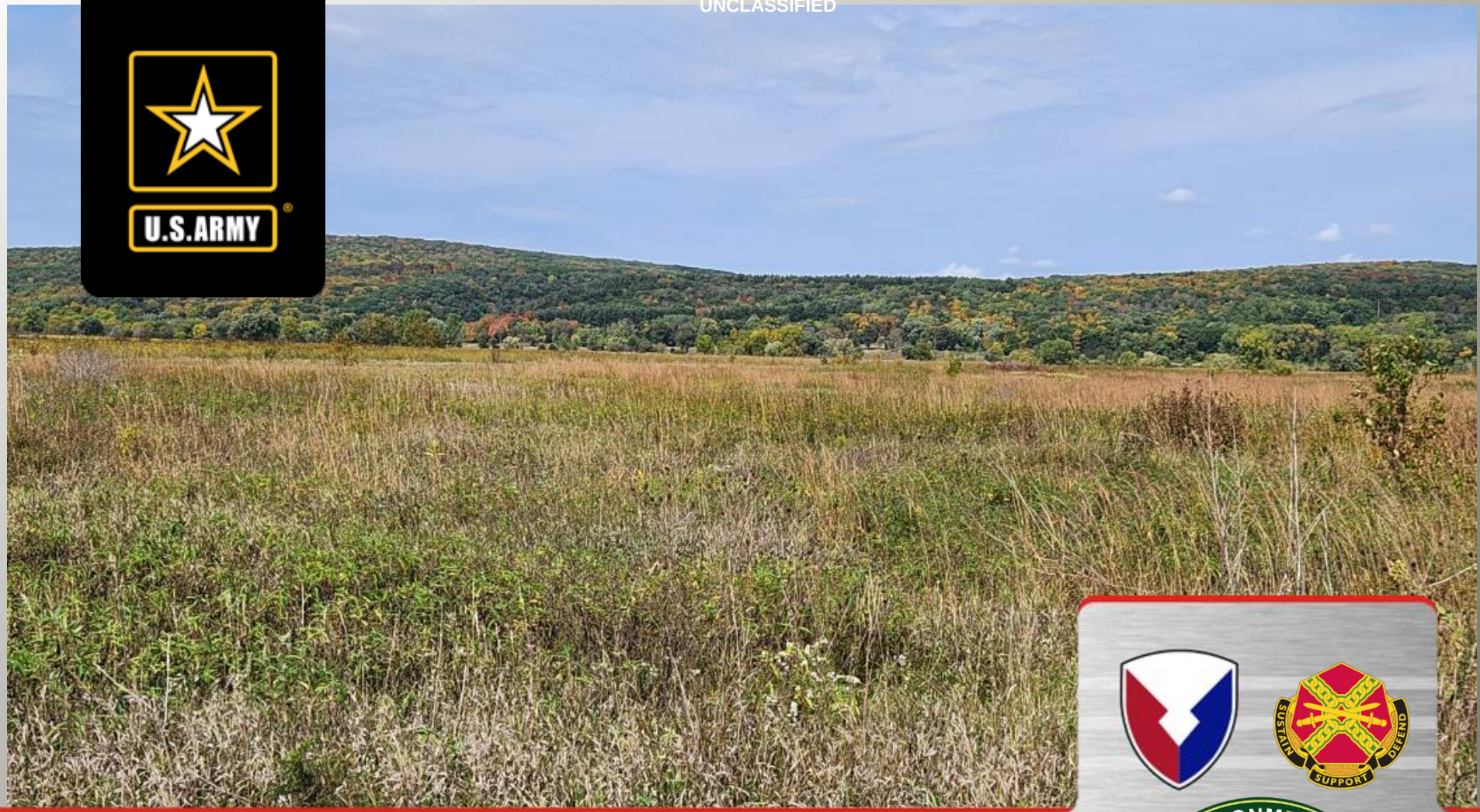


Former Badger AAP RAB Meeting

October 19, 2023

RAB Agenda – October 19, 2023

- **Welcome and Opening Remarks**
- **Roll Call**
- **Review of the Minutes from July RAB**
- **Proposed Plan Response to Comments**
- **EVO Overview**
- **Optimization Update:**
  - Well Installations
- **Groundwater Sampling Update**
- **Gruber's Grove Bay Sediment RI Update**
- **USGS Groundwater Modeling Update**
- **Project Management Updates**
- **Future Meetings**
- **Questions and Closing Comments**

