ENERGY NORTHWEST

Subsurface Investigation Approach

Xe-100 Project on Former WNP-1 Site

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Agenda

- Background and Purpose of Meeting
- Regulatory Foundation – Subsurface Investigation
- Site History Former WNP-1
- Geologic and Hydrologic Investigation
- Comprehensive Resource Analysis
- Summary

Background and Purpose of Meeting

- Follow-up from January 19, 2022 meeting with DOE-EM, DOE-NE, NRC, XE, EN – path forward on WNP-1 site characterization for XE-100 Advanced Reactor Development Program (ARDP) Project
- Subsurface investigations (core boring, well drilling) understood to be necessary to support construction permit application (CPA) dependent on DOE written authorization
- DOE written authorization dependent on meeting National Environmental Policy Act (NEPA) requirements – resolution for application of NEPA to subsurface investigations being evaluated
- A few options for resolution are being considered:
  - Determine if NEPA Categorical Exclusion criteria could apply for site characterization work
  - Determine if additional subsurface investigations (core boring/well drilling) are necessary for the CPA since site was previously licensed for nuclear construction (purpose of today's meeting)

Regulatory Foundation - Subsurface Investigations

- Appendix A to 10 CFR 50, GDC II – Design Basis for Protection Against Natural Phenomena
  - Assessment of the potential impact of natural phenomena affecting the site is necessary to support a determination of adequacy of plant design and operation (*same in RG 1.232 for mHTGR designs*)
- 10 CFR 100 Reactor Site Criteria
  - All seismic and geologic factors that may affect design/operation of proposed plant must be investigated
- Reg Guide 1.132, Sect C.4, Detailed Site Investigation
  - Number and depths of core borings/ground water monitoring criteria established
- Reg Guide 1.208, Sect C.1, Geological, Geophysical, Seismological, and Geotechnical Investigation
  - Comprehensive site area and regional investigations should be conducted to support performance-based approach to site specific earthquake ground motion
- NUREG/CR-5378, Field Investigations for Foundations of Nuclear Facilities
  - The depth, layout, spacing of sampling borings, and sampling requirements for a site study depends on the subsurface requirements of the foundation

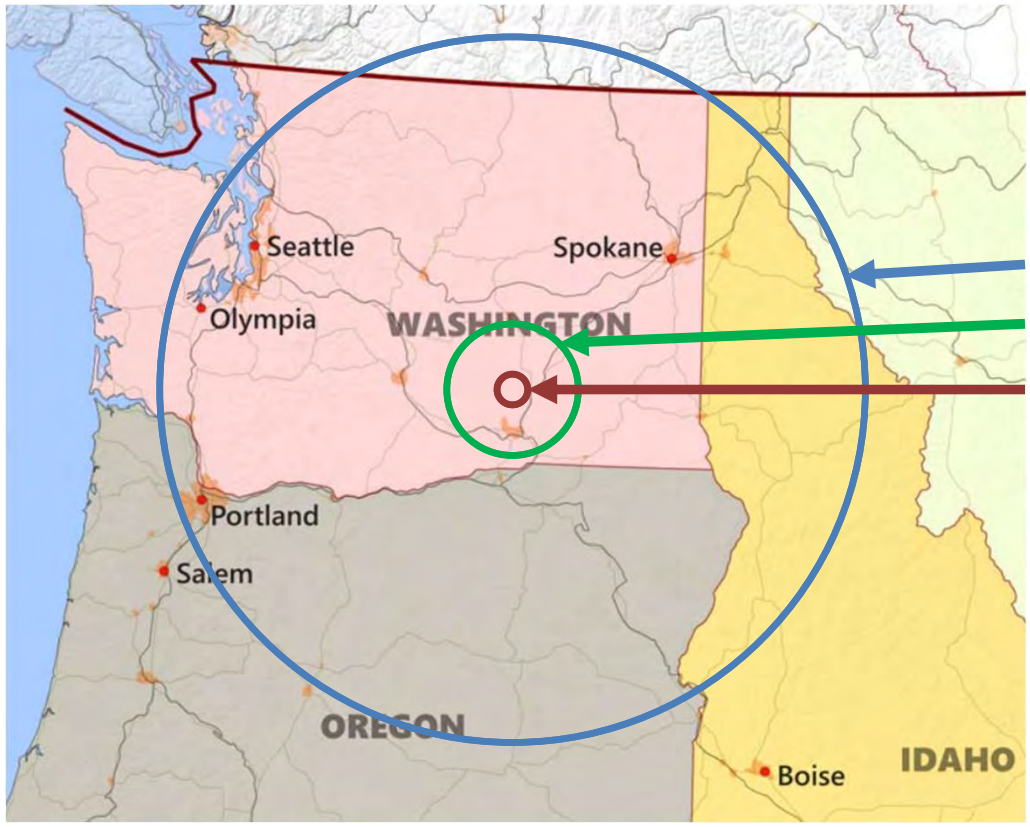
(Also, RG 4.2, 4.7, NUREG-1555, etc.)

Site History Former WNP-1 (Docket 50-460)

WNP-1 in the foreground - Columbia Generating Station (WNP-2) in the background

- July 1973 – Construction permit application submitted
- May 1975 - NUREG 75-036 Safety Evaluation Report issued
- Dec 1975 - Construction Permit CPR-134 Issued
- Jun 1980 – Final Safety Analysis Report (FSAR) Submitted
- Apr 1982 – Construction stopped (65% complete)
- May 1994 - Project formally terminated
- Feb 2007 – Construction Permit CPR-134 terminated

Geologic and Hydrologic Investigation



Seismology, Geology, Meteorology, Hydrology

Site Region (radius of 200 miles)

Site Vicinity (radius of 25 miles)

Site Area (radius of 5 miles)

Geologic and Hydrologic Investigation

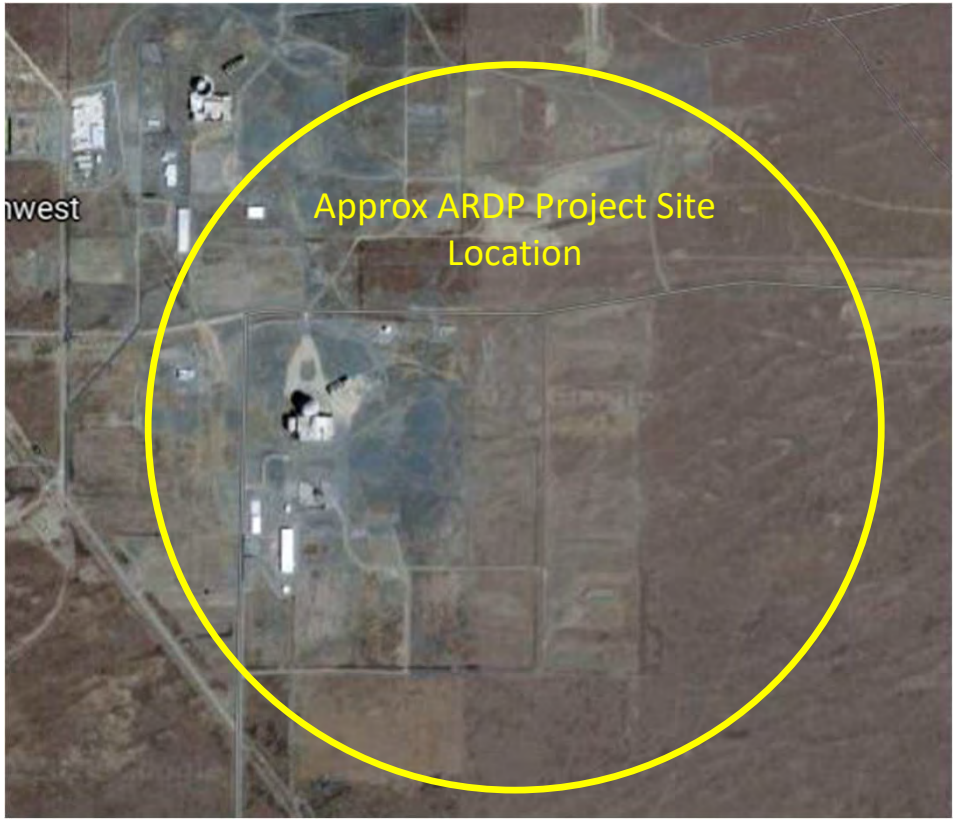
Site Location (radius of 0.6 miles/1 km)

