	Pink lady's slipper		CE	
Diervilla lonicera	Northern bush honeysuckle		T	
Hydrastis canadensis	Goldenseal		CE	
Juglans cinerea	Butternut		T	
Panax quinquefolius	Ginseng		S, CE	
Saxifraga careyana	Carey's saxifrage			Of regional importance
Spiranthes ovalis	October ladies'-tresses			Sensitive
Thuja occidentalis	Northern white cedar		SR	

State status codes:

E – Endangered
T – Threatened
D – In need of Management
S – Of special Concern
SR – Rare
CE – Commercially exploited
P-T – Considered rare or regionally important, previously listed as threatened
P-D – Considered rare or regionally important, previously listed as in need of management

APPENDIX C. UTILITIES MAP

APPENDIX C. UTILITIES MAP

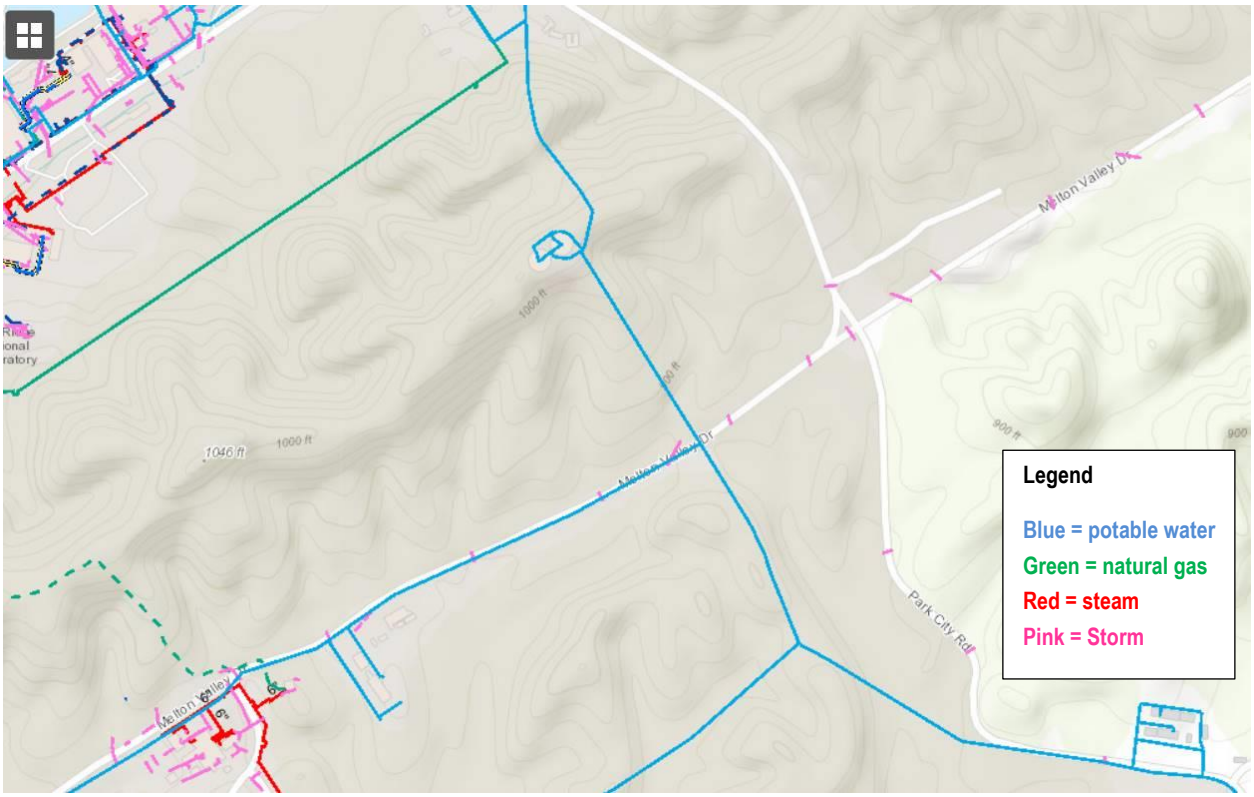

Figure C-1. Locations of some relevant utilities in the proximity of the potential Oak Ridge VTR site.

APPENDIX D. NATURAL GAS LINE MAP

APPENDIX D. NATURAL GAS LINE MAP

Figure D-1. Natural gas line map.

APPENDIX E. ARCHAEOLOGICAL AND HISTORICAL REVIEW

APPENDIX E. ARCHAEOLOGICAL AND HISTORICAL REVIEW

Archaeological and Historical Review for Construction and Operation of the Versatile Test Reactor at the Department of Energy Oak Ridge National Laboratory in Oak Ridge, Tennessee

Acknowledgement: *This appendix includes contributions from Karen Foster (Leidos) and Kirk Owens (Leidos) in addition to authors already listed in the Acknowledgements of this main report including Ernest Ryan, Greg Byrd, and Walt Doty.*

PURPOSE OF THIS APPENDIX: The Proposed Undertaking would occur at the United States Department of Energy (DOE) Oak Ridge National Laboratory (ORNL) on Oak Ridge Reservation in Oak Ridge, Tennessee. Activities on the ORNL are covered under the *Final Site-Wide Programmatic Agreement for the Oak Ridge National Laboratory* agreed upon by the DOE Oak Ridge Operations Office, the Tennessee State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (Advisory Council). Per Stipulation VII.A.2.e, an undertaking will not require further review by the SHPO or the Advisory Council provided that the internal review of the undertaking is based upon information adequate to identify and evaluate affected historic properties and that DOE Oak Ridge Operations Office "has determined that these undertakings will either be no effect or no adverse effect based upon the Criteria of Effect and Adverse Effect enumerated in 36 CFR Part 800.5." The following provides an archaeological and historical review of the project area to support DOE's determination that the Proposed Undertaking would have no adverse effect on historic properties.

PROPOSED UNDERTAKING: DOE proposes to construct and operate a Versatile Test Reactor (VTR) facility and has selected an area located within ORNL as a possible site (Figure E-1). The new VTR complex would include the VTR facility, a spent fuel pad, a hot cell facility, and other ancillary structures. The VTR complex would provide a fast-neutron source to test fuels, materials, instrumentation, and sensors for a variety of existing and advanced reactor designs. These experiments would expand the state-of-the-art knowledge of reactor technology. The completed VTR complex would occupy less than 50 acres in an undeveloped area of ORNL. Perimeter Intrusion, Detection, and Assessment System security fencing would surround the complex. Additional land would be disturbed during the construction of the VTR complex for items such as temporary staging of construction materials and equipment and worker office trailers and parking. In total, construction activities could result in the disturbance of about 150 acres (*Temporary Disturbance Area* shown on Figure E-2), inclusive of the completed VTR complex (*Permanent Disturbance Area* shown on Figure E-2).

LOCATION OF ACTION: The Proposed Undertaking would take place at a site located about a mile east of ORNL's main campus, southeast of the intersection of Melton Valley Access Road and Ramsey Drive and east of Greenway Road, in an undeveloped portion of Melton Valley within the ORNL portion of the DOE Oak Ridge Reservation (Figure E-1 and Figure E-2).

AREA OF POTENTIAL EFFECTS (APE): The DOE has determined that the APE for the Proposed Undertaking for direct physical effects is the construction footprint shown on Figure E-2. It comprises 150 acres and includes both the temporary and permanent disturbance areas described above. Due to local vegetation and terrain, the APE also includes a 1/4-mile radial buffer surrounding the construction footprint to address potential visual impacts on historic properties.

