Utilizing the Nuclear Energy Institute (NEI) 07-07 Industry Groundwater Protection Initiative as a Foundation for Addressing Subsurface Site Assessments

USNRC 2nd Annual Public Workshop on Subsurface Investigations – Via MS Teams May 11th, 2022

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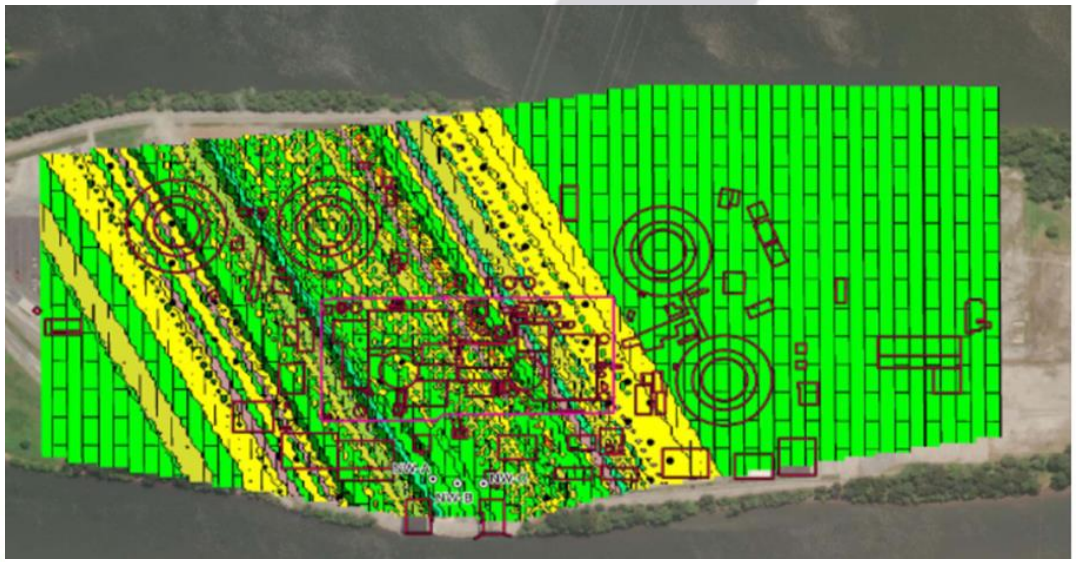

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Outline

- Recap of graded approach to subsurface characterization (July 2021 Workshop)
  - Triad and graded approach at nuclear sites
  - Use of a Conceptual Site Model (CSM)
- NEI's 07-07 Groundwater Protection Initiative
  - Scope (subsurface investigations/decommissioning)
  - Hydrogeologic CSM within the 07-07 Framework
  - 07-07 GWMP Objectives to address and plan subsurface site assessment
    - Hydrogeology: aquifer(s), preferential flow paths, barriers to flow, fixed head boundaries, anthropogenic effects etc.,
    - System, structure, component and work practice risk ranking
    - Remediation and record keeping
    - Oversight/updates
- Applied examples and discussion

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Triad Approach

- Systematic Planning:
  - Land use Survey / Historical Site Assessment
  - Develop a dynamic Conceptual Site Model (CSM)
    - CSM drives characterization plan and methods
- Dynamic Work Strategies:
  - DQO's
  - The characterization plan's tech basis is the CSM
  - Characterization data driven decision making in the field
    - Characterization and Remediation
  - Characterization methods selected to meet DQO's with rapid deployment capabilities/tech
- Real-Time Measurements:
  - Mobile labs, and instrumentation
  - Remote sensing, GIS/GPS data integration with digital twins

https://triadcentral.clu-in.org/

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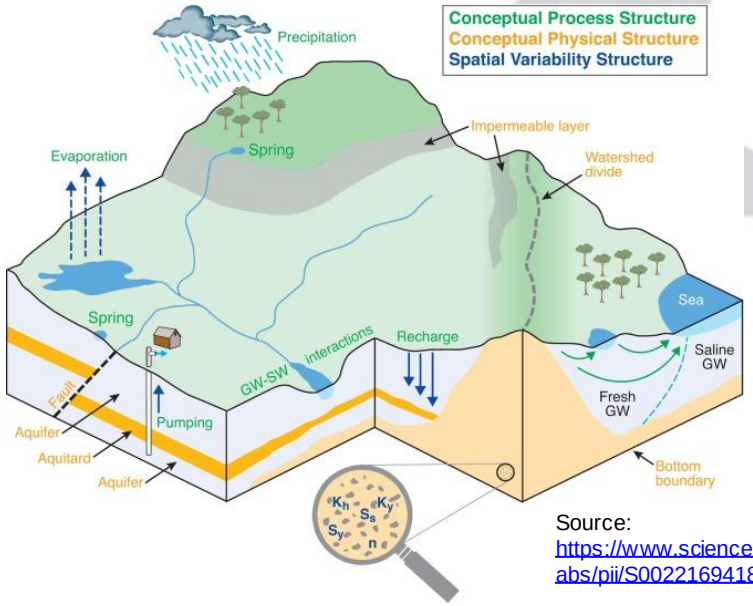
What is a Hydrogeologic CSM?