RG 1.132, Appendix D

- *For favorable, uniform geologic conditions, where continuity of subsurface strata is found, the recommended spacing is as indicated for the type of structure.*
- *At least three borings should be at locations within the footprint of every safety-related structure, unless other reliable information is available in the immediate vicinity or otherwise justifiable.*

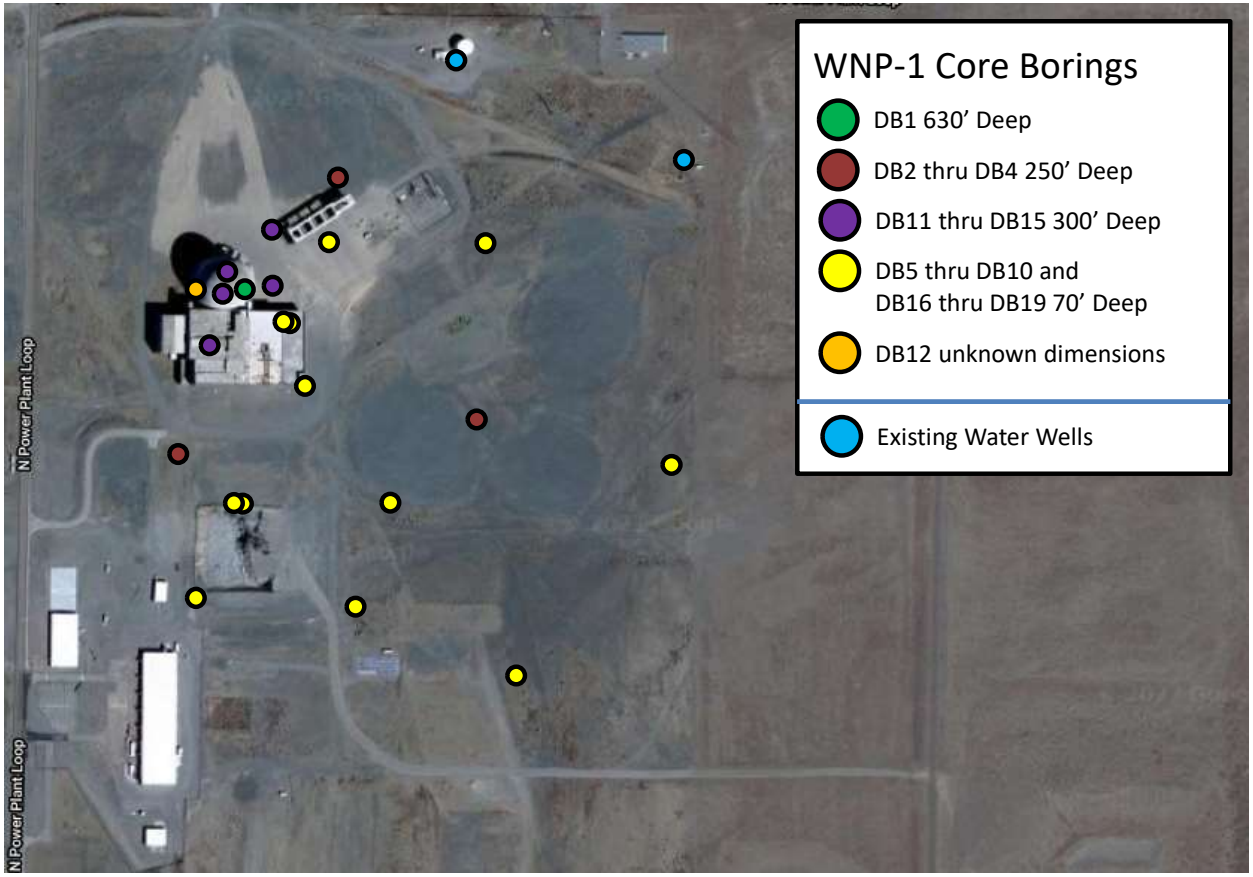
RG 1.132, Section C.5

- *Ground water observation wells should be installed in as many locations as needed to adequately define the ground water environment.*