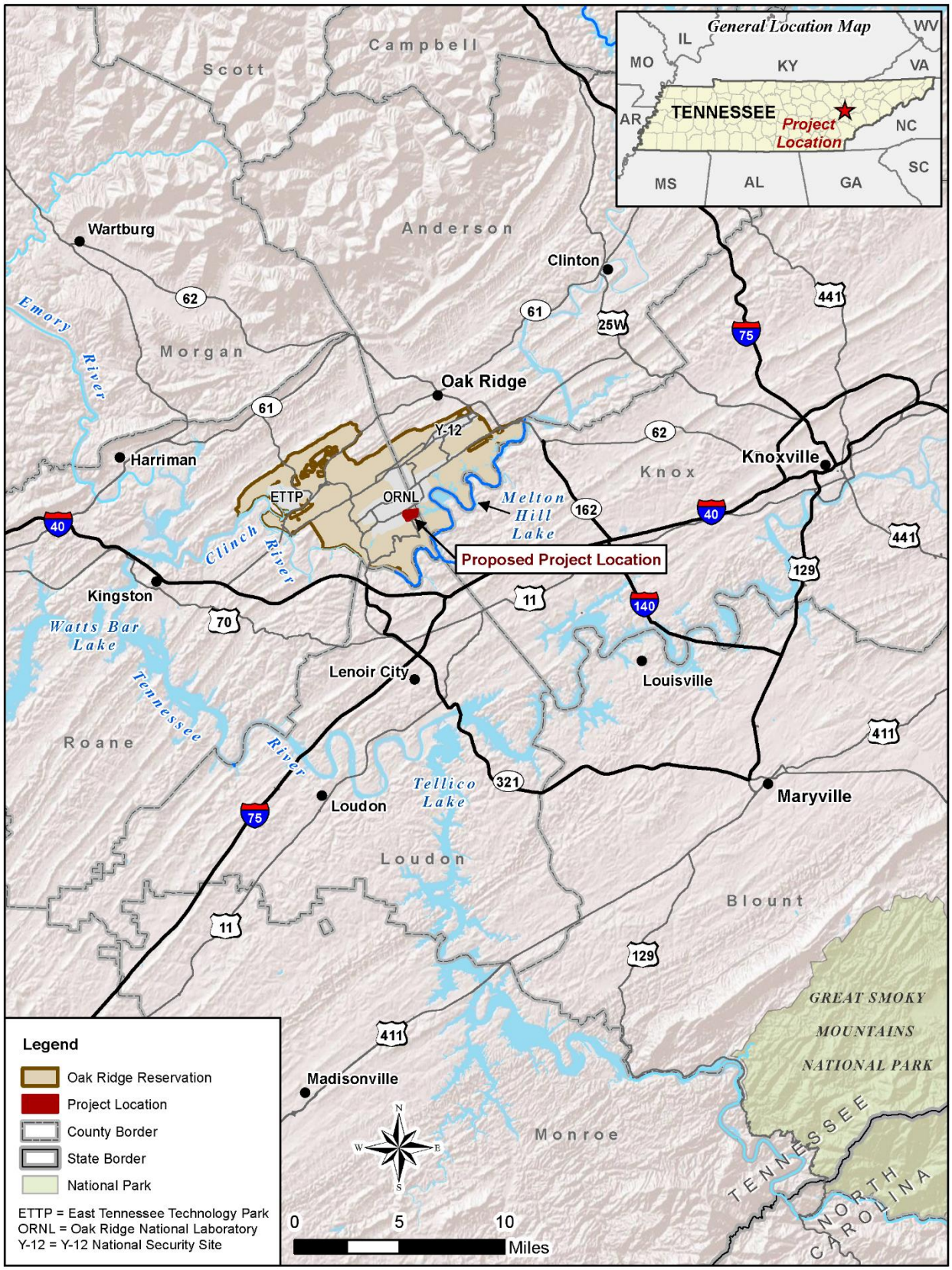

Figure E-1. Oak Ridge National Laboratory Location Map Showing Location of Proposed Undertaking

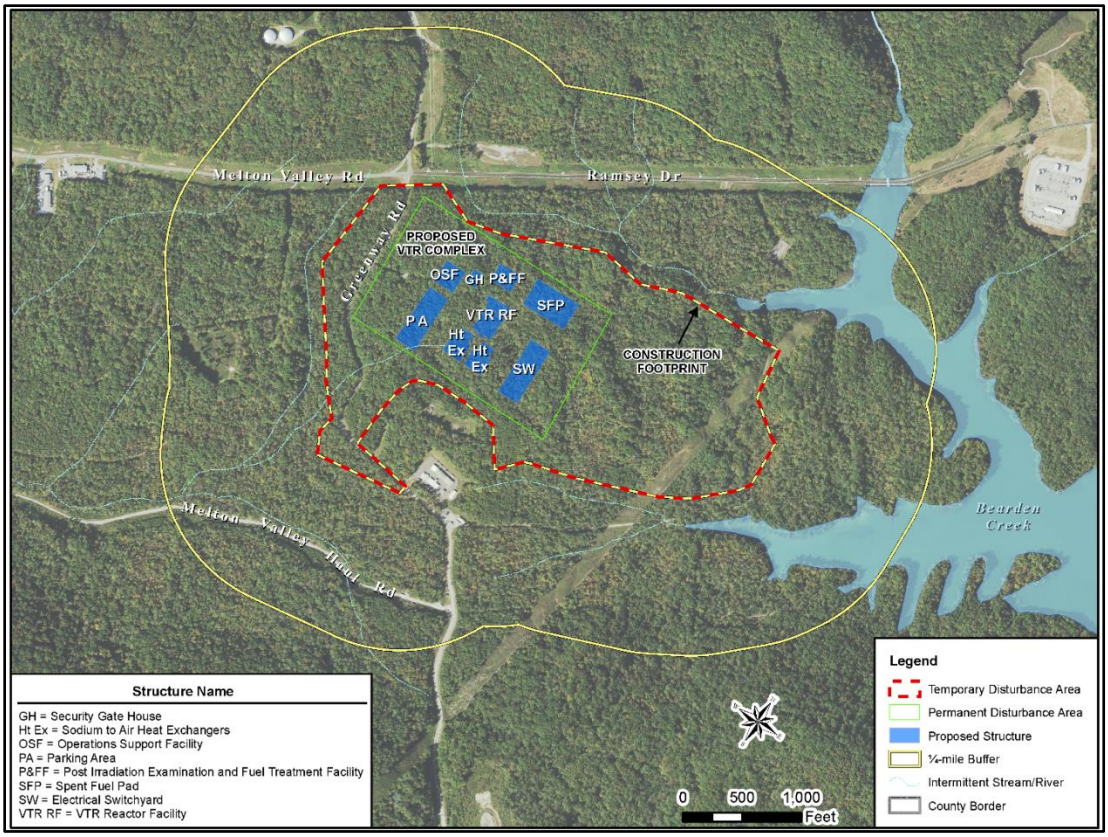

Figure E-2. Construction Footprint for the Proposed Complex for ORNL VTR Alternative

METHODOLOGY: To determine whether any historic properties are located within the APE, DOE conducted a careful review of previous archaeological and historical survey reports, together with data validation using a combination of field visits and comparison with historic aerial photography of the site and surrounding area. The results of this review are provided below.

BACKGROUND INFORMATION: The DOE Oak Ridge Reservation, including ORNL, was created as a part of the Manhattan Project during World War II (WWII) for the purpose of secretly supporting development of the world's first thermonuclear weapons. The site was selected for its relatively low population and geographically remote location, together with ready access to hydro-electrical power and nearby railway connections. Communities and families were notified that their land and properties were being appropriated by the federal government in support of the war effort and given notice to vacate within a matter of weeks. In all, approximately 900 families were removed from a total of 56,000 acres located in East Tennessee. The United States Army Corps of Engineers (USA/COE) conducted surveys of all the seized properties and prepared inventories used to determine the valuation of each parcel's acreage and "improvements" (buildings and structures). As discussed further below, the resulting parcel maps provide important indicators as to the possible presence of pre-WWII historic remains.
More information about the prehistory and history of ORNL and the Oak Ridge Reservation can be found in the *DOE Oak Ridge Reservation Cultural Resource Management Plan* (CRMP) (DOE-ORO 2001).

REVIEW OF PRIOR STUDIES: The Oak Ridge Reservation CRMP (DOE-ORO 2001) provides a summary of prior cultural resources studies and known cultural resources identified and recorded on the reservation and serves as a foundation for this current study. Other key studies include an archaeological reconnaissance for the Advanced Neutron Source Project (DuVall 1991), an evaluation of previously recorded archaeological sites on the Oak Ridge Reservation (DuVall and Souza 1996), and the USA/COE

pre-World War II inventory maps. In particular, the DuVall (1991) archaeological survey covered the proposed permanent disturbance area and most of the proposed temporary disturbance area associated with the Proposed Undertaking, as shown on Figure 3.12 of the CRMP (DOE-ORO 2001) and reproduced here in Figure E-3.