"A hydrogeologic CSM is a description of various natural and anthropogenic factors that govern and contribute to the movement of groundwater in the subsurface"

Kresic N., Mikszewski A., CRC Press 2013

- Collection of tested hypotheses that iteratively attempt to answer:
  - Where is GW coming from?
  - What type of porous media is it flowing through?
  - How much GW is there and how fast is it flowing?
  - Where is GW going?
  - How did GW behave in the past and how will it change in the future (natural and anthropogenic)?
  - What are the past, present and future contamination risks to GW?
  - How do contaminants move in GW? (F&T)



Source:
https://www.sciencedirect.com/science/article/abs/pii/S0022169418309387

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07-07 Industry Groundwater Protection Initiative

- Initially developed in 2007 to describe the industry's Groundwater Protection Initiative
- Applicability: Operating and decommissioning nuclear power plants and new plants under construction after 2006
- Voluntary program that all US commercial nuclear fleet Chief Nuclear Officers (CNO's) agreed to
  - Subsequently USNRC added review of GW monitoring programs to routine REMP inspection procedures (71124.07 "Radiological Environmental Monitoring Programs")
- Initiative provides utilities improved management and response to inadvertent release of radioisotopes that may result in low but detectable plant-related materials in subsurface soils and water.
  - Three Parts:
    1) GW Protection Program
    2) Communication
    3) Program Oversight

https://www.nrc.gov/docs/ML1914/ML19142A071.pdf

Part 1: NEI NUCLEAR ENERGY INSTITUTE Groundwater Protection Program

- Manage inadvertent Rad releases that enter GW:

Hydrogeologic CSM

– Objective 1: Site Hydrology and Geology:

"Ensure site characterization provides an understanding of predominant GW gradients based on current site conditions. This characterization is the basis of the CSM"

– Objective 2: Site Risk Assessment

"Evaluate all systems structures, components [and work practices] that could contain lic. material where there is a credible mechanism [for a release] to groundwater"

– Objective 3: On-going Groundwater Monitoring

"Establish an on-site GW monitoring program to ensure timely detection of inadvertent radiological releases to GW"

– Objective 4: Remediation

"Establish a remediation protocol to prevent migration of lic. material off-site and to minimize decommissioning impacts"

– Objective 5: Record Keeping

"Records of leaks, spills and remediation efforts are retained to meet the requirements of 10 CFR 50.75(g)"

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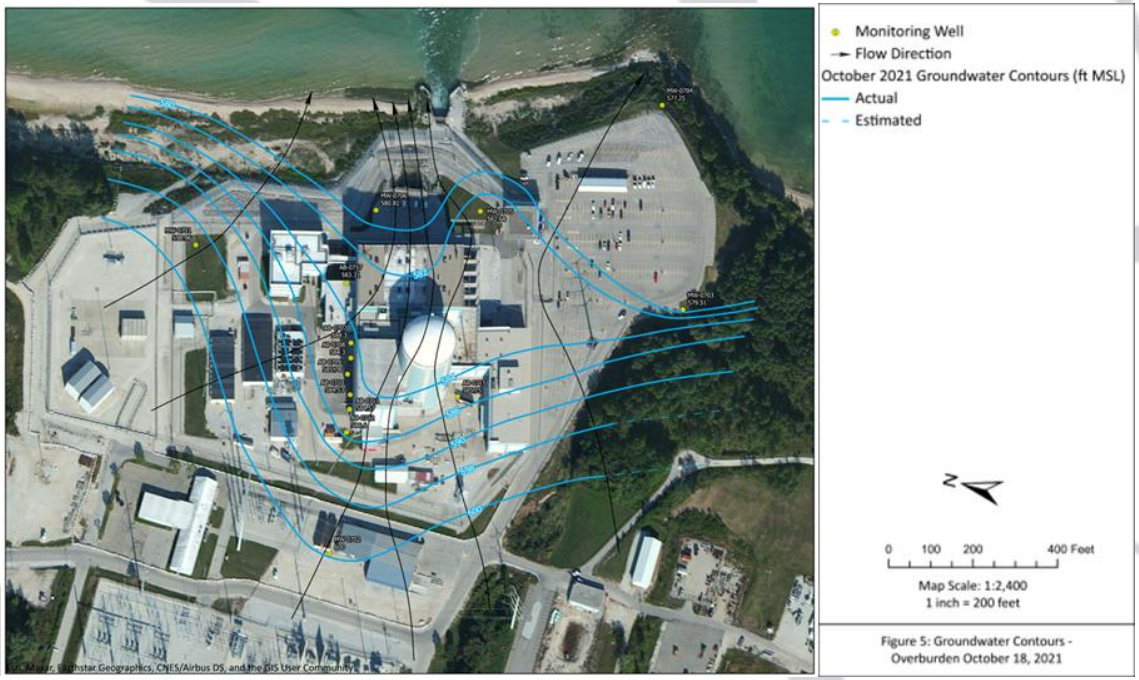
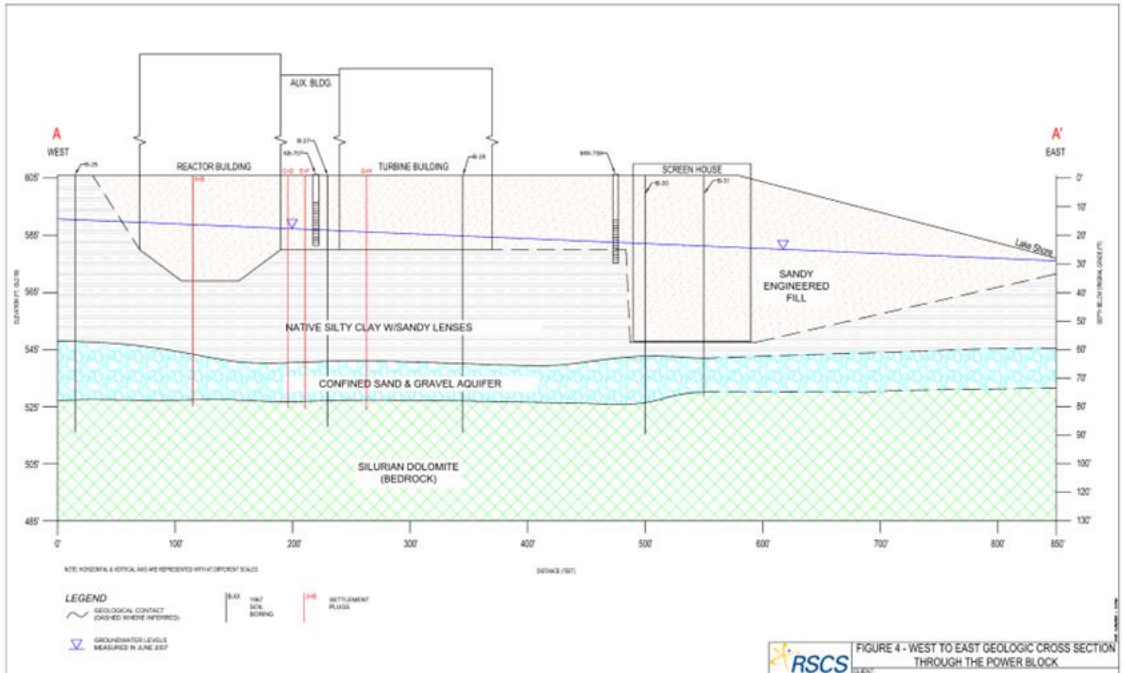
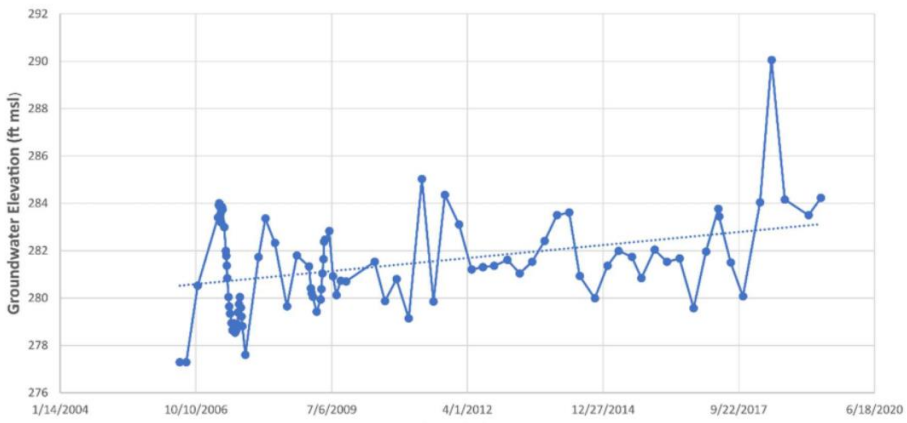
Objective 1: Site Hydrology and Geology:

- Aquifers
- Recharge/discharge
- Gradients/hydraulic head trends
- Hydraulic head boundaries
- Anthropogenic effects
- Barriers to flow
- Preferential flow
- Backfill and native fill distributions



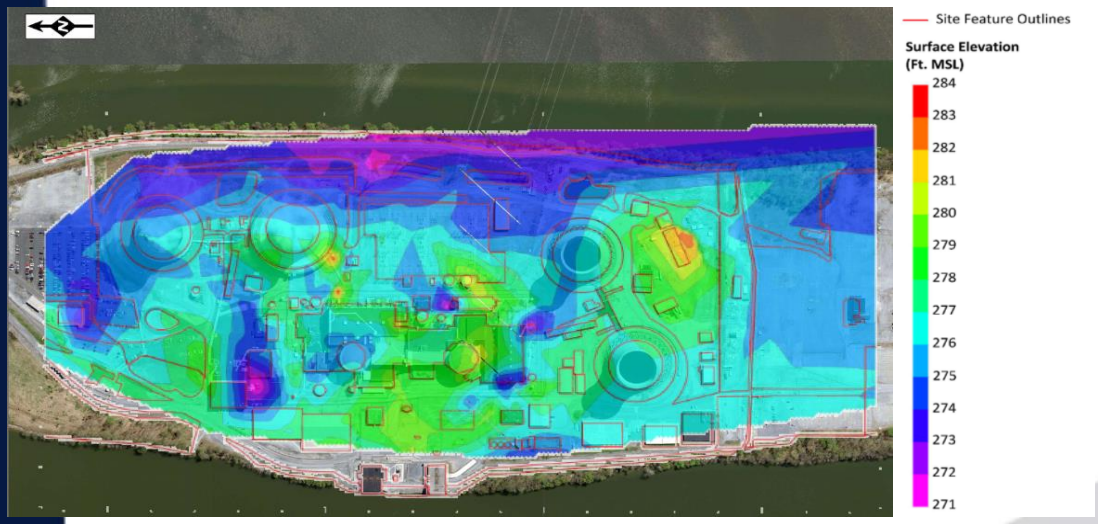


- Are wells in the right locations to monitor SSC's and work practices?