Welcome/Opening Remarks

Former Badger Army Ammunition Plant Restoration Advisory Board

October 19, 2023

Proposed Plan Update

#	WDNR	ARMY Response
1	Requests involvement with pilot scale testing	Agree
2	All relevant tables and figures should be updated using recently available data.	To avoid delaying the PP and remediation process, the Army proposes to update the relevant tables and figures with the newest groundwater data in a separate report.
3	The RI/FS and Draft PP do not adequately demonstrate that site conditions are favorable for anaerobic bioremediation. Provide data that would indicate anaerobic bioremediation will be an effective remedy given site conditions.	The Army is proposing using emulsified vegetable oil (EVO) to address DNT groundwater contamination at BAAP. EVO is currently used to remediate TNT and RDX groundwater contamination at the Cornhusker Army Ammunition Plant (CHAAP) in Grand Island, Nebraska. This site has similar geologic and groundwater aerobic conditions. EVO amendments create anaerobic conditions in the subsurface causing anaerobic biodegradation; however, additional study would be required to evaluate its effectiveness at BAAP. This study would be conducted before the Remedial Design phase
4	Recommends amending on-site COCs for all groundwater plumes using a $1x10^{-6}$ cancer risk threshold. Any additional on-site COCs identified should then be reviewed for potential action or additional evaluation.	The Army acknowledges the WDNR's $1x10^{-6}$ risk policy; however, the cancer risk thresholds were selected in compliance with NCP and EPA guidelines. In off-site areas, where the Army does not have control over the use of the groundwater as a drinking water source, a cumulative cancer risk greater than $1x10^{-6}$ is cause for potential action or additional evaluation. WDNR and the ARMY are in discussions of resolving technical questions between the two distinct compliance regulations of CERCLA and State requirements.
5	The RI/FS and Draft PP state MNA is expected to reduce concentrations of VOCs via natural processes. Provide data that has been collected to date that would indicate MNA will be an effective remedy. Consider analyzing groundwater for additional geochemical parameters to support MNA effectiveness.	The Draft Technical Report Natural Attenuation Screening Study for the Propellant Burning Ground (Stone & Webster, August 1999) provided evidence that VOCs are naturally attenuating in the PBG Plume. The Army is considering collecting additional information to support the MNA remedy.

Proposed Plan Update

#	WDNR	ARMY Response
6	Elevated concentrations of DNT in groundwater continue to be detected in the PBG Plume source area. Describe how the proposed remedy will address this potentially continuous source of DNT contamination in groundwater.	The Army is considering the option to inject treatment solution through existing wells located within and around the PBG cap, or installing 9 injection wells ~150 ft south of the PBG Waste Pits cap.
7	The PBG plume continues to shift toward the east since the shutdown of the two groundwater extraction systems. Evaluate the need to modify the groundwater sampling program, for both monitoring wells and residential wells to understand PBG Plume dynamics and potential residential well risk.	The Army is planning to develop a comprehensive groundwater sampling plan. This sampling plan will include evaluating the shift of the PBG plume towards east. The Army anticipates that the sampling plan will include additional existing monitoring and residential wells
8	Evaluate the need for additional monitoring wells compliant to Wisconsin regulations to enhance defining the nature and extent of DNT affected groundwater associated with the NC Plume.	Currently, there is no risk associated with the NC Plume. The Army acknowledges the WDNR's request, but there is no potential risk to the public and their drinking water from the NC Plume. However, the Army is planning to develop a comprehensive groundwater sampling plan that may include additional wells to better define the NC Plume.
9	PP acceptance will be determined after the PP Public comment period ends. Acceptance will be described in the Record of Decision (ROD).	Acknowledged