Geologic and Hydrologic Investigation

Initial site-specific Core Boring documented and submitted in WNP-1 FSAR



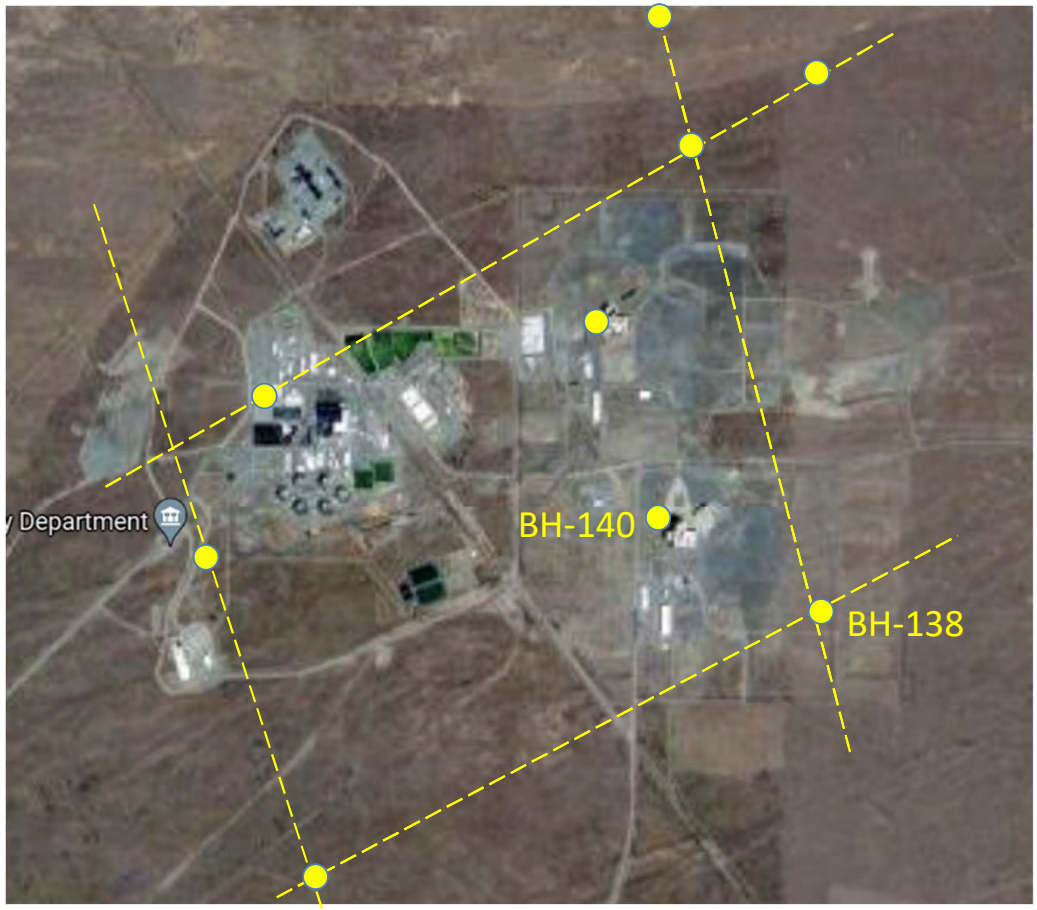
Geologic and Hydrologic Investigation

Additional WNP Project Boreholes

Pictured are approximate locations of 9 deep hole core borings (567’-947’) documented and submitted in WNP-2 (Columbia) FSAR Appendix 2.5B

Boreholes BH-138 and BH-140 are closest to ARDP project

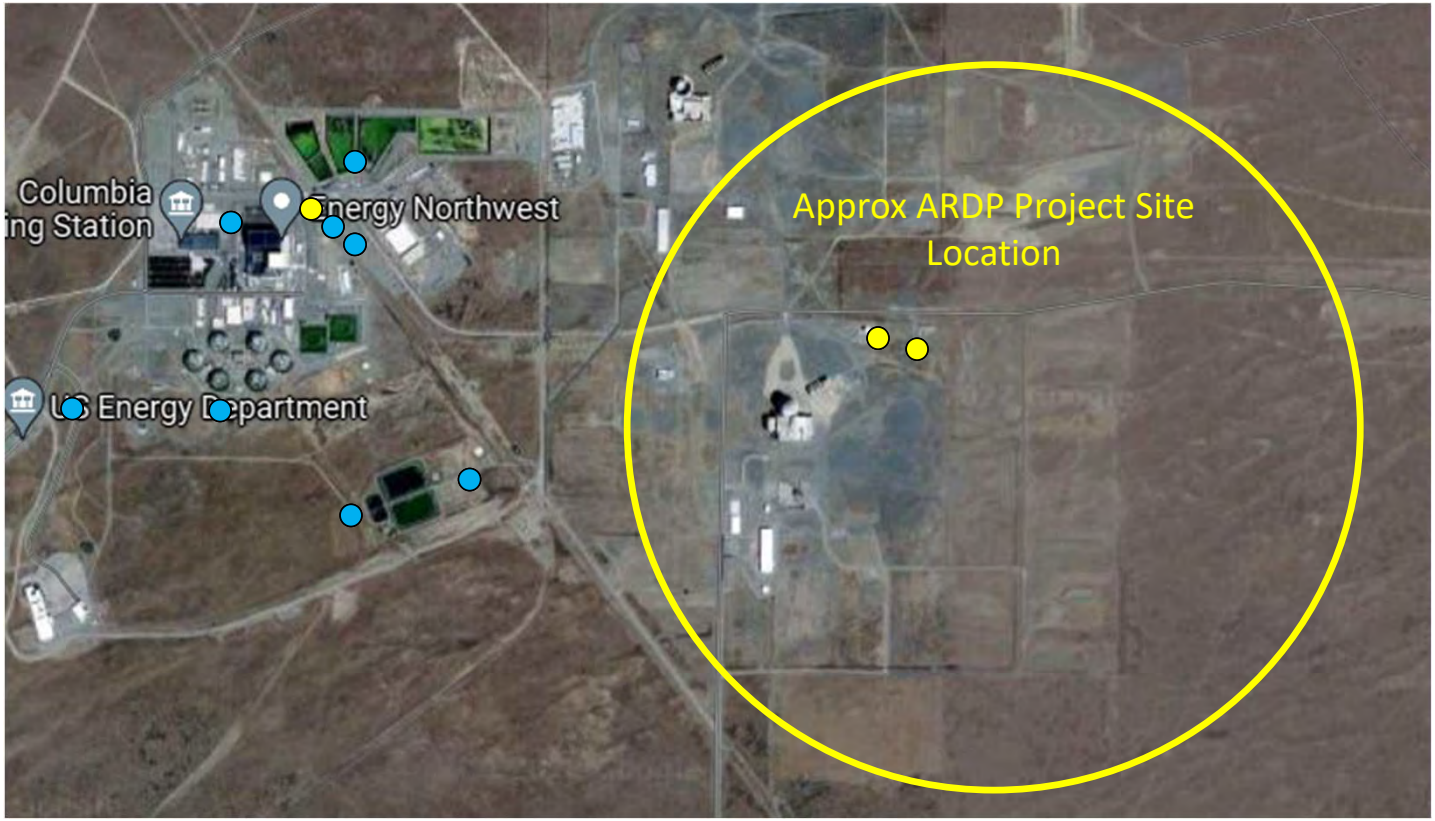
Borehole	BH-138	BH-140
Borehole Elevation	454’	441’
Basalt Elevation	-22’	-24’
Total Depth of borehole	886’	656’



Geologic and Hydrologic Investigation

Monitoring Wells

- Deep Well (>400 ft)
- Shallow Well (<100 ft)



Comprehensive Resource Analysis Environmental Report (ER)

- Land Use
- Water
  - Surface Water
  - Groundwater*
  - Hydrology, Use, Water Quality
- Ecology
  - Terrestrial
  - Aquatic
  - Important/Sensitive Species and Habitats
  - Essential Fish Habitat
- Meteorology and Air Quality
  - Regional Climatology
  - Local Meteorology
  - Short/Long Term Diffusion Est
- Socioeconomics
  - Demographics
  - Community Facilities
  - Economics
  - Transportation
  - Noise
  - Historic and Cultural Resources
  - Environmental Justice
- Solid and Hazardous Wastes
- Radioactive Waste Management
- Radiological Health
- Non-radiological Health
- Uranium Fuel Cycle
- Geology*

*see subsequent slides for additional discussion/approach

Comprehensive Resource Analysis - ER

- **Information of Record (all environmental resources, extensive)**
  - Hanford Reservation data sets and reports
  - FSAR WNP-1 and WNP-4, Columbia Generating Station (CGS) license renewal, National Pollutant Discharge Elimination System permitting studies, CGS Radiological Environmental Monitoring Program monitoring, Hanford/CGS water quality monitoring, etc.
  - Publicly available data sources
- **Supplemented with onsite field studies**
  - “Standard Operating Procedures” and “Quality Assurance Project Document”
  - Quarterly terrestrial ecology (pedestrian surveys) (in progress)
  - Wetland/”waters of the US” field review (completed)
  - Cultural resources pedestrian review (completed)