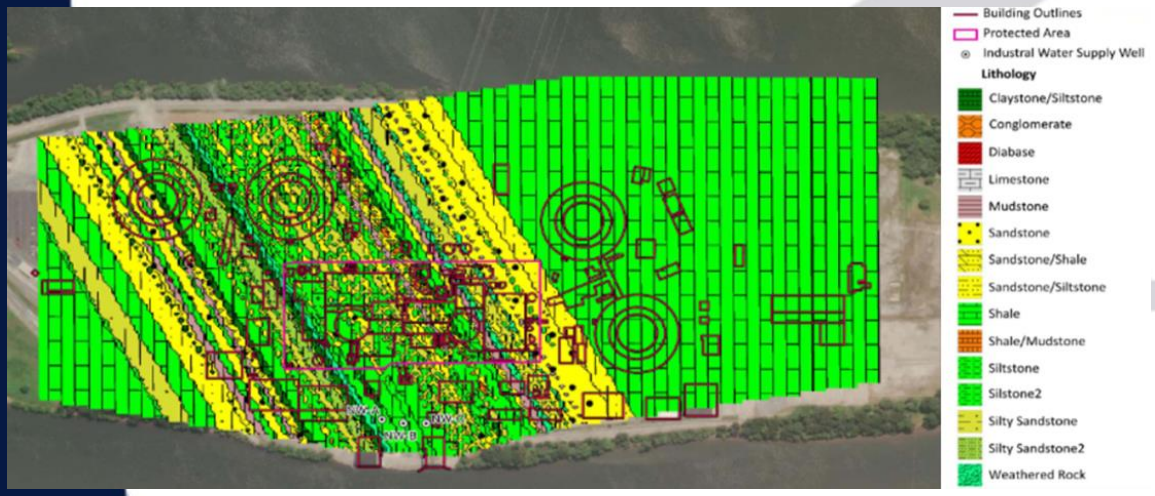
Tested Hypotheses

Bedrock Surface/Soil Thickness:



Surficial Aquifer Flow Net:

Bedrock Lithology:



Bedrock Aquifer Flow Net:

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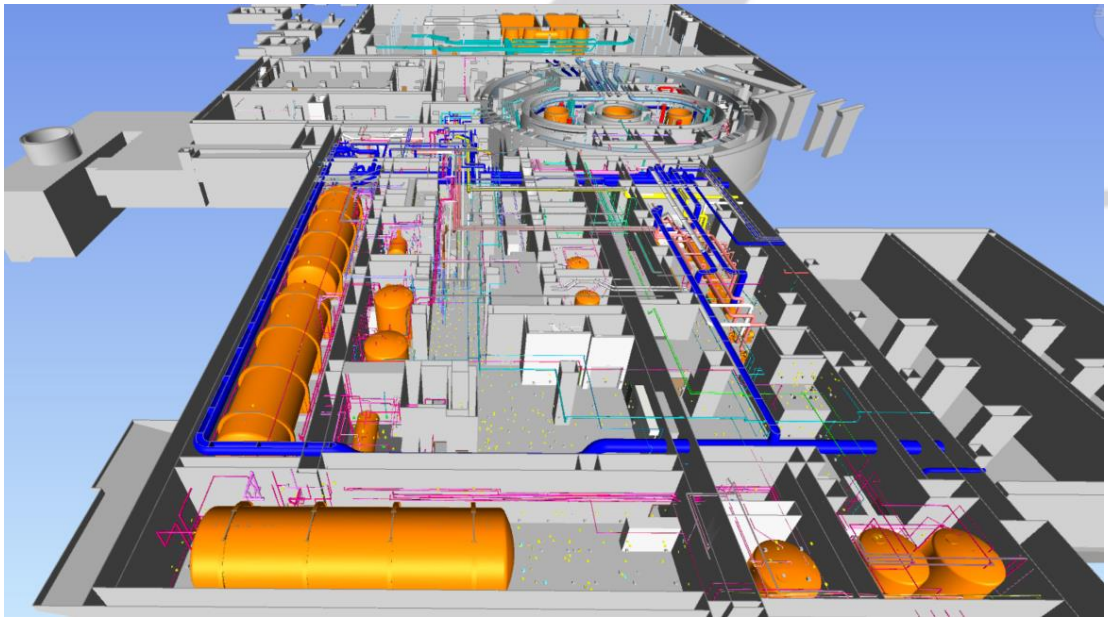
Objective 2: Site Risk Assessment:

- Evaluate SSC's and WP's that contain or could contain licensed material with a credible pathway to reach GW
  - Identify all SSC's; examples: SFPs, outdoor tanks, buried pipes, foundation joints etc.
  - Identify existing leak detection methods for these SSCs: GWM wells, leak detection systems, integrity testing etc.
  - Identify WPs that could result in a leak, spill/release of lic. Material
  - Evaluate for potential enhancements to leak detection systems or programs
    - NEI 09-14 Underground pipe and tank inspection initiative:
      - SSC Risk Rank = consequence X Susceptibility (all safety related piping and tanks)
  - Evaluate potential enhancements to prevent spills or leaks from reaching GW
  - Identify tracking for corrective actions
  - Establish a frequency for periodic review of SSCs/WPs



*"credible pathway": single barrier between SSC/WP and environment

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Objective 3: On-going Groundwater Monitoring

- <u>Timely detection of inadvertent releases:</u>
  - [Hydrology and Geology] + [Risk assessment] = Initial CSM
  - Initial Hydrogeologic CSM becomes basis for GW monitoring well array and monitoring program
    - Identify gaps in CSM (develop monitoring array and SSC/WP wells)
  - Establish sampling and analysis protocols
  - Establish a formal written program for long-term monitoring (SAPs/SOPs)
  - Periodic review of lab(s) analytical capabilities/protocols
  - Long term PM of wells
  - Establish frequency [and triggers] for periodic review of the GWMP

*Program reviews and updates should trigger revision of Hydrogeologic CSM

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Remediation, Record Keeping and D&D/SAFSTOR Impacts