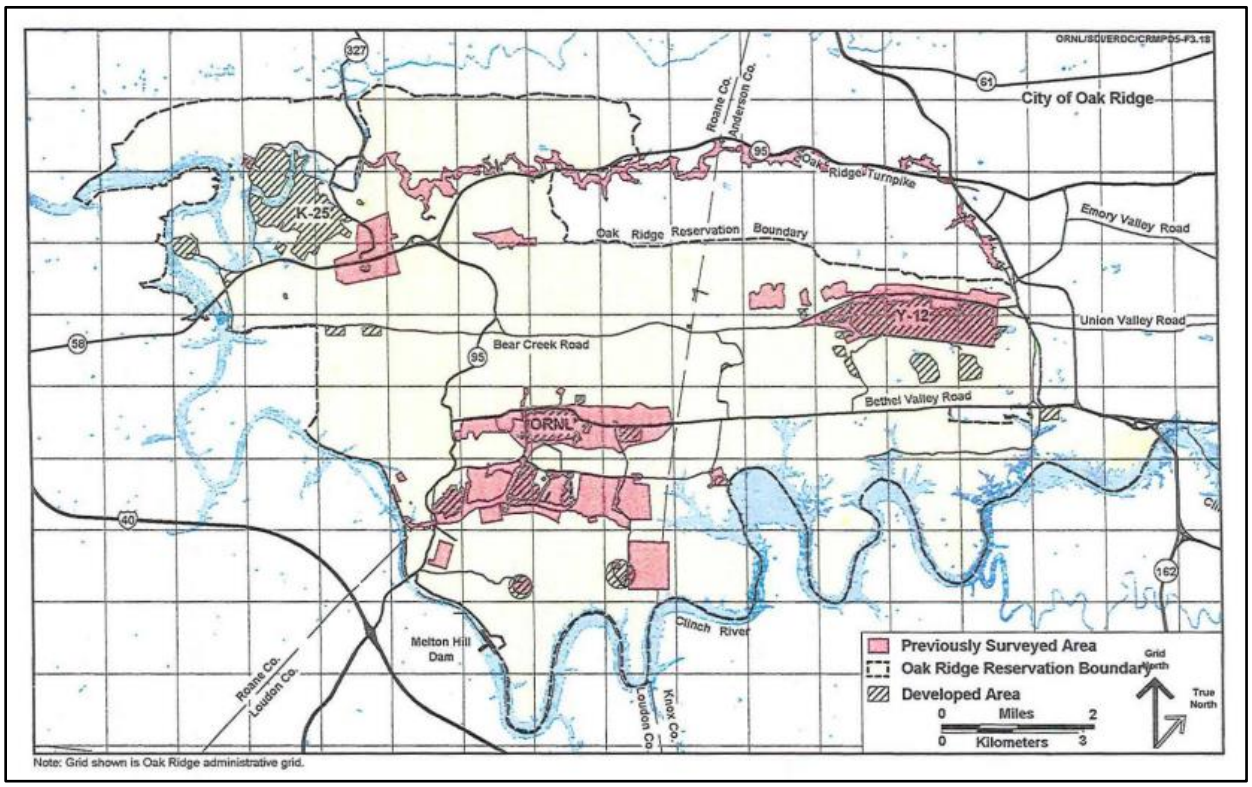

Figure E-3. Reproduction of Figure 3.12 from the Oak Ridge Reservation CRMP (DOE-ORO 2001) showing previously surveyed areas.

PREHISTORIC RESOURCES: Prehistoric archaeological sites recorded at the Oak Ridge Reservation include villages, potential burial mounds, camps, quarries, a chipping station, limited activity locations, and shell scatters. There are no prehistoric archaeological sites recorded within the 150-acre construction footprint. While the DuVall (1991) archaeological survey covered the proposed permanent disturbance area, some of the proposed temporary disturbance area along the eastern side of the construction footprint was not previously surveyed although this area has likely been previously disturbed by agricultural activities and subsequent re-forestation. However, there remains a slight chance that unrecorded prehistoric archaeological sites may exist in the unsurveyed area.

HISTORIC RESOURCES: Historic resources identified at the Oak Ridge Reservation consist of both archaeological remains, standing structures, and cemeteries. Historic archaeological remains consist primarily of historic building foundations, roads, and trash scatters. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, grave houses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Other National Register of Historic Places (NRHP)-eligible standing buildings and facilities are associated with the Manhattan Project (DOE-OR 2001), none of which are located within the APE.

There are no historic resources recorded within the 150-acre construction footprint. To verify this, DOE reviewed the USA/COE parcel maps to identify any pre-World War II structures mapped within the APE

(Figure E-4) and confirmed that none are mapped within the construction footprint. There are mapped locations within the 1/4-mile radial buffer. DOE cross referenced mapped locations with prior NRHP evaluations (DuVall and Souza 1996) and conducted a walkover field visit to attempt to locate any remnants of these structures. DOE also documented any changes noted since the 1996 study and documented a few locations that were not addressed in the 1996 study.

A total of 18 parcels from the USA/COE inventory are contained within or intersect with the APE (see Figure E-4). The USA/COE survey protocols called for splitting any parcels that included acreage in both Anderson (Section G properties) and Roane Counties (Section A properties) for purposes of the inventory, such that 8 individually held properties associated with inventoried structures were represented by a total of 10 parcels (A-21, A-22, A-44, A-45, A-47, G-602, G-603, G-604, G-605, and G-614). The remaining 8 parcels that intersected the APE contained no inventoried structures.

Table E-1 provides a summary of the pre-World War II structures mapped within the 1/4-mile radial buffer. These include a church, dwellings, barns, and various outbuildings related to homesteads. The 2020 field visit confirmed there are no extant standing structures at any of these locations, although some have remains of building foundations or other types of historic archaeological debris. Most of these areas were evaluated in the DuVall and Souza 1996 report, which was submitted to SHPO in 2000 (see Figure 2.1 of DuVall and Souza 1996 for mapped locations). Most of the sites were recommended not eligible for listing on the NRHP in the DuVall and Souza 1996 report because either no physical remains could be located or the physical remains were degraded to the point that they lacked integrity. Similar observations regarding degraded site conditions were made during the 2020 field visit (see Table E-1).

One other property located within the 1/4-mile radial buffer is the Friendship Cemetery. The Friendship Cemetery consists of a single grave with a low metallic marker and is one of 32 identified cemeteries on the Oak Ridge Reservation (see Table 3.7 of the CRMP [DOE-ORO 2001]). The Friendship Cemetery has not been evaluated for listing on the NRHP.

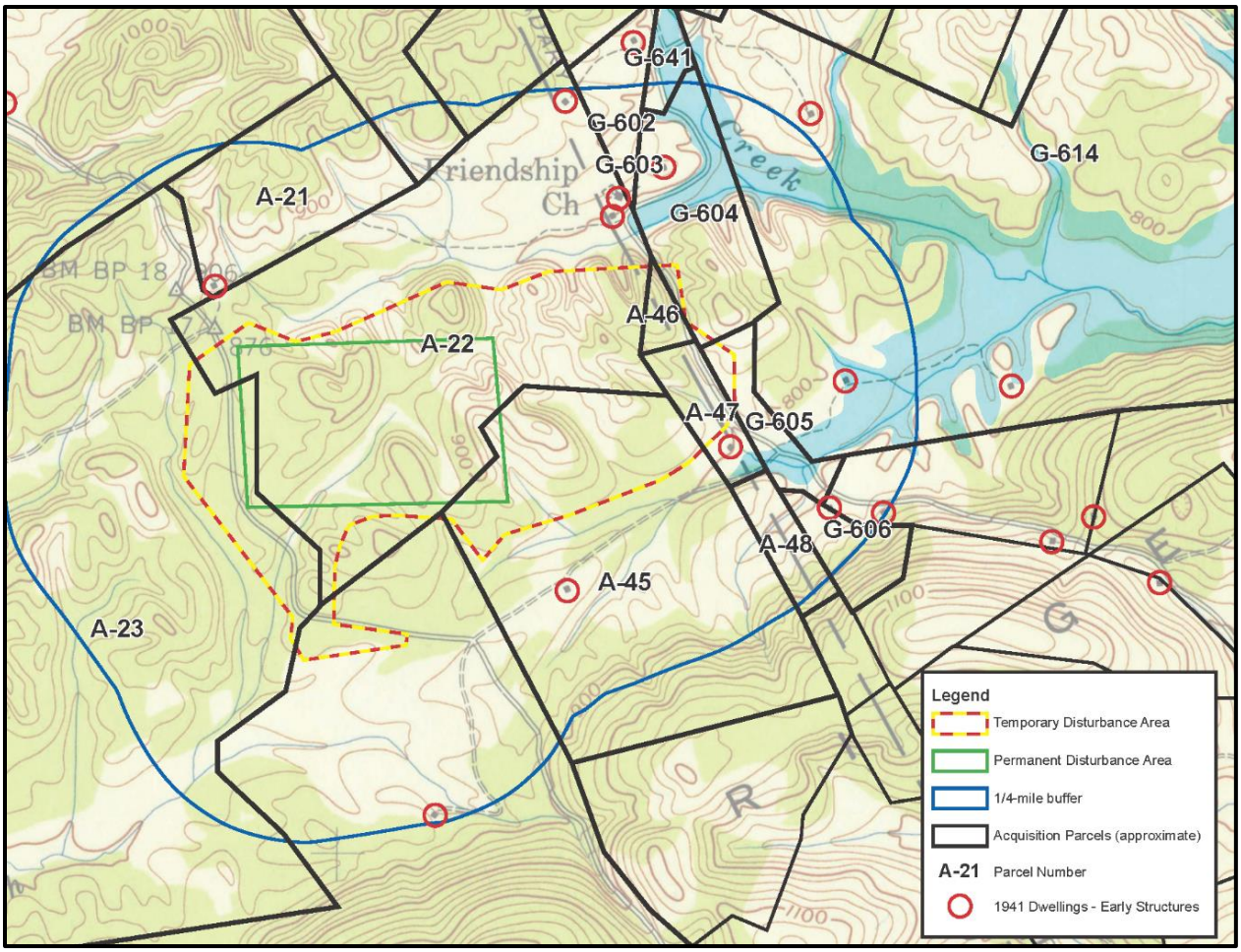

Figure E-4. Proposed Undertaking Shown with USA/COE Parcel Boundaries and Pre-1942 Structure Locations