Comprehensive Resource Analysis - ER

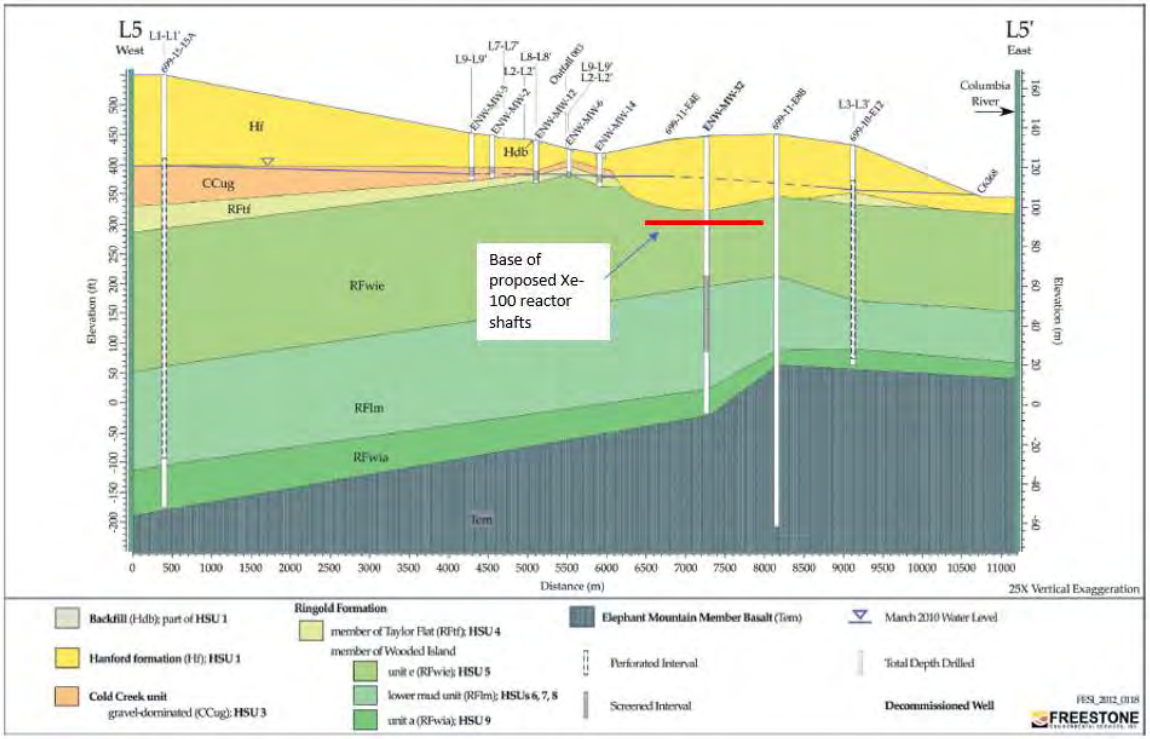
- **Supplemental site-specific data that is NOT available due to DOE restrictions on subsurface investigations**
  - Groundwater levels (monthly) and physical parameters
  - Groundwater quality (quarterly)
  - Geotechnical data
- **All supplemental studies are being conducted under current EN terms of lease**

Comprehensive Resource Analysis - ER

Characterization of Affected Environment—Groundwater

- **Physical characteristics:**
  - Aquifer characteristics
  - Groundwater contours, potentiometric surfaces
  - Properties (hydraulic gradients, permeabilities, etc.)
- **Data sources examples:**
  - Hanford regional groundwater model/reports
  - CGS groundwater mounding model/report
  - WNP-1 and WNP-4 FSAR
  - CGS OL FSAR

East-West Cross Section



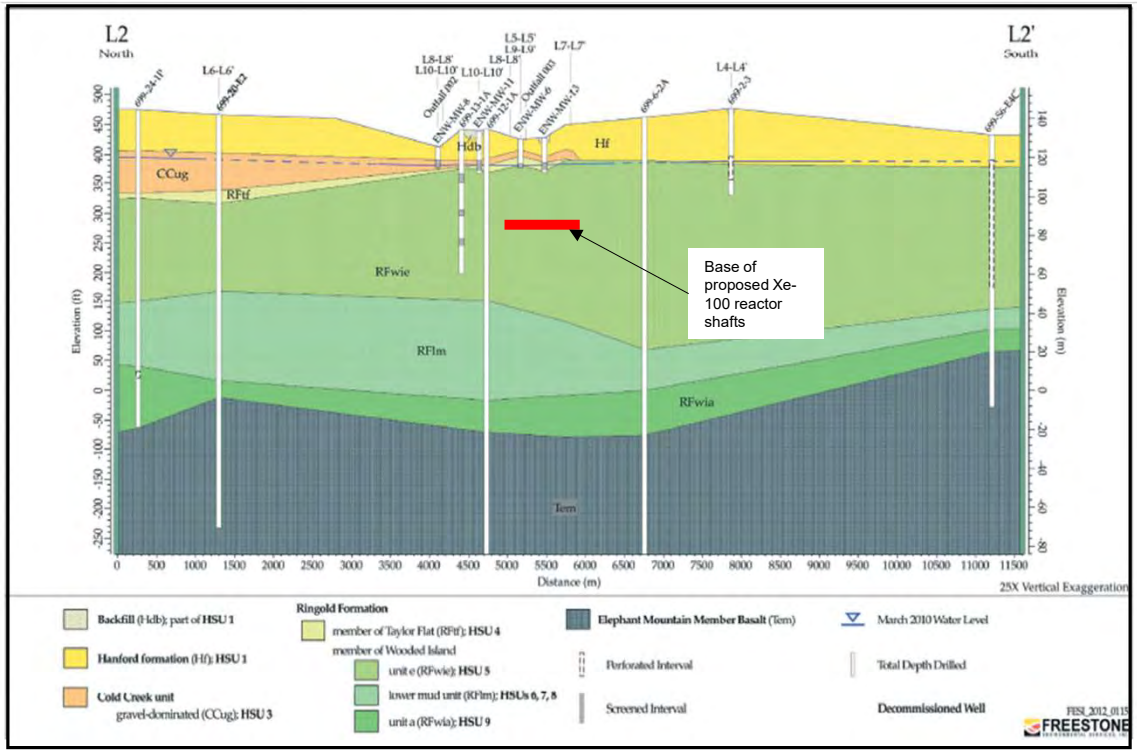
Note: Existing wells are not screened in proper formations related to the reactor shaft

Comprehensive Resource Analysis - ER

Characterization of Affected Environment—Groundwater

- **Water Quality Characteristics**
  - Parameters per NUREG 1555
  - Other site-specific parameters
- **Data source examples:**
  - Hanford regional groundwater quality data: https://www.hanford.gov/page.cfm/EnvironmentalDataAccess
  - CGS groundwater quality data
  - Freestone, 2012 (CGS Groundwater quality study report)
- **Several gaps in recommended water quality parameters in NUREG 1555**
- **Documentation of contaminant plumes in vicinity and region**

North-South Cross Section



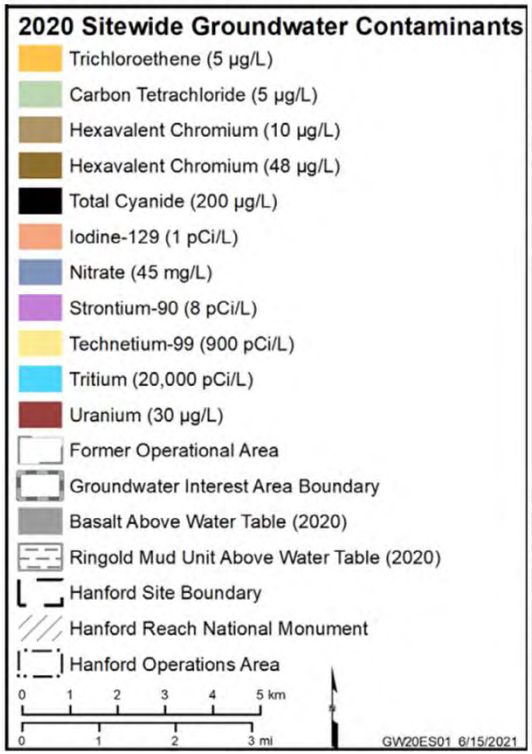
Note: Existing wells are not screened in proper formations related to the reactor shaft