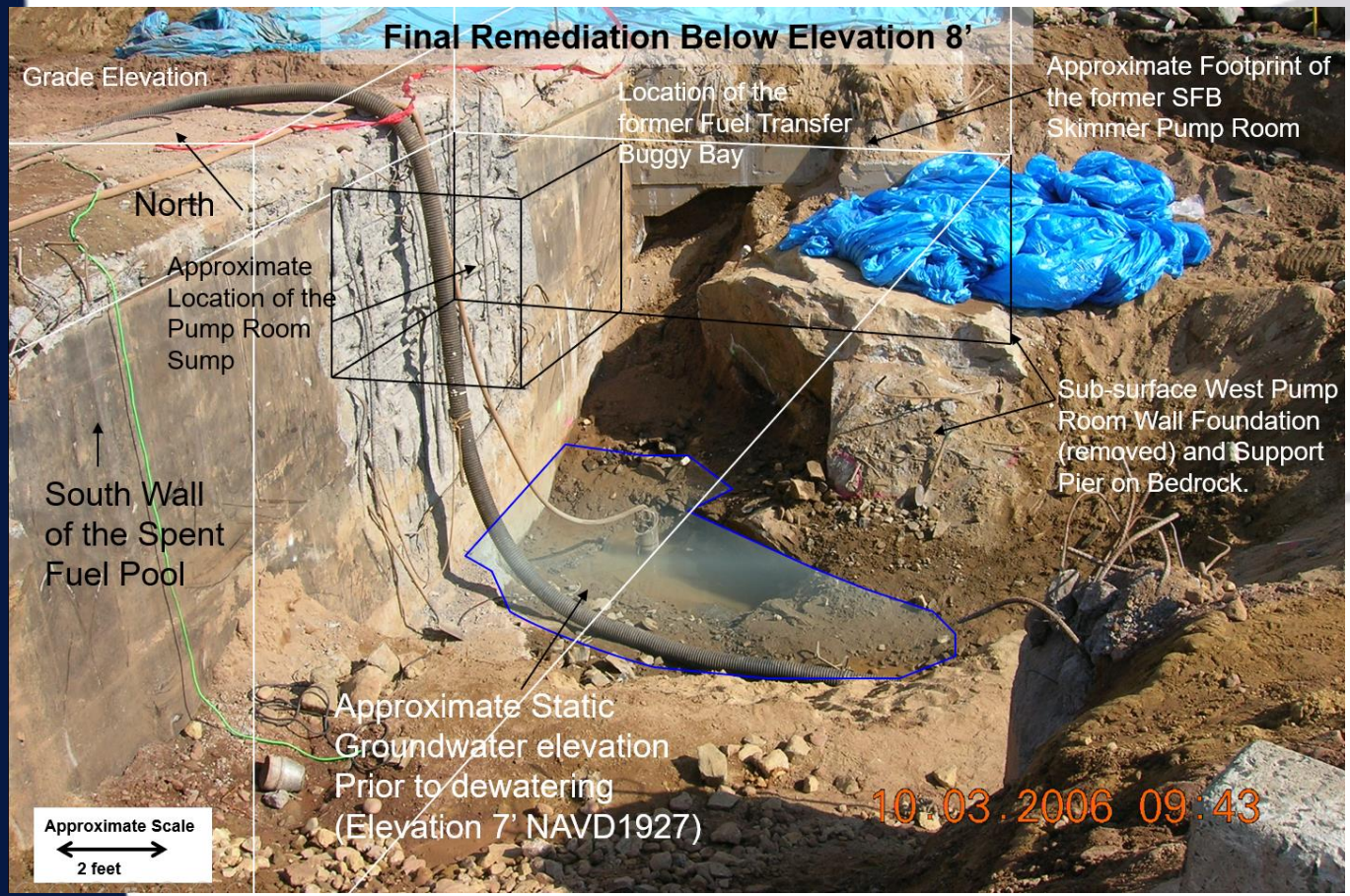
- Objective 4: Remediation

"Establish a remediation protocol to prevent migration of lic. material off-site and to minimize decommissioning impacts" *mitigation vs. remediation*

Mitigation: Reduce Threat, Remediation: Remove Threat

- Objective 5: Record Keeping

"Records of leaks, spills and remediation efforts are retained to meet the requirements of 10 CFR 50.75(g)"



- Objective 6: D&D/SAFSTOR Impacts
  - CSM and Risk Ranking needs to align with new site conditions and changes

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Part 3: NEI NUCLEAR ENERGY INSTITUTE Program Oversight

a. Initial independent program self assessment

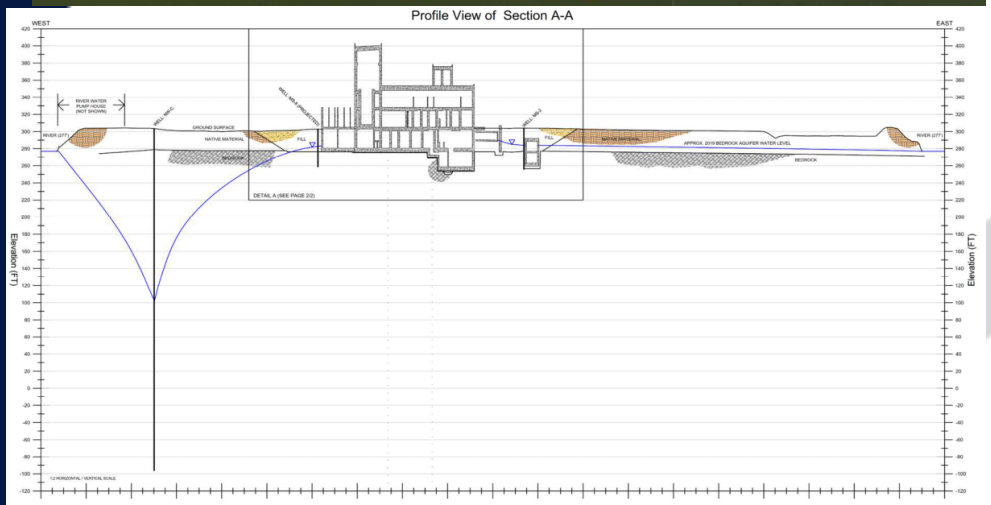
b. Assessment of GPI program every 5 years