Table E-1. Summary of Pre-World War II Mapped Structures within the APE

Recorded Owner	Parcel	Inventory No.	Function	Condition	NRHP Evaluation
J.T. and Virgie Bivens	A-21	-	Dwelling, Poultry House, Crib, Barn	2020 field visit confirmed the area had been obliterated by power line construction and no longer exists	NE[2]
Walter Huskey	A-22	-	-	No associated structures	-
Walter Huskey	G-602	602A	Dwelling	Could not be located for the 1996 study; could not be located in 2020	NE[1]
R.A. Melton	A-44	44A	Crib	Could not be located for the 1996 study; could not be located in 2020	NE[1]
R.A. Melton	A-44	44B	Dwelling	Foundation only, per 1996 study	NE[1]
R.A. Melton	A-44	44C	Dwelling	Foundation only and recommended as NRHP-eligible in 1996 study; however, chimney mound could not be located in 2020, and it is now recommended not NRHP-eligible due to subsequent disturbances to the site resulting in loss of integrity and consequent inability to adequately relocate the historic remains	NE[2]
David Sherwood Heirs	A-45	45A	Dwelling	Foundation only, per 1996 study; further degradation of site conditions noted in 2020	NE[1]
David Sherwood Heirs	A-45	45B	Storage	Could not be located for the 1996 study; could not be located in 2020	NE[1]
Mitt Stringfield	A-47	-	Barn, Dwelling, Outbuildings	Only dwelling area located in 2020 and appeared disturbed (possibly by Park City Road/Bearden Creek Road relocation due to creation of Melton Hill Lake); recommended not NRHP-eligible due to past and ongoing degradation of site conditions	NE[2]
Mitt Stringfield	G-605	-	Barn	Found depression and stones at shoreline in 2020; site appears to be intermittently submerged by Melton Hill Lake; recommended not NRHP-eligible due to past and ongoing degradation of site conditions	NE[2]
Trustees of the Friendship Baptist Church	G-603	603A	Church	Foundation only, per 1996 study; further degradation of site conditions noted in 2020	NE[1]
Trustees of the Friendship Baptist Church	G-603	#24	Friendship Cemetery	Located southwest of the church; the cemetery is small (9 feet by 12 feet) and contains one grave with a low metallic marker	-

Table E-1. Summary of Pre-World War II Mapped Structures within the APE

Recorded Owner	Parcel	Inventory No.	Function	Condition	NRHP Evaluation
Henry Price	G-604	-	Residence, Chicken House, Privey, Barn	Residence area located in 2020, with a rectangular mound and artifacts present, but it appears a power line access trail was built through the site; no other structural remains identified; recommended not NRHP-eligible due to past and ongoing degradation of site conditions	NE[2]
Mary Nelson Stewart	G-614	614A	Dwelling	Could not be located for the 1996 study; location likely outside APE	NE[1]
Mary Nelson Stewart	G-614	614B	Dwelling	Could not be located for the 1996 study; location likely outside APE	NE[1]
-	-	48A	Undetermined	Foundation only with no site integrity, per 1996 study (not revisited in 2020)	NE[1]

Key: APE = Area of Potential Effect; NRHP = National Register of Historic Places; NE = not eligible for listing on the NRHP.

Notes:

1 – NRHP evaluation based on DuVall and Souza 1996 (submitted to SHPO in 2000)

2 – NRHP evaluation based on the 2020 field visit and degraded site conditions

While most of the historic archaeological sites within the 1/4-mile radial buffer have been recommended as ineligible for listing on the NRHP, even if any were determined to be eligible, the Proposed Undertaking would not physically alter any resource within the 1/4-mile radial buffer and would not introduce a visual element that would diminish the integrity of a significant historic feature if one existed. Much of the general area had been cleared for agricultural purposes before the government appropriated the land but has since changed to the current state of re-forestation. Clearing some land for the VTR facility would not adversely affect an already compromised viewshed. Therefore, none of the historic resources would be adversely affected by a change in viewshed associated with the Proposed Undertaking (i.e., introduction of a visual element would not diminish the integrity of a significant historic feature per 36 CFR Part 800.5).

DETERMINATION: DOE has determined that there are no recorded historic properties located within the construction footprint associated with the Proposed Undertaking. There is a slight chance that unrecorded prehistoric archaeological sites may exist in the unsurveyed portion of the proposed temporary disturbance area along the eastern side of the construction footprint. With implementation of the following measures, there would be no adverse effect on archaeological resources within the construction footprint:

- DOE will minimize ground-disturbing activities (e.g., temporary staging of construction materials and equipment and worker office trailers and parking) within the unsurveyed portion of the proposed temporary disturbance area.
- If avoidance of the unsurveyed area is not possible, DOE will ensure that an archaeologist that meets the qualifications contained in the Secretary of the Department of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44720-44726) monitors all ground disturbing activities in the unsurveyed area.
- If there is an unanticipated cultural resource discovery during construction of the VTR facility, DOE will follow Section 5.1.6 of the Oak Ridge Reservation CRMP (DOE-ORO 2001).

Although historic archaeological sites and one small cemetery are located within the 1/4-mile radial buffer surrounding the construction footprint, the Proposed Undertaking would not physically alter any resource within the 1/4-mile radial buffer. Additionally, clearing land and building the VTR facility would not adversely affect an already compromised viewshed, and there would be no adverse visual impacts on any potential historic properties within the 1/4-mile radial buffer.

DOE determined that the Proposed Undertaking would have no adverse effect on historic properties within the APE. Therefore, the Proposed Undertaking requires no further review by the SHPO or the Advisory Council, per Stipulation VII.A.2.e of the PA.

REFERENCES:

DOE-ORO. 2001. Cultural Resources Management Plan for the Department of Energy Oak Ridge Reservation, *Anderson and Roane Counties, Tennessee.* DOE/ORO 2085.

DOE-ORO. 2005. *Programmatic Agreement Among the Department of Energy Oak Ridge Office, the Tennessee State Historic Preservation Officer, and the Advisory Council on Historic Preservation Concerning Management of Historical and Cultural Properties at the Oak Ridge Reservation*. April.

DuVall, Glyn. 1991. *An Archaeological Reconnaissance of the Advanced Neutron Source Project on the Oak Ridge Reservation, Anderson and Roane Counties, Tennessee*. Prepared for Martin Marietta Energy Systems, Inc.

DuVall, Glyn. 1994. *An Archaeological Reconnaissance and Evaluation of the Oak Ridge National Laboratory, Oak Ridge Reservation, Anderson and Roane Counties, Tennessee*. ORNL/M-3245.

DuVall, Glyn and Peter A. Souza. 1996. *An Evaluation of Previously Recorded and Inventoried Archeological Sites on the Oak Ridge Reservation, Anderson and Roane Counties, Tennessee*. ORNL/M-4946.

United States Army Corp of Engineers (USA-COE). *Kingston Demolition Range photos and inventories of Pre-1942 Properties taken by the US Government and Removed to Build Oak Ridge Tennessee.* Copied from the National Archives and curated by the Pellissippi Genealogical and Historical Society.

APPENDIX F. ECOLOGICAL RESOURCES TABLES

APPENDIX F. ECOLOGICAL RESOURCES TABLES

Table F-1. Federally-listed species with potential to occur within the proposed ORNL VTR Alternative construction area. Table F-2 includes US Fish and Wildlife Birds of Conservation Concern (BCC) or Birds of Management Concern (BMC).

Common Name	Scientific Name	Status	ECOS Doc	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary	Notes / Suspected Impacts
Amphibians							
Berry Cave salamander	*Gyrinophilus gulolineatus*	CS	[link] [link] [link]	no	Underlying karst and aquatic subterranean habitat exists, but a lack of human-accessible caves might prevent detection under provided timeline.	**no***	Disturbance of deeper karst and groundwater would be detrimental to this and other subterranean taxa.
Mammals							
Gray Bat	*Myotis grisescens*	FE	[link]	**yes**	Foraging habitat	**yes**	Known hibernaculum and maternity habitat within 0.5 miles of project area.
Indiana Bat	*Myotis sodalis*	FE	[link]	**yes**	Foraging and maternity habitat	**probable**†	Probable hibernacula within regulatory limits of project area - numerous caves with previous observations.
Northern Long-eared Bat	*Myotis septentrionalis*	FT	[link]	**yes**	Foraging and Maternity habitat	**probable**†	Suitable hibernaculum within 0.5 miles of project area.
Tricolored Bat	*Perimyotis subflavus*	UR	[link]	**yes**	Foraging habitat	**yes**	
Little Brown Bat	*Myotis lucifugus*	UR	[link]	**yes**	Forging habitat	**yes**	
Clams							
Alabama Lampmussel	*Lampsilis virescens*	FE	[link]	no	no	no	no impact
Cracking Pearlymussel	*Hemistena lata*	FE	[link]	no	no	no	no impact
Dromedary Pearlymussel	*Dromus dromas*	FE	[link]	**yes**	no	no	low to no impact
Fanshell	*Cyprogenia stegaria*	FE	[link]	**yes**	no	no	low to no impact

Common Name	Scientific Name	Status	ECOS Doc	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary	Notes / Suspected Impacts
Finerayed Pigtoe	*Fusconaia cuneolus*	FE	[link]	**yes**	no	no	low to no impact
Orangefoot Pimpleback	*Plethobasus cooperianus*	FE	[link]	**yes**	no	no	low to no impact
Pink Mucket	*Lampsilis abrupta*	FE	[link]	**yes**	no	no	low to no impact
Ring Pink	*Obovaria retusa*	FE	[link]	no	no	no	no impact
Rough Pigtoe	*Pleurobema plenum*	FE	[link]	no	no	no	no impact
Rough Rabbitsfoot	*Quadrula cylindrica strigillata*	FE	[link]	**yes**	no	no	low to no impact
Sheepnose Mussel	*Plethobasus cyphyus*	FE	[link]	**yes**	no	no	low to no impact
Shiny Pigtoe	*Fusconaia cor*	FE	[link]	**yes**	no	no	low to no impact
Spectaclecase	*Cumberlandia monodonta*	FE	[link]	**yes**	no	no	low to no impact
White Wartyback	*Plethobasus cicatricosus*	FE	[link]	no	no	no	no impact
Snails							
Anthony's Riversnail	*Athearnia anthonyi*	FE	[link]	no	no	no	no impact
Spiny Riversnail	*Io fluvialis*	FR	[link]	**yes**	no	no	low to no impact
Flowering Plants							
Virginia Spiraea	*Spiraea virginiana*	FT	[link]	no	Several streams with high degree of scouring from periodic flood, many areas resulting in low potential for competition from woody vegetation.	no	no impact
White Fringeless Orchid	*Platanthera integrilabia*	FT	[link]	no	Several seepy, boggy wetlands within the VTR construction area provide ideal habitat for this species.	**possible**‡	Possible *Platanthera* spp sprouts observed in March 2020 in wetlands within project area. Could not yet be identified to species level.