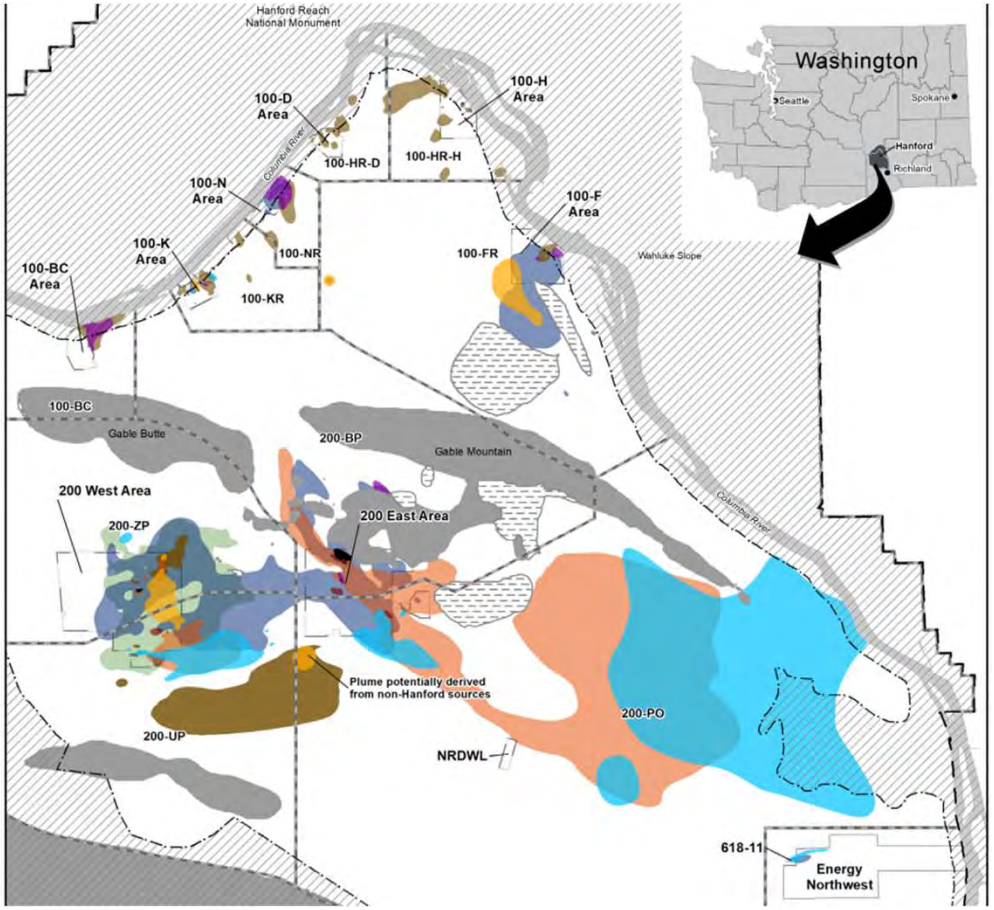
Comprehensive Resource Analysis - ER

Hanford Site Contaminant Plumes

Hanford Annual Site Environmental Report for Calendar Year 2020

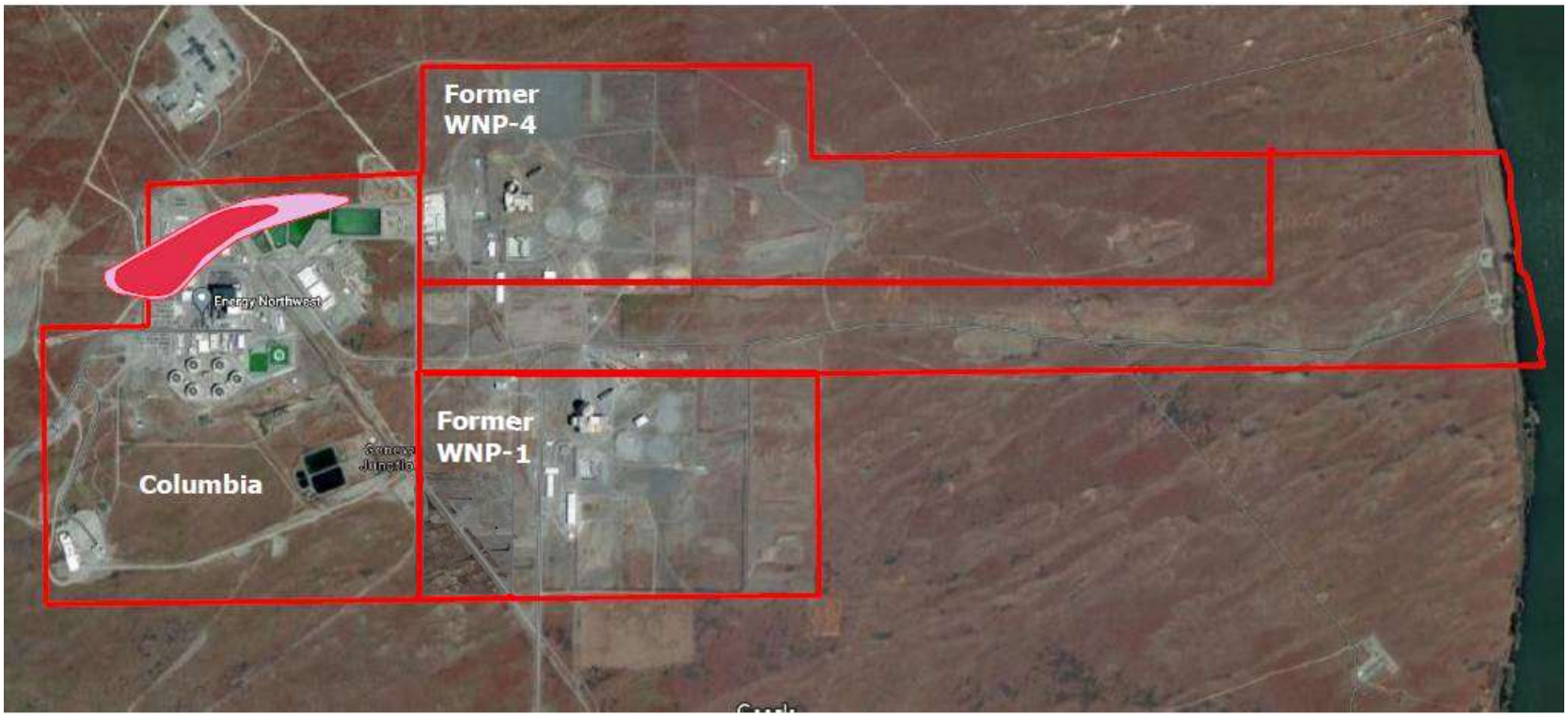
DOE/RL-2021-15





Comprehensive Resource Analysis - ER

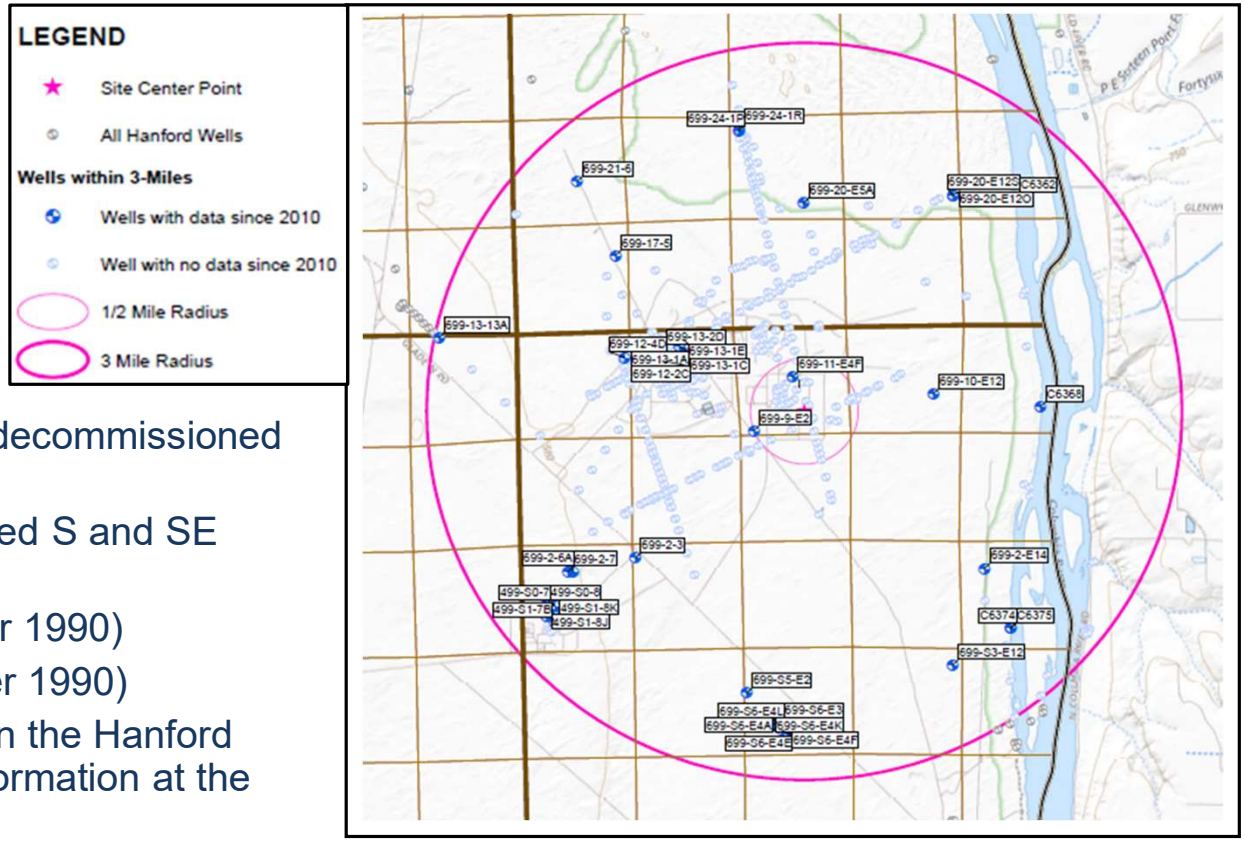
618-11 Burial Ground Tritium Plume



Comprehensive Resource Analysis - ER

Characterization of Affected Environment—Groundwater

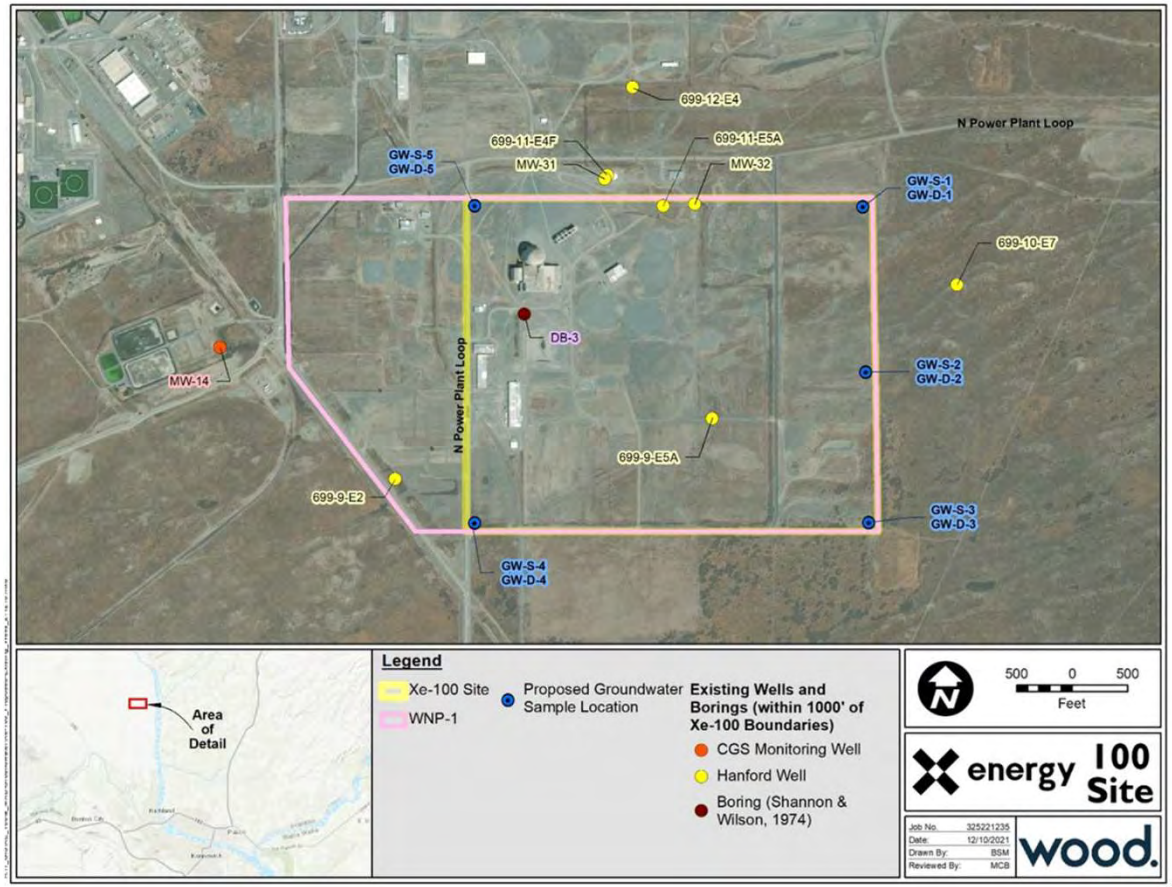
- **Wells at CGS**
- **Wells in Hanford Database**
- **Wells in 3-mile radius**
  - 668 total wells in 3-mile radius
  - 38 wells with data since 2010 (others decommissioned or no recent data)
  - 17 with potentially usable data (excluded S and SE wells, basalt wells, “C” wells on river)
  - 8 possible Ringold Fm.(1 installed after 1990)
  - 9 shallow groundwater (5 installed after 1990)
  - Note: existing wells are not screened in the Hanford Formation or the part of the Ringold Formation at the base of the reactor shaft