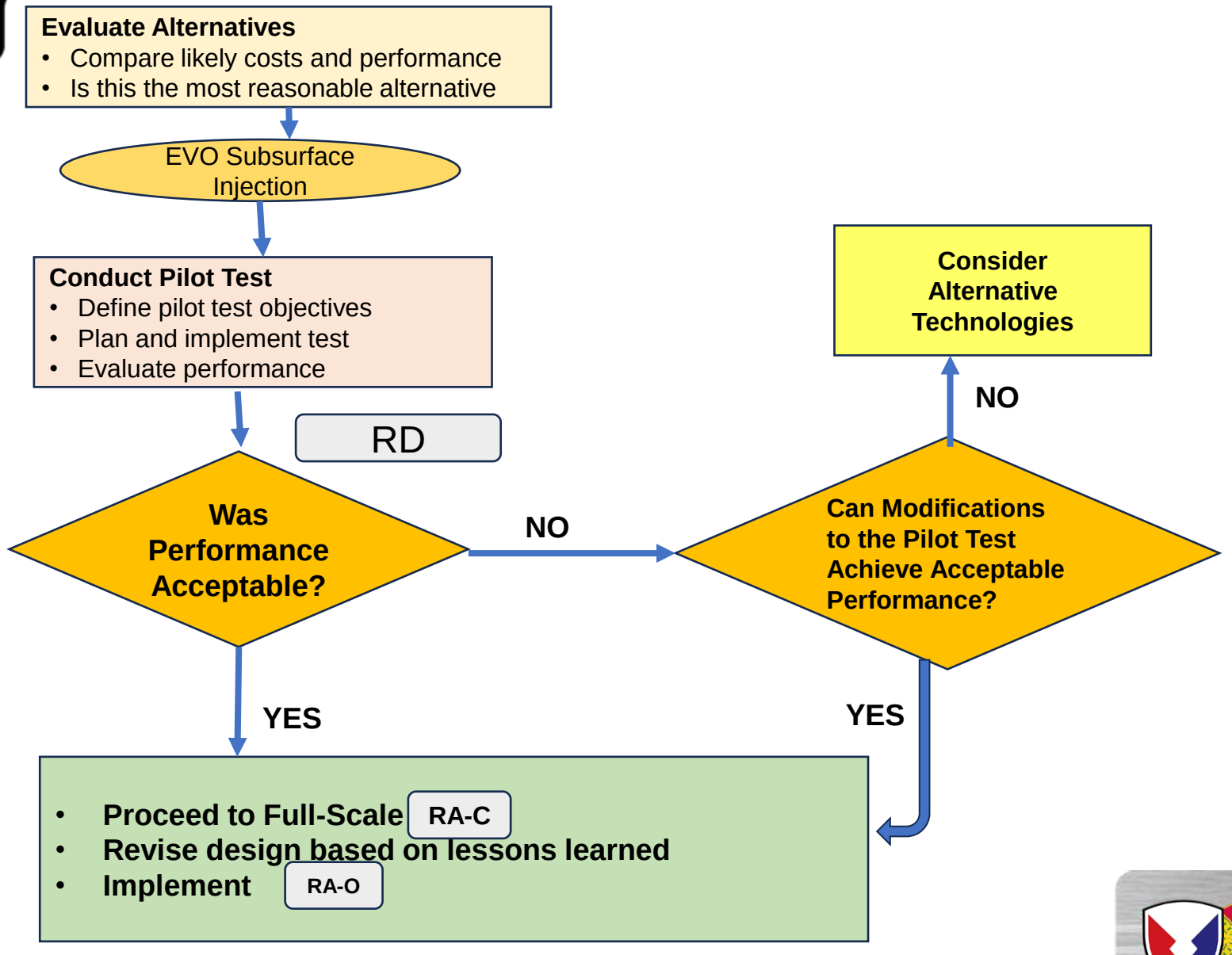
EVO Overview: How it works and Analog

- In **anaerobic conditions**, microorganisms will ultimately metabolize organic contaminants to methane, limited amounts of carbon dioxide, and trace amounts of hydrogen gas.
- The treatment processes at the Cornhusker Army Ammunition Plant (CHAAP) in Nebraska resulted in an anaerobic degradation that promoted strong denitrification, ferric iron reduction, sulfate reduction, and methanogenesis occurred in the treatment zones. This is important because the denitrification process is ultimately what destroys contamination.
- If you have an aerobic (oxygenated) groundwater subsurface environment, the EVO will create its own anaerobic (no oxygen) environment.
  - This subsurface process is observed at CHAAP.
  - CHAAP injects a soy oil- and lactate-based amendment and an amendment primarily comprised of blackstrap molasses and whey for the EVO process to proceed.