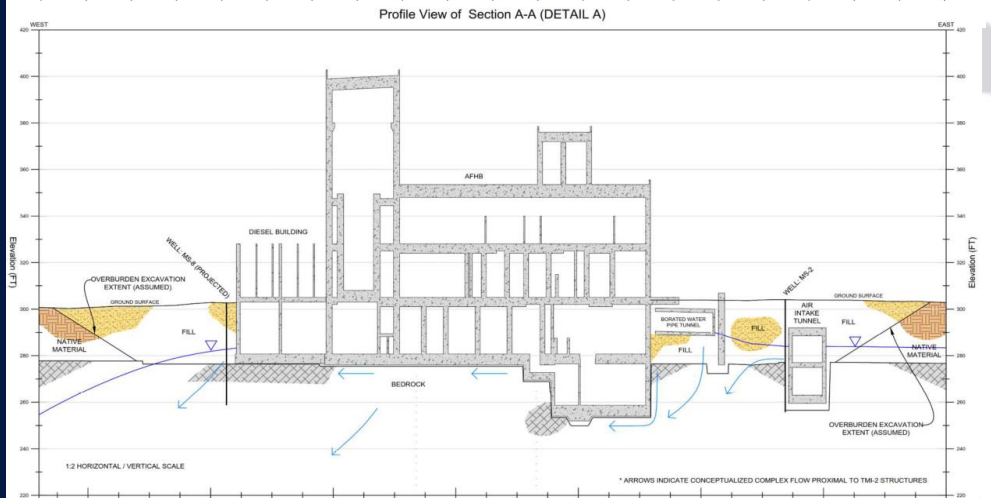
- CSM review and update as necessary
- More frequent review of update in response to site changes/events

c. 5-year assessments to review GPI objectives

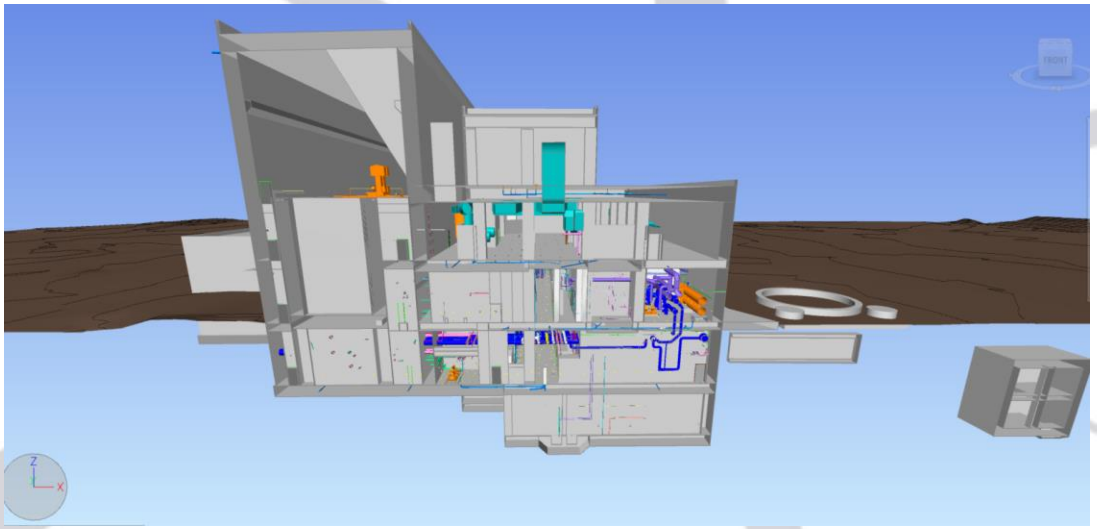
*Provides a programmatic path to routing CSM updates and record keeping through D&D!

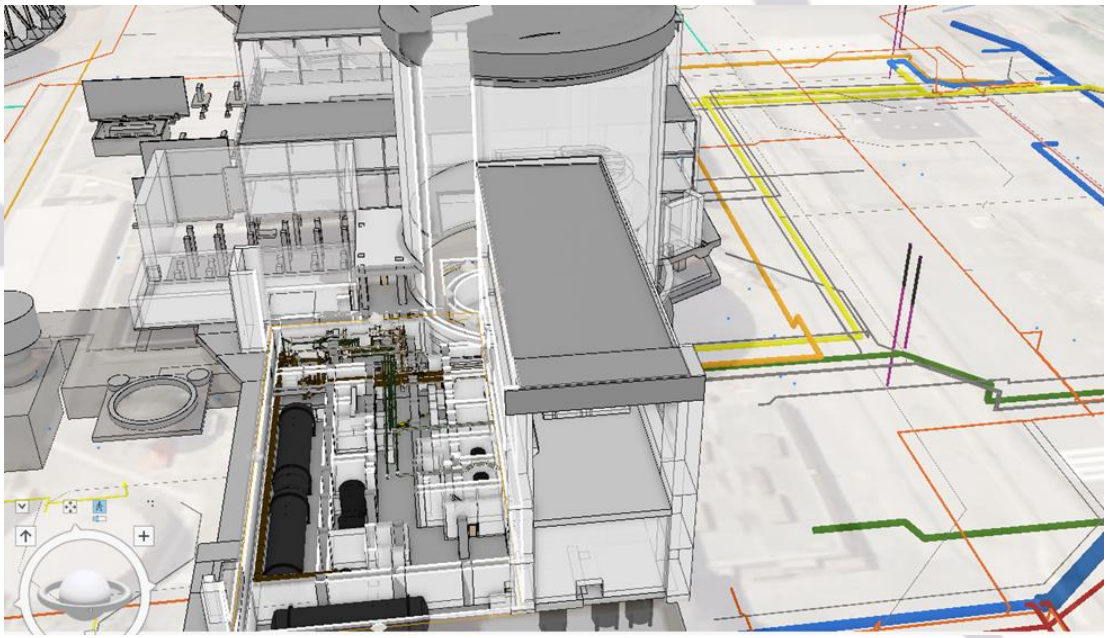
Applied Examples





Common Data Environment (CDE) Use:





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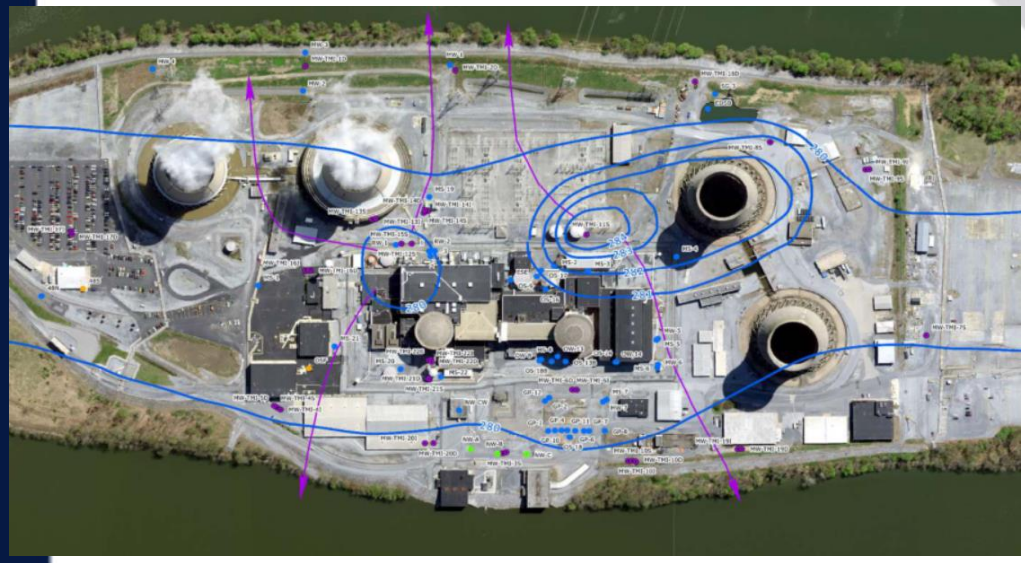
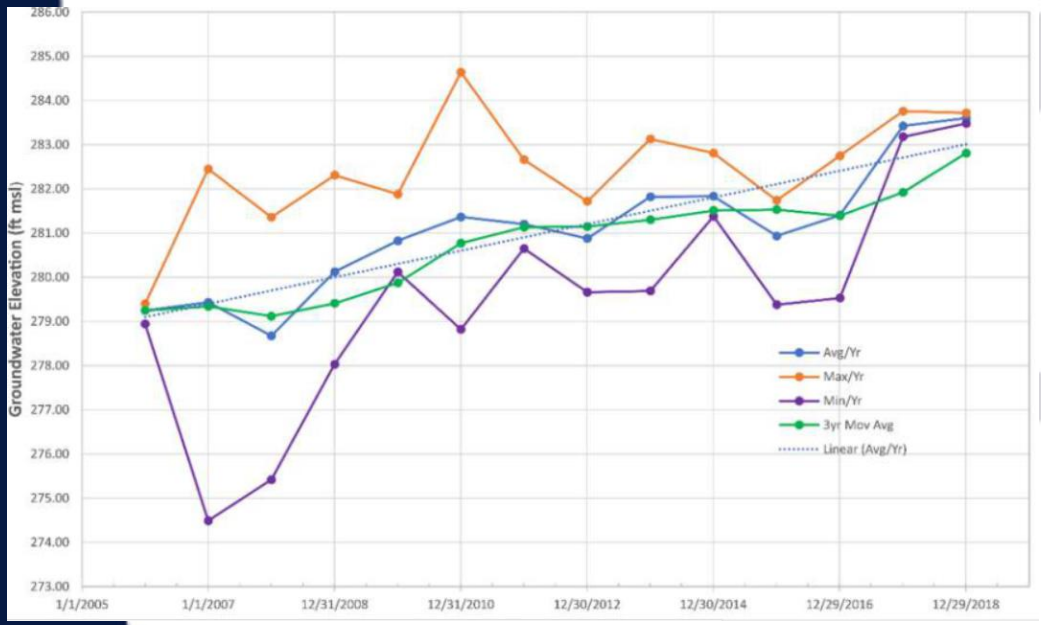
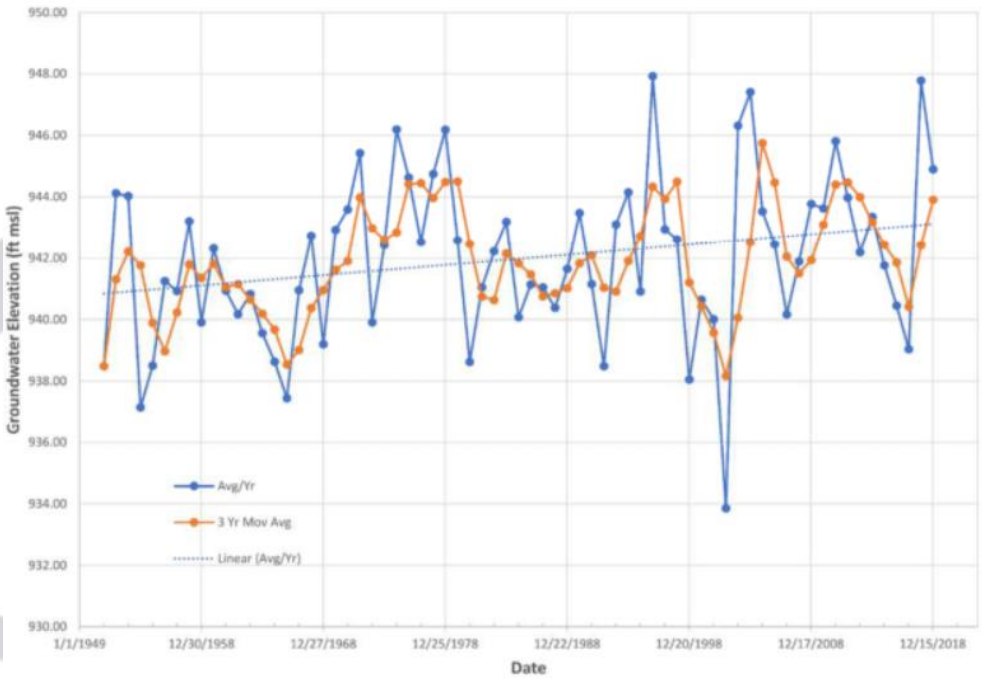


Climate change considerations





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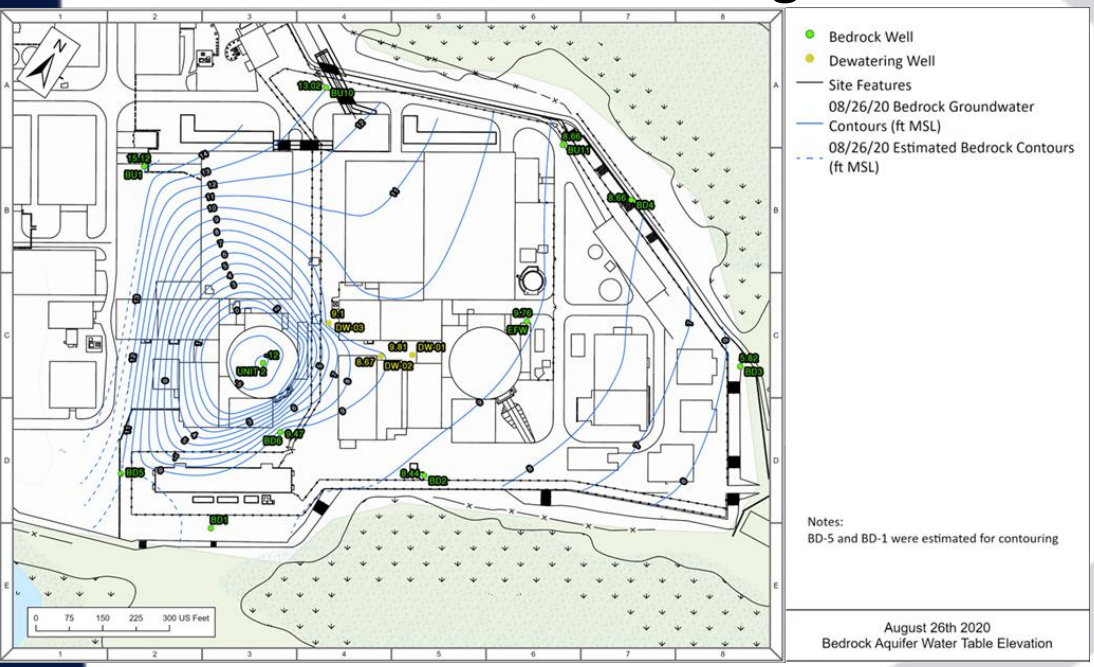
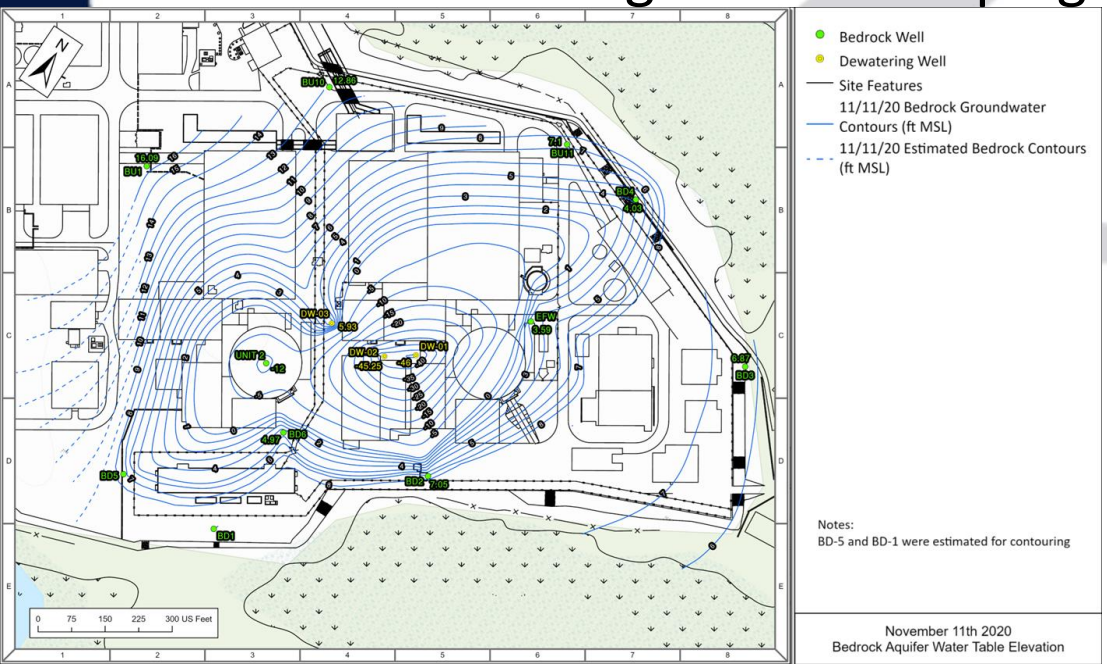
Triggers for CSM updates

Structure Dewatering:



Structure Dewatering & Well Pumping:



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Comments, Questions

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