Comprehensive Resource Analysis - ER

Proposed Well Installation Plan

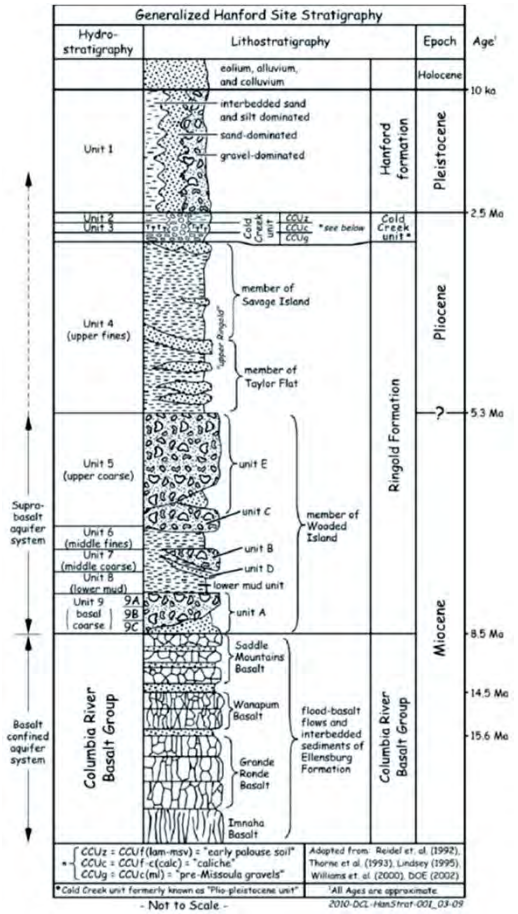
- **Well Installation Plan already developed**
- **Implementation of Well Installation Plan following issuance of Xe-100 Construction Permit**
  - 5 well pairs
  - Shallow wells: target “first water” (70-100’)
  - Deep wells: target base of reactor shafts (~140’)
  - Install under Appendix B
  - Water levels and water quality
- **Implementation of monitoring plan in support of construction, operation and decommissioning**



Comprehensive Resource Analysis - Geotech

Characterization of Affected Environment - Geology

- **Regional geology well understood**
- **Site geology obtained from prior information of record:**
  - WNP-1/4 FSAR
  - CGS FSAR
  - Soil properties (permeabilities or transmissivities, storage coefficients or specific yields, total and effective porosities, clay content, and bulk densities)
- **ER to include continuity with information from Xe-100 PSAR**



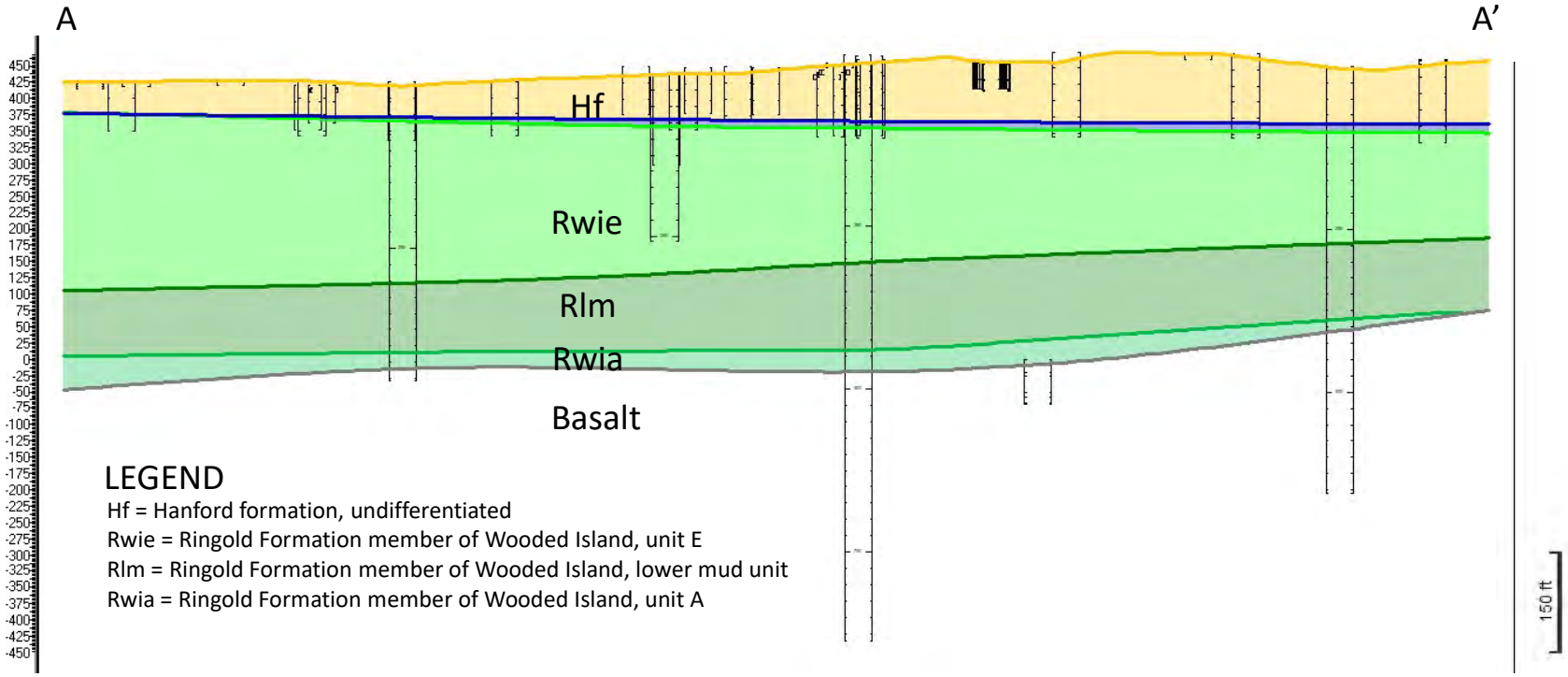
Comprehensive Resource Analysis - Geotech

Characterization of Affected Environment - Geology

Cross-section of subsurface characterization and geologic interpretation* based on historic core borings

*Extract from DOE's Hanford South Geologic Framework Model *Kingdom*™ Geologic Software