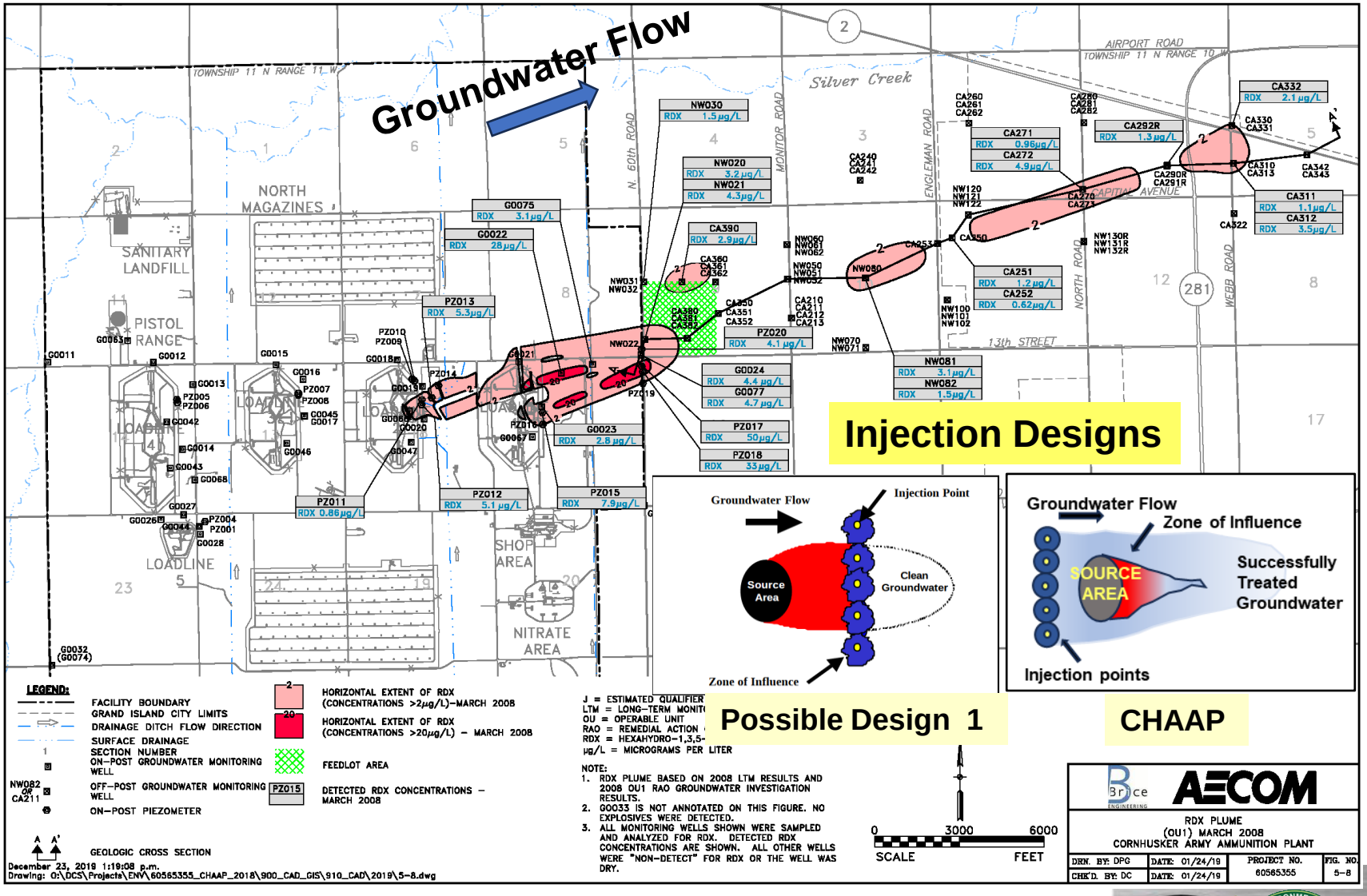
Similarities between CHAAP and BAAP

- Both BAAP and CHAAP normally have aerobic subsurface conditions.
- Both have similar horizontal hydraulic conductivity: BAAP site avg is ~ 175 ft/year. CHAAP is between 242 to 373 ft/year
- Similar porosity: BAAP 26%; CHAAP 20%
- Both have similar contaminants. CHAAP has RDX and TNT. BAAP has DNT.

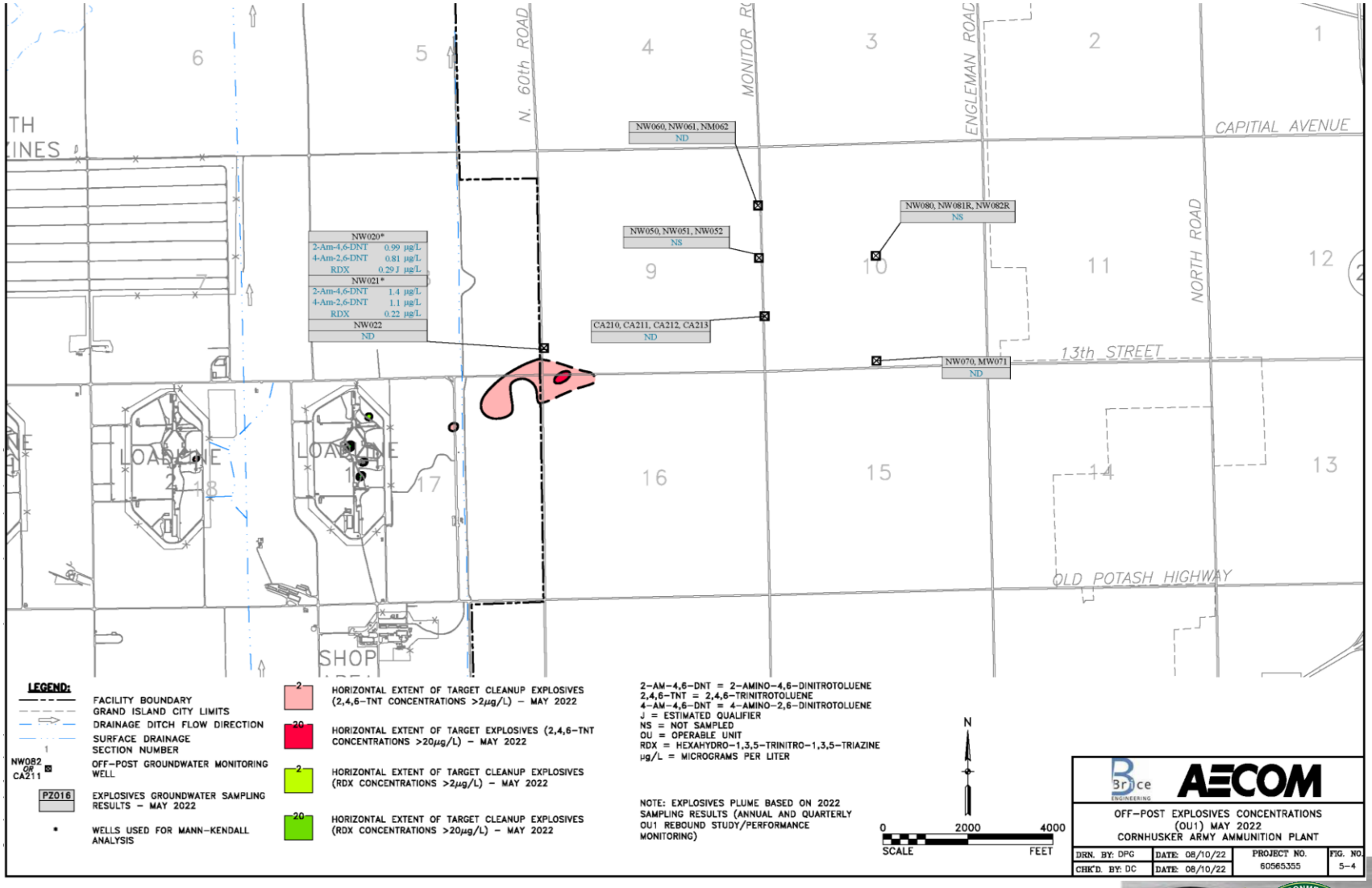
Process to Follow for EVO Subsurface Injection



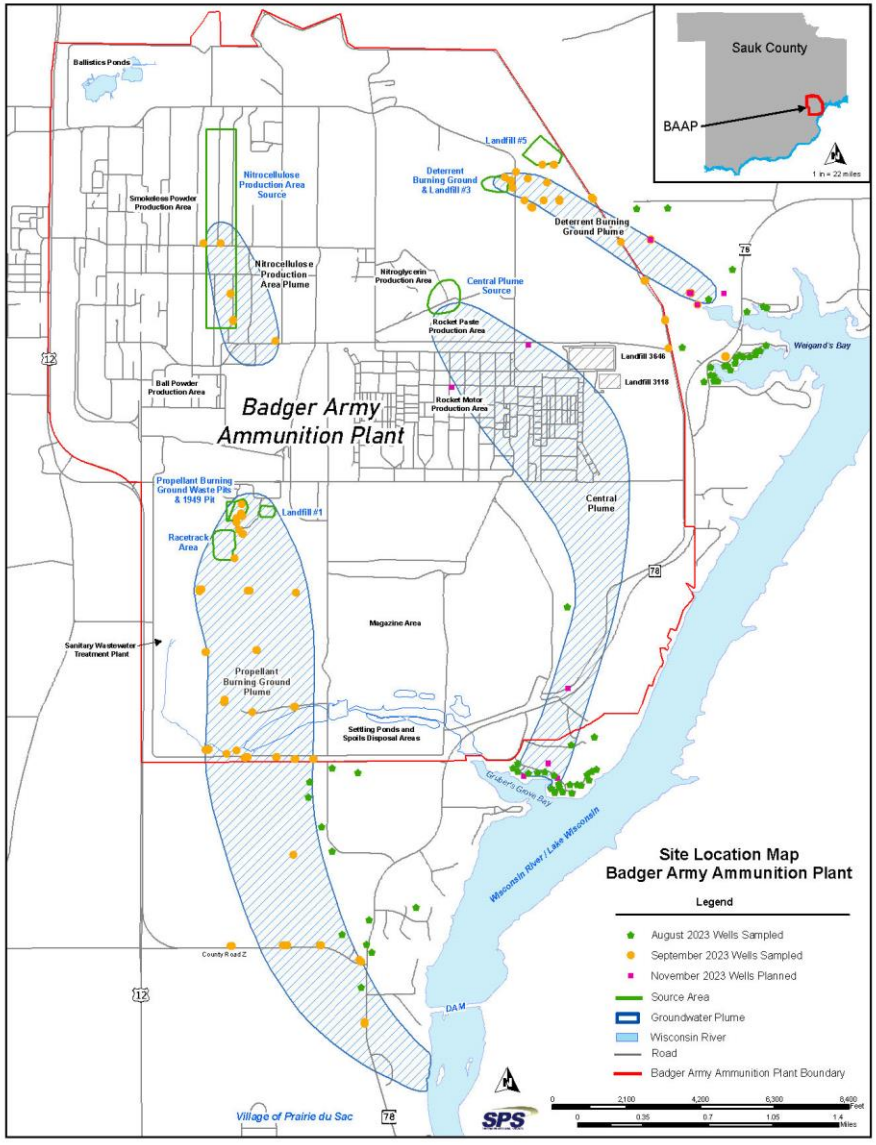
EVO Overview: CHAAP EVO Implementation (2008)



EVO Overview: CHAAP EVO Implementation (2022)



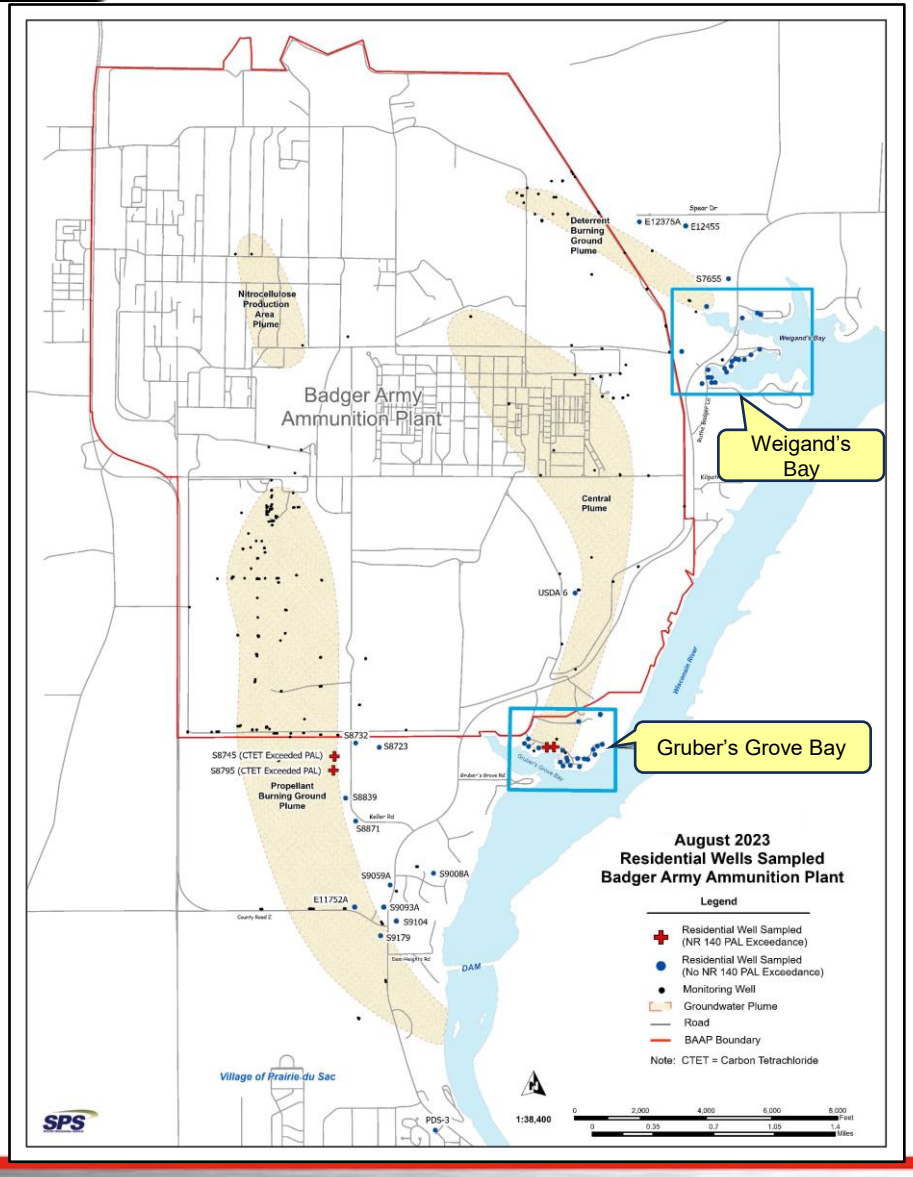
Groundwater Sampling Update



Sampling Summary

- August 2023 - Groundwater sampled in 62 residential wells - Annual event (WDNR submission – Sept 2023)
- September 2023 - Completed semi-annual groundwater sampling of 126 monitoring wells (results pending). Sampling was conducted in the DBG, Nitrocellulose & PBG Plumes.
- November 2023 – 23 monitoring wells in Central & DBG Plumes will be sampled

Groundwater Sampling Update



Residential Well Sampling August 2023

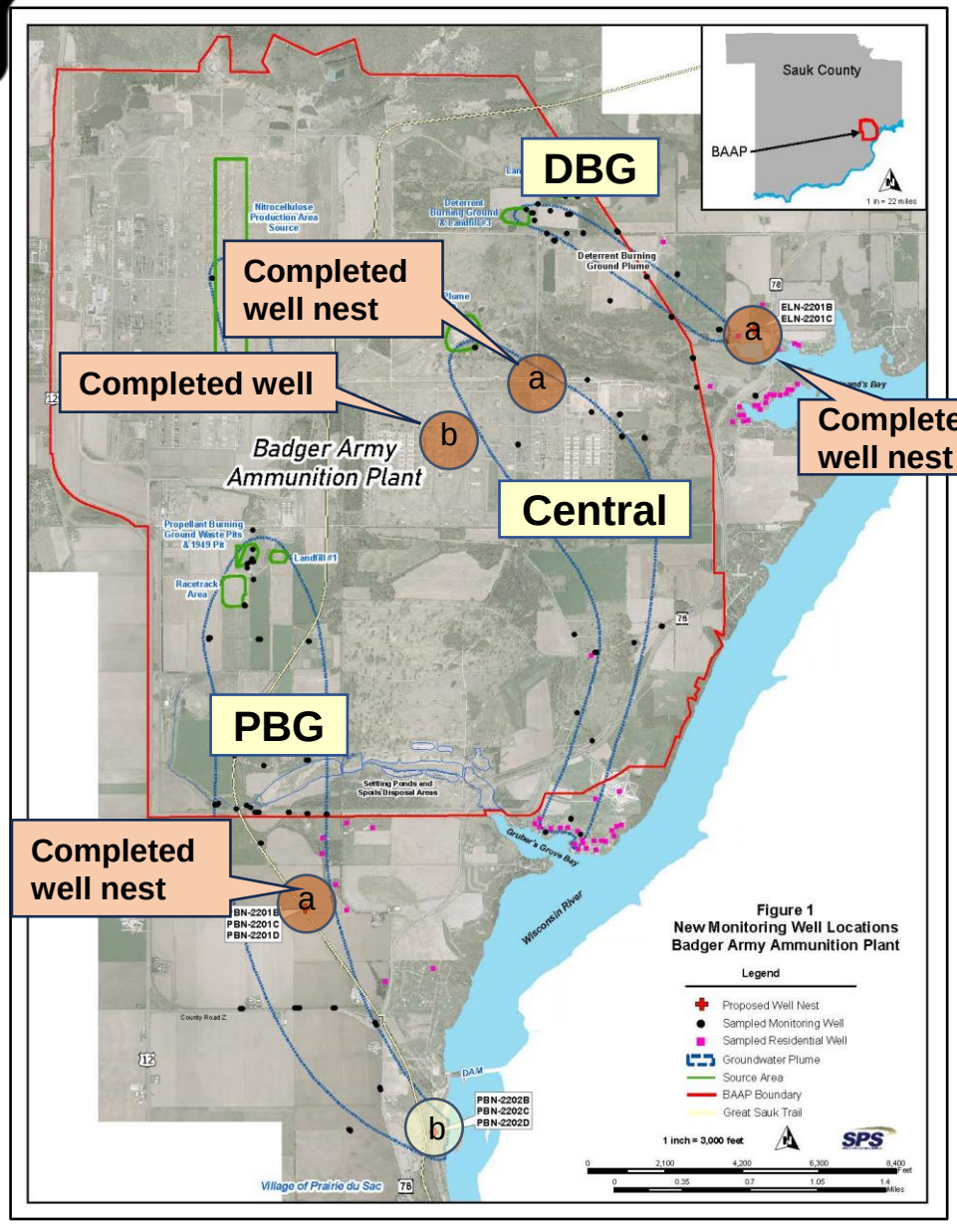
- 62 residential wells sampled
- One residential well could not be sampled - no power
- Dinitrotoluene (DNT) not detected in 62 wells
- PBG Plume - Carbon Tetrachloride (CTET) exceeded NR 140 PAL in two wells
- Central Plume - Chloroform exceeded NR 140 PAL in two wells

PAL = Preventive Action Limit (ug/L)
ES = Enforcement Standard (ug/L)
ug/L= microgram/Liter = ppb
DNT: PAL= 0.005; ES = 0.05
CTET: PAL= 0.5; ES = 5
Chloroform: PAL= 0.6; ES = 6

Optimization Update: Monitoring Wells

- **The Army has completed drilling eight monitoring wells to help define/delineate the Deterrent Burning Ground (DPG), Propellant Burning Ground (PBG) and Central Plumes**.
  - Completed a PBG Well Nest of three wells near the Great Sauk State Trail on May 25, 2023.
  - Completed two wells installed to help monitor the DBG on September 28, 2023. After negotiations, ROE was agreed to on July 17, 2023.
  - Completed three wells installed to help monitor the Central Plume on October 5, 2023. Wells were drilled to comply with a WDNR request to further delineate the plume. WDNR controls the areas where the wells are installed.
  - Continuing to work with the USACE-Omaha District Property Management to secure property right-of-entry (ROE) for additional PBG monitoring wells on the property controlled by Wisconsin Power and Light Company (WPLC). Wells are currently planned to be drilled in FY24 depending on ROE agreement and funding.

Optimization Update: Monitoring Wells



- **Deterrent Burning Ground Plume (DBG)**: 1 location; 2 wells
  - a) Completed Depths (Sept 2023)
    - i. ELN-2301B 93 ft
    - ii. ELN-2301C 158 ft
- **Central