* Could not confirm due to no known human accessible caves within project area. Does not preclude occurrence.
† Record based on few acoustic monitor detections, but presence is assumed given habitat and nearby records.
‡ Timing of surveys did not permit positive identification, because diagnostic characters are largely absent during spring/early summer.

Federal listing status codes: FE – Federally listed endangered species; FT – Federally listed threatened species; UR – Currently Under Review for federal listing; CS – Species is not listed or under review currently but continues to be a Candidate Species for federal listing owing to insufficient data.

Table F-2. State-listed taxa, sensitive communities, and ORR focal species. Note that the State of Tennessee adopts by default all federally-listed species statuses (see Table F-1 for federally-listed taxa).

Common Name	Scientific Name	Status	Other Protection Status	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary
Amphibians						
Green salamander	*Aneides aeneus*	R	S3S4	**yes**	**unlikely**; minimal availability of: damp crevices in shaded rock outcrops and ledges; beneath loose bark and cracks of trees and sometimes in/or under logs.	no
Hellbender	*Cryptobranchus alleganiensis*	E	S3	**yes**	no	no
Berry Cave salamander	*Gyrinophilus gulolineatus*	T	S1	no	**possible***, but aquatic subterranean habitat present	**no***
Four-toed salamander	*Hemidactylium scutatum*	NM	S3; populations on ORR are the subject of ongoing research	**yes**	**yes**; moist forest and sphagnum in and along all wetlands and slow-moving waterways within project area	**yes**
Mud salamander	*Pseudotriton montanus*	R	populations on ORR are the subject of ongoing research	?	**yes**; headwater streams, seepages, and mucky wetlands throughout project area	**yes**
Arachnids						
A cave spider	*Nesticus paynei/tennesseensis*	R	S3, S2S4	**yes**	**unlikely**; terrestrial cave obligate	**no***
Southeastern cave pseudoscorpion	*Hersperochernes mirabilis*	R	S3	no	**unlikely**; terrestrial cave obligate	**no***
Crustaceans						
cave isopods	*Caecodotea incurva/recurvata*	R	S1, S2	unknown	**yes**; aquatic subterranean	**yes**
Insects						
Cave beetle (multiple species, including one yet to be described)	*Pseudanophthalmus* spp	R	S1–S3	**yes**	**yes**; troglobitic, typically along subterranean streams	**no***

Common Name	Scientific Name	Status	Other Protection Status	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary
Mammals						
Allegheny woodrat	*Neotoma magister*	NM	S3	**yes**	**yes**; outcrops, cliffs, talus slopes, crevices, sinkholes, caves & karst. Observations exist in caves just outside project area.	**probable**
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	NM	S3S4	**yes**	**yes**; caves, hollow trees, abandoned buildings; often associated with forested areas. Calls recorded near site.	**yes**
Gray bat	*Myotis grisescens*	E	see Table F-1	yes	yes	**yes**
Eastern small-footed bat	*Myotis leibii*	NM		yes	yes	**yes**
Little brown bat	*Myotis lucifugus*	T	see Table F-1	yes	yes	**yes**
Northern long-eared bat	*Myotis septentrionalis*	T	see Table F-1	yes	yes	**probable**[†]
Indiana bat	*Myotis sodalis*	E	see Table F-1	yes	yes	**probable**[†]
Tri-colored bat	*Perimyotis subflavus*	T	see Table F-1	yes	yes	**yes**
Southern bog lemming	*Synaptomys cooperi*	NM	S4	**yes** (pre-1995)	**yes**; marshy meadows, wet balds, & rich upland forests (especially in northern and eastern portion of project area).	no
Birds						
Bald eagle	*Haliaeetus leucocephalus*	NM	BCC, BGEPA, FS, BMC, MBTA	breeding habitat	**yes**; breeding pairs have been noted in recent years.	**yes**
Worm-eating Warbler	*Helmitheros vermivorum*	SNR	BCC, BMC, PIF, MBTA	breeding habitat	**yes**	**yes**
Eastern whip-poor-will	*Caprimulgus vociferus*	SNR	BCC, PIF, MTBA	breeding habitat	**yes**	**yes**
Red-headed Woodpecker	*Melanerpes erythrocephalus*	SNR	BCC, PIF	breeding habitat	**yes**	**yes**
Chuck-Will's Widow	*Antrostomus carolinensis*	SNR	PIF, MBTA	breeding habitat	**yes**	**yes**
Wood thrush	*Hylocichla mustelina*	NM	BCC, PIF, BMC, FS, MBTA	breeding habitat	**yes**	**yes**

Common Name	Scientific Name	Status	Other Protection Status	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary
Yellow-bellied sapsucker	*Sphyrapicus varius*	SNR	BCC, BMC, MBTA	breeding habitat	**yes**	**yes**
Yellow-billed Cuckoo	*Coccyzus americanus*	SNR	PIF, MBTA	breeding habitat	**yes**	**yes**
Kentucky Warbler	*Geothlypis formosa*	SNR	BCC, PIF, MBTA	breeding habitat	**yes**	**yes**
Plants						
Spreading False-foxglove	*Aureolaria patula*	SC	S3	**yes**	**yes**, oak woods and edges.	
Pink Lady's-slipper	*Cypripedium acaule*	SC-CE	S4	**yes**	**possible**; piney woods, central portion of project area.	
Appalachian Bugbane	*Cimicifuga rubifolia*	R	S3	**yes**	**yes**; rich woods (especially northeastern portion of project area and west of HPRR Access Rd).	
Canada Lily	*Lilium canadense*	R(T)	S3; monitored as rare for the Oak Ridge Reservation	**yes**	**yes**; rich woods and seeps.	
Goldenseal	*Hydrastis canadensis*	SC-CE	S4	**yes**	**yes**; moist woods with rich soils (especially in shaded valleys in the southern and eastern portions of project area, and west of HPRR Access Rd).	
Ginseng	*Panax quinquefolius*	SC-CE	S3S4	**yes**	**yes**; especially in northeastern portion of project area and west of HPRR Access Rd.	**yes**
Tubercled rein orchid	*Platanthera flava* var. *herbiola*	T	S2	**yes**	**yes**; mucky seeps, swamps, and floodplain throughout project area.	**highly likely**[‡]**;** *Platanthera* spp sprouts observed in project area
White Fringeless Orchid	*Platanthera integrilabia*	E	S2S3	no	**yes;** several seepy, boggy wetlands within the VTR construction area provide ideal habitat for this species.	**possible**[‡]; *Platanthera* spp sprouts observed in project area

Common Name	Scientific Name	Status	Other Protection Status	ORR Historical	Habitat within VTR Project Area	VTR Confirmed Contemporary
October Ladies'-Tresses	*Spiranthes ovalis*	S	SNR	**yes**	**yes**; wet to mesic forests.	
Northern Bush-honeysuckle	*Diervilla lonicera*	T	S2	**yes**	**possible**; rocky woodlands and bluffs.	
Northern White Cedar	*Thuja occidentalis*	SC, R	S3	**yes**	**yes**; calcareous rocky seeps, cliffs (eastern portion of project area).	
Butternut	*Juglans cinerea*	T	S3	**yes**	**yes**; rich woods and hollows.	
Rare Plant Communities						
Northern White Cedar Woodland	*Thuja occidentalis; various species*	R	G2G3, S1	**yes**	no	no
Ridge and Valley Calcareous Mixed Mesophytic Forest	*various species*	R	G3, S3	**yes**	**yes**; but subjected to disturbance.	**yes,** integrity compromised
Other Plant Communities						
Eastern hemlock treatment area	*Tsuga canadensis*	SNR	ORNL focal species; vulnerable in Southeastern US	**yes**	**yes**; site contains 37 treated hemlocks, among the largest diameter hemlocks on the ORR.	**yes**
Reptiles						
Northern pine snake	*Pituophis melanoleucus*	T	S3	**yes**	**yes**; well-drained sandy soils in pine/pine-oak woods.	no
Eastern slender glass lizard	*Ophisaurus attentuatus longicaudus*	NM	S3	**yes**	**yes**; dry upland areas including brushy, cut-over woodlands and grassy fields; fossorial (eastern and central portion of project area).	no
Snails						
Cave thorn snail	*Carychium stygium*	R	S2	no	**yes**; stygobitic, Highland Rim and Cumberland Plateau.	no*
A cave obligate snail	*Helicodiscus notius specus*	R	S1	no	**yes**; troglobitic, Ridge & Valley and Eastern Highland Rim	no*

* Could not confirm due to no known human accessible caves within project area. Does not preclude occurrence.

† Record based on few acoustic monitor detections, but presence is assumed given habitat and nearby records.

‡ Timing of surveys did not permit positive identification, because diagnostic characters are largely absent during spring/early summer.

ORNL FS – ORNL Focal Species for Management and Research

State-listing status codes: SNR – state not ranked; S – Sensitive; R – Rare; NM – In Need of Management; SC – Special Concern; T – Threatened; E – Endangered

REFERENCES

C. Crabtree, D. Gallagher, M. Kidder, D. Outlaw, K. Owens, G. Santee, *Information for Construction and Operation of the Versatile Test Reactor Complex at the Oak Ridge National Laboratory*, VTR-RPT-01, Leidos, August 2020 **(FINAL DRAFT, LEIDOS PROPRIETARY).**

DOE/EA-2014. Environmental Assessment of the Emergency Operations Center Project, US Department of Energy National Nuclear Security Administration, September 2015.

NatureServe 2020a. Anthony's Riversnail (*Athearnia anthonyi*). Accessed: http://explorer.natureserve.org/servlet/NatureServe?searchName=Athearnia%20anthonyi on 13 February 2020.

NatureServe 2020a. Alabama Lampmussel (*Lampsilis virescens*). Accessed: http://explorer.natureserve.org/servlet/NatureServe?searchName=Lampsilis%20virescen on 13 February 2020.

NatureServe 2020c. Finerayed Pigtoe (*Fusconaia cuneolus*). Accessed: http://explorer.natureserve.org/servlet/NatureServe?searchName=Fusconaia%20cuneolus on 13 February 2020.

NatureServe 2020d. Rough Rabbitsfoot (*Quadrula cylindrica strigillata*). Accessed: http://explorer.natureserve.org/servlet/NatureServe?searchName=Quadrula+cylindrica+strigillata on 13 February 2020.

NatureServe 2020e. Shiny Pigtoe (*Fusconaia cor*). Accessed: http://explorer.natureserve.org/servlet/NatureServe?searchName=Fusconaia%20cor on 13 February 2020.

NatureServe 2020f. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Status Definitions. Accessed: http://explorer.natureserve.org/ on 23 January 2020.

Tennessee Wildlife Resources Agency (TWRA) 2020a. Gray Bat, Myotis Federally Endangered Accessed: https://www.tn.gov/twra/wildlife/mammals/mammals-bats/gray-bat.html on 13 February 2020.

Tennessee Wildlife Resources Agency (TWRA) 2020b. Indiana, Myotis Federally Endangered. Accessed: https://www.tn.gov/twra/wildlife/mammals/mammals-bats/indiana-bat-myotis.html on 13 February 2020.

Tennessee Wildlife Resources Agency (TWRA) 2020c. Norther Long-eared Bat, Myotis. Accessed: https://www.tn.gov/twra/wildlife/mammals/mammals-bats/northern-long-eared-bat.html on 13 February 2020.

TWRA 2016. Tennessee Wildlife Resources Agency. Proclamation 1660-01-32, Endangered and Threatened Species. Accessed: https://www.tn.gov/content/dam/tn/twra/documents/1660-01-32%20threatened-endangered-species-rule.pdf on 23 January 2020.

US Fish and Wildlife Service (USFWS) 1997. Fanshell (*Cyprogenia stegaria*). Accessed: https://www.fws.gov/midwest/endangered/clams/fansh_fc.html on 13 February 2020.

USFWS 2000. Blackside Dace (*Phoxinus cumberlandensis*). Accessed: https://www.fws.gov/northeast/virginiafield/pdf/endspecies/fact_sheets/blackside%20dace.pdf on 13 February 2020.

USFWS 2008. Birds of Conservation Concern 2008. Accessed: https://ecos.fws.gov/ServCat/DownloadFile/134745 on 16 March 2020.

USFWS 2010a. Dromedary Pearly mussel (*Dromus dromas*). Accessed: https://www.nrc.gov/docs/ML1219/ML12192A110.pdf on 13 February 2020.

USFWS 2010b. Purple Bean (*Villosa perpurpurea*). Accessed: https://www.fws.gov/northeast/pdf/Purple_bean_1010.pdf on 13 February 2020.

USFWS 2015a. Spotfin chub (*Erimonax monachus*). Accessed: https://www.fws.gov/asheville/htmls/listed_species/Spotfin_chub.html on 13 February 2020.

USFWS 2015b. Virginia spiraea (*Spiraea virginiana*). Accessed: https://www.fws.gov/southeast/wildlife/plants/virginia-spiraea/ on 13 February 2020.

USFWS 2016. White fringeless orchid (*Platanthera integrilabia*). Accessed: https://www.fws.gov/cookeville/Whitefringelessorchid.html on 13 February 2020.

USFWS 2019a. Pink Mucket (*Lampsilis orbiculata*). Accessed: https://www.fws.gov/midwest/endangered/clams/pinkmucket/pinkm_fc.html on 13 February 2020.

USFWS 2019b. Cracking Pearlymussel (*Hemistena lata*). Accessed: https://www.fws.gov/midwest/endangered/clams/crack_fc.html on 13 February 2020.

USFWS 2019c. Orange-Footed Pearly Mussel (*Plethobasus cooperianus*). Accessed: https://www.fws.gov/midwest/endangered/clams/orang_fc.html on 13 February 2020.

USFWS 2019d. Ring Pink (*Obovaria retusa*). Accessed: https://www.fws.gov/midwest/endangered/clams/orang_fc.html on 13 February 2020.

USFWS 2019e. Rough Pigtoe (*Pleurobema plenum*). Accessed: https://www.fws.gov/midwest/endangered/clams/rough_fc.html on 13 February 2020.

USFWS 2019f. Sheepnose (*Plethobasus cyphyus*). Accessed: https://www.fws.gov/midwest/endangered/clams/sheepnose/ on 13 February 2020.

USFWS 2019g. Spectaclecase (*Cumberlandia monodonta)*. Accessed: https://www.fws.gov/midwest/endangered/clams/spectaclecase/SpectaclecaseFactSheet.html on 13 February 2020.

USFWS 2019h. White Wartyback (*Plethobasus cicatricosus*). Accessed: https://www.fws.gov/midwest/endangered/clams/warty_fc.html on 13 February 2020.

APPENDIX G. OFFSITE INTERFACE AGREEMENTS

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Due to the multiple sites and multiple contractors located within the Oak Ridge area, the majority of the Memoranda of Understanding (MOUs), Memoranda of Agreements (MOAs), and Mutual Aid Agreements (MAAs) that involve Oak Ridge National Laboratory (ORNL) are developed based on an area concept as opposed to a facility concept. The DOE Consolidated Service Center (CSC) is responsible for the MOU/MOA program. In addition, there is also an agreement between Consolidated Nuclear Security, LLC, and UT-Battelle, LLC, for fire protection assistance. All agreements are maintained in the *United States Department of Energy Oak Ridge Reservation Memoranda of Understanding and Memoranda of Agreement*. A summary of each agreement is provided below.

SECURITY MEMORANDA OF UNDERSTANDING

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Anderson County Sheriff's Department.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Knox County Sheriff's Department.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Loudon County Sheriff's Department.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Loudon County Emergency Communications District 911 Center.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Oak Ridge Police Department.***

*Memorandum of Agreement Among the US Department of Energy Oak Ridge, the National Nuclear Security Administration Production Office, and the **Office of Secure Transportation.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Roane County Sheriff's Office.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Roane County Emergency Communications District 911 Center.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Tennessee Emergency Management Agency.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Tennessee Highway Patrol.***

*Memorandum of Understanding Among the US Department of Energy – Oak Ridge, the National Nuclear Security Administration Production Office, and the **Tennessee Wildlife Resource Agency.***

Purpose: Security and law enforcement support while protecting special nuclear material and other national security assets, people, equipment, and property located on the Oak Ridge Reservation *(same or very similar for all Security MOAs).*

Signed by: NNSA Production Office, ORNL Site Office, Oak Ridge Office of Environmental Management, Oak Ridge Office (except for agreement with Office of Secure Transport which is only signed by NPO and Oak Ridge Office)

MUTUAL AID AGREEMENTS

Mutual Aid Agreement ***Emergency Ambulance Service East Tennessee Region***

Purpose: Includes the US Department of Energy – Oak Ridge National Laboratory into the State of Tennessee, Department of Health, mutual aid agreement for emergency ambulance service in the East Tennessee Region's 16 counties – Anderson, Blount, Campbell, Claiborne, Cocke, Grainger, Hamblen, Jefferson, Knox, Loudon, Monroe, Morgan, Roane, Scott, Sevier, and Union.

Signed by: ORNL Site Office

Mutual Aid Ambulance Service Agreement Among the US Department of Energy Oak Ridge National Laboratory Site Office, the National Nuclear Security Administration Production Office, and ***Anderson County***

Purpose: Establishes the terms and conditions by which any party in the agreement may request ambulance aid from the other in a response that exceeds available resource capabilities.

Signed by: NNSA Production Office, ORNL Site Office, Anderson County

Mutual Aid Fire Protection Agreement between the ***City of Oak Ridge****, the US Department of Energy Oak Ridge National Laboratory Site Office, and the National Nuclear Security Administration Production Office*

Purpose: Provides mutual assistance in fire protection support, broadly defined as emergency services, including fire response, hazardous materials response, emergency medical services, and/or rescue services provided by qualified, fire department personnel.

Signed by: NNSA Production Office, ORNL Site Office, Oak Ridge City Manager

MEMORANDUM OF UNDERSTANDING FOR WILDLAND FIRE FIGHTING

Memorandum of Understanding for Wildland Fire Fighting Among U.S. Department of Energy Oak Ridge Office, the National Nuclear Security Administration Production Office and the State of Tennessee, Department of Agriculture, Division of Forestry

Purpose: Describe the wildland fire fighting support that will be provided by the State of Tennessee, Department of Agriculture, Division of Forestry, should a wildland fire occur that requires firefighting resources in excess of those maintained by the DOE or the NPO on the Oak Ridge Reservation.

Signed by: NNSA Production Office, ORNL Site Office, Oak Ridge Office of Environmental Management, Oak Ridge Office, State of Tennessee Department of Agriculture

OTHER

*Mutual Aid Fire Protection Agreement between the **Consolidated Nuclear Security, LLC,** and UT-Battelle, LLC*

Purpose: Provides mutual assistance in fire protection support, broadly defined as emergency services, including fire response, hazardous materials response, emergency medical services, and/or rescue services provided by qualified, fire department personnel.

Signed by: ORNL Facilities and Operations Directorate, Y-12 Safeguards, Security and Emergency Services

*Agreement between the US Department of Energy and the **State of Tennessee for Emergency Management Coordination***

Purpose: Documents how DOE, including NNSA and Tennessee Emergency Management Agency, will carry out emergency management activities, including cooperative planning, joint training and exercises, and public education.

Signed by: NNSA Production Office, Oak Ridge Office, State of Tennessee Department of the Military

APPENDIX H. METEOROLOGY

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Meteorological and Atmospheric Mixing: Supporting Figures and Details

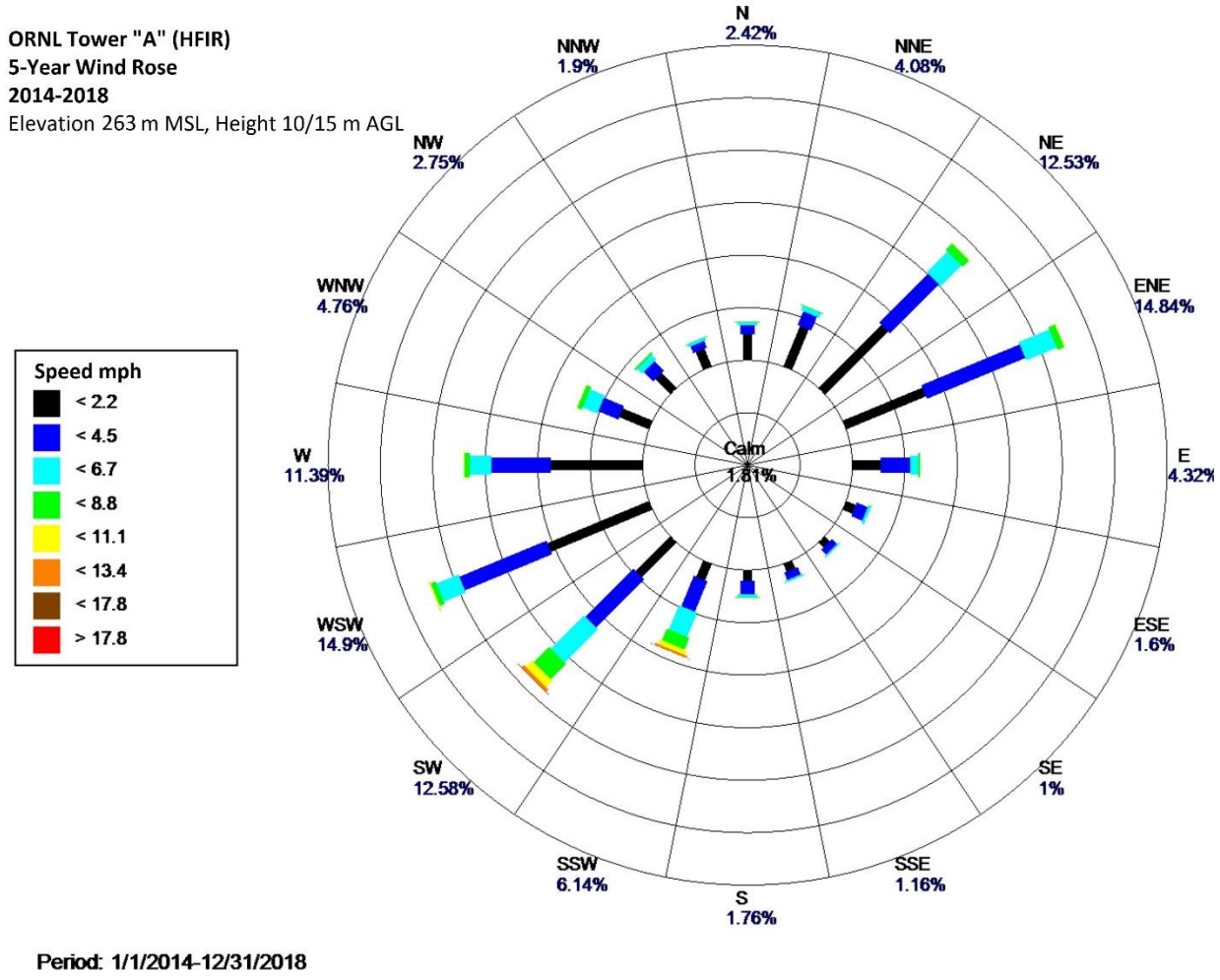

Figure H-1. HFIR Tower A 5-year wind rose, 2014–2018, height 10/15 m AGL.

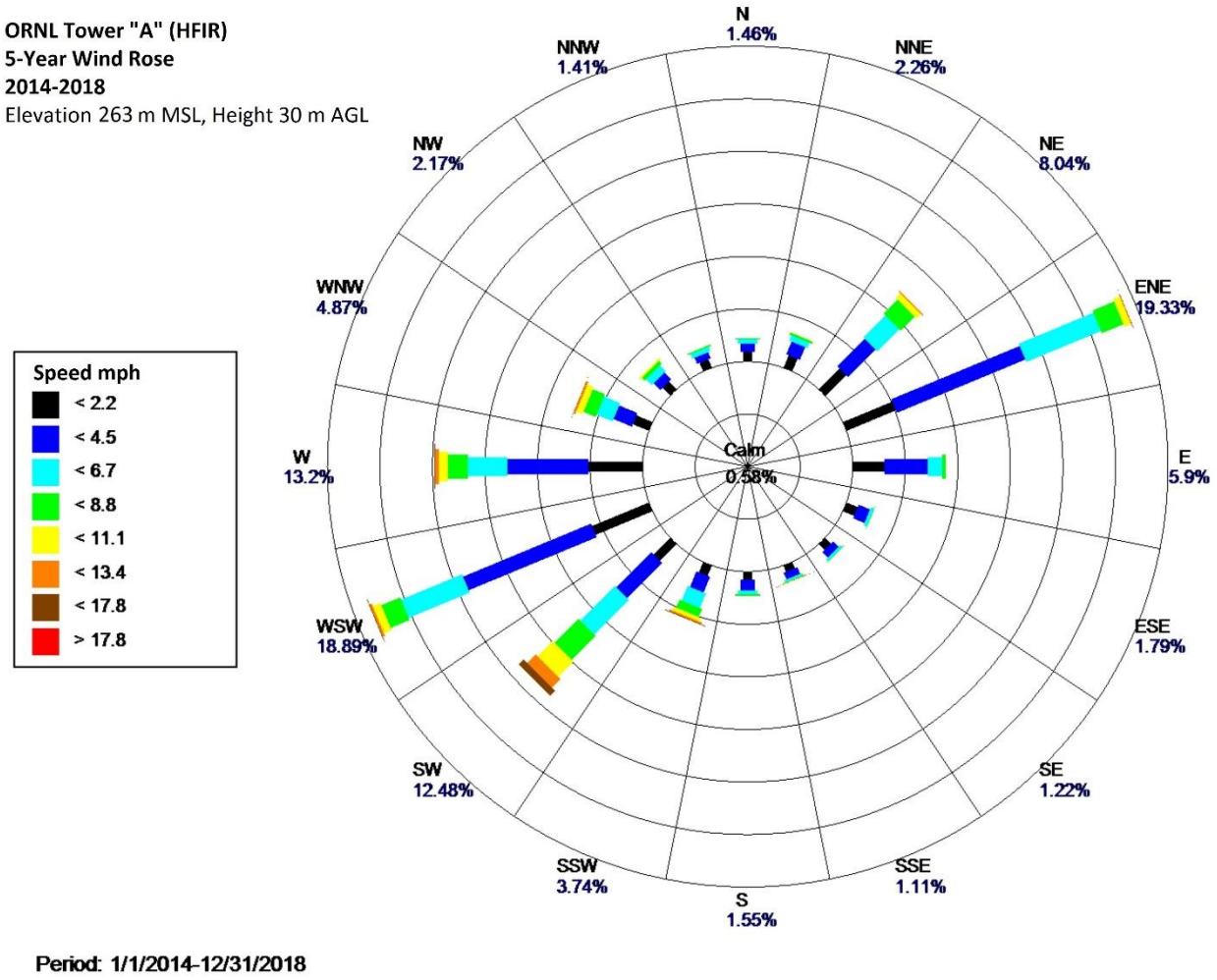

Figure H-2. HFIR Tower A 5-year wind rose, 2014–2018, height 30 m AGL (continued).

APPENDIX I. WILDFIRE FUELS MAP

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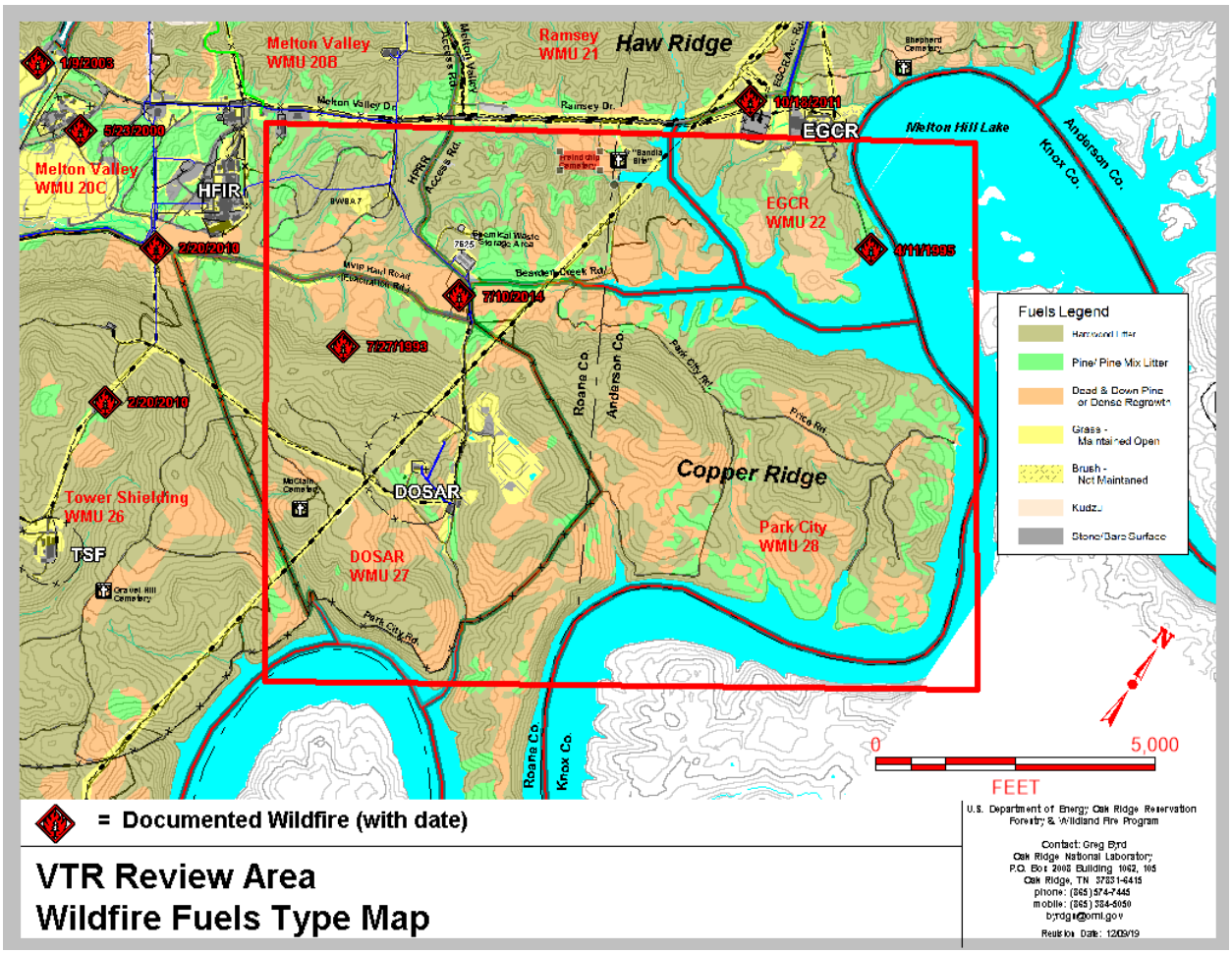

Figure I-1. Wildfire fuels map.

APPENDIX J. FOREST COVER MAP

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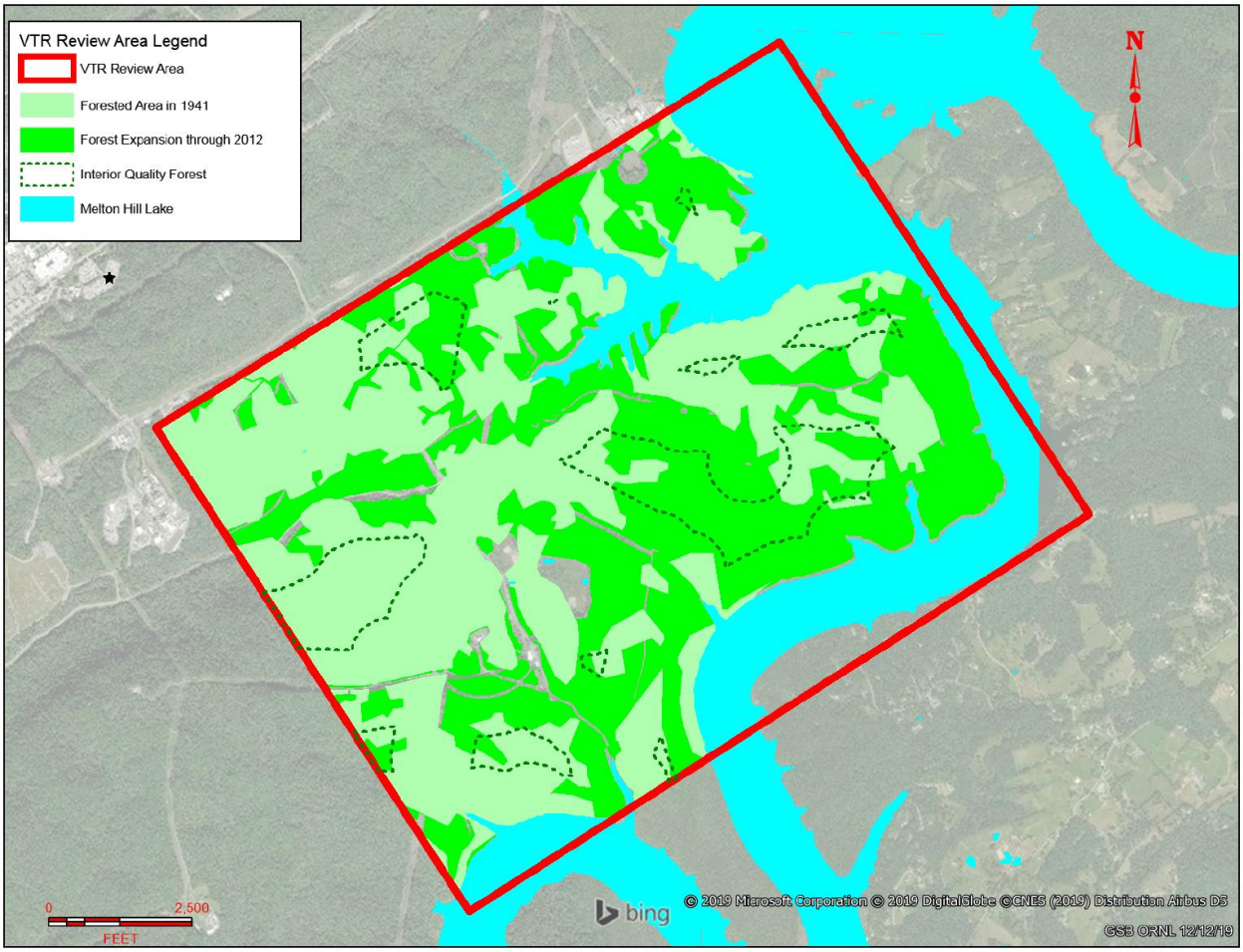

Figure J-1. Forest cover map.