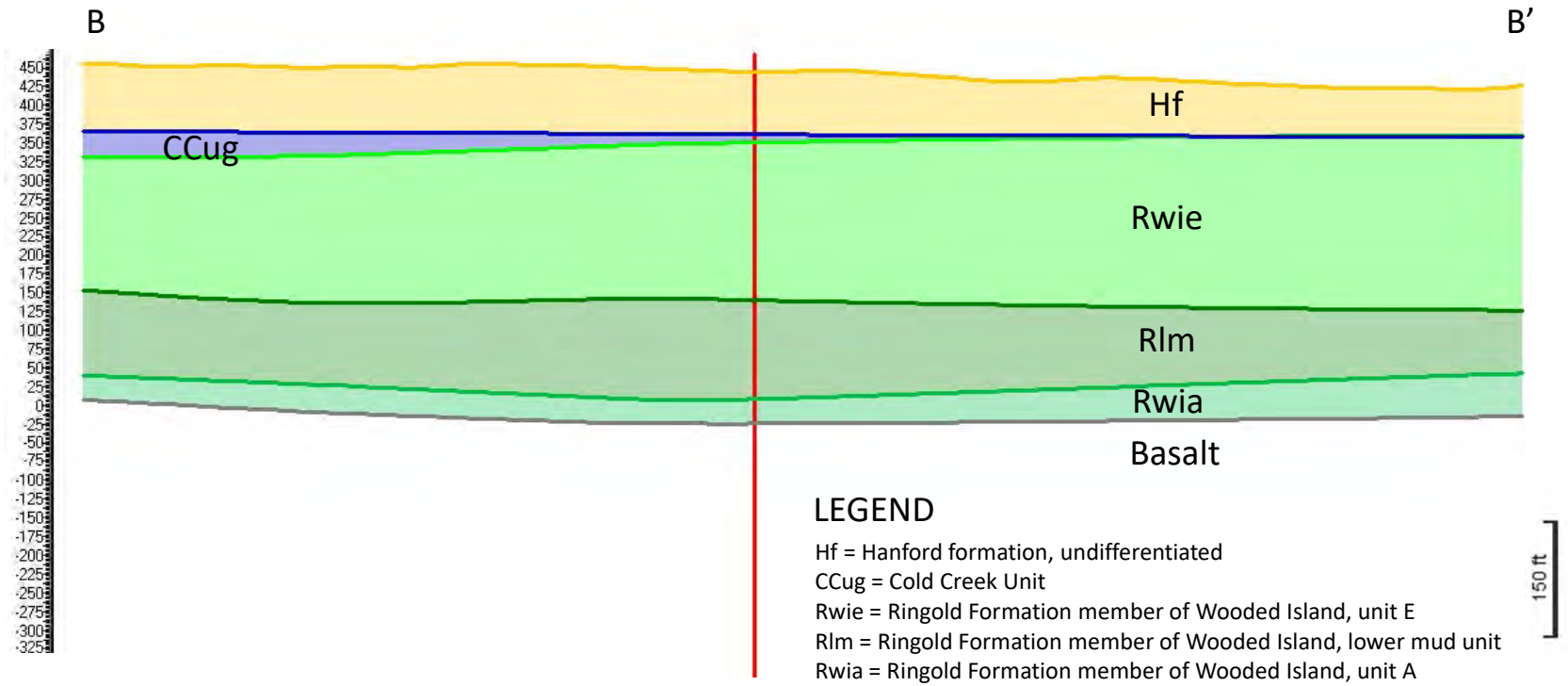
Comprehensive Resource Analysis - Geotech



LEGEND

Hf = Hanford formation, undifferentiated
Rwie = Ringold Formation member of Wooded Island, unit E
Rlm = Ringold Formation member of Wooded Island, lower mud unit
Rwia = Ringold Formation member of Wooded Island, unit A

Comprehensive Resource Analysis - Geotech



Intersection with A-A' cross section

Comprehensive Resource Analysis - Geotech

Characterization of Affected Environment - Geology

Relative Uniformity

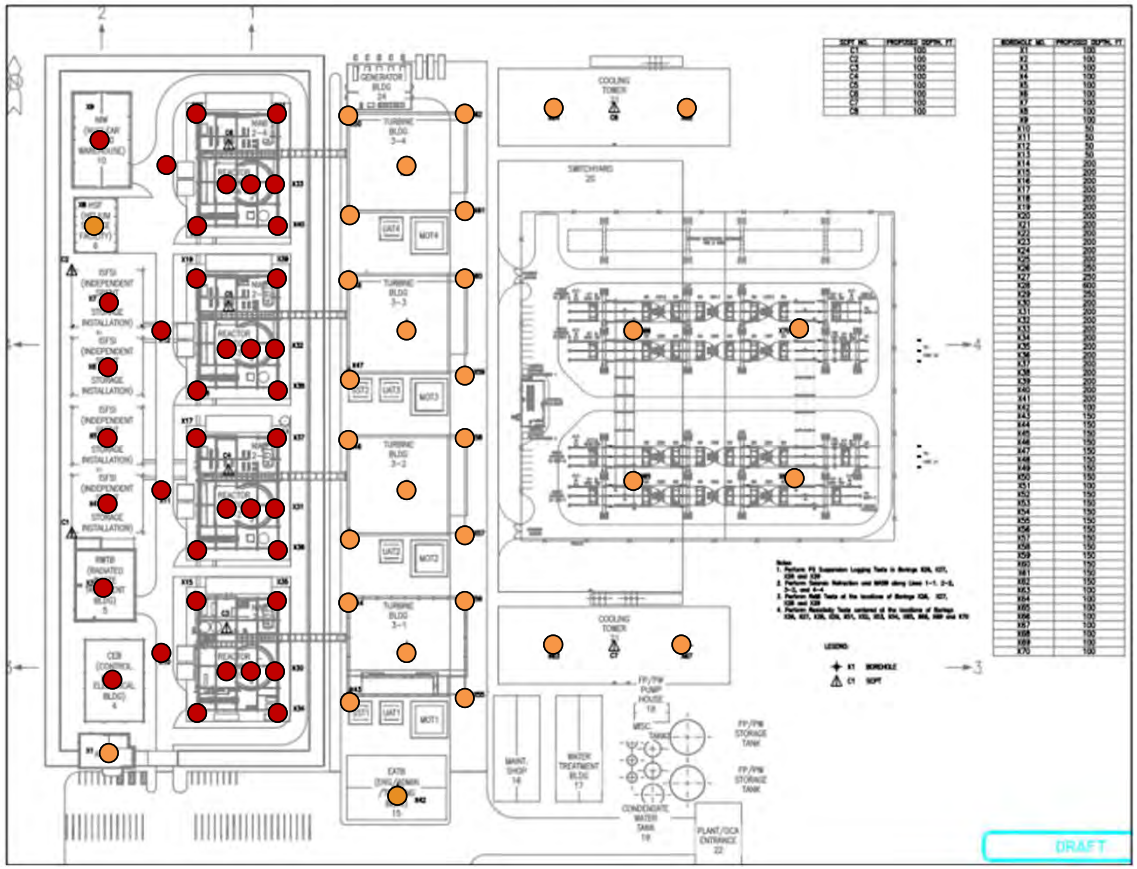
- Subsurface profiles indicate relatively uniform strata thicknesses across the WNP-1/4 area
- Boring logs indicate relatively consistent soil densities and composition
- Available data should be suitable to develop a PSAR for the Xe-100 located on the WNP-1 site

It is noted that subsurface explorations and laboratory testing will be conducted in accordance with NRC RG 1.132 to confirm the preliminary design basis evaluations and findings that will be presented in the PSAR. These data should be incorporated into the design basis during final structural design and prior to construction.

Comprehensive Resource Analysis - Geotech

Proposed Core Boring Plan

- **Proposed Core Boring Plan already developed**
  - Upwards of 70 core borings per 4-unit facility
  - Proposed safety significant borings
  - Capital investment protection
- **Implementation of plan following issuance of Xe-100 Construction Permit**
- **Safety significant borings will be used to confirm previous understandings of site characteristics**



Summary

- **Construction Permit Application**
  - Seismic, geologic, and hydrologic factors for the site region, vicinity, area, and location are well understood
  - Subsurface investigation information requirements (geologic and groundwater) will be supported by numerous historical and recent evaluations without any further subsurface investigations at this time
- **Operating License Application**
  - Plans for core boring and well drilling have been developed and would be used to validate previously understood information
  - Implementation of these plans would follow completion of applicable NEPA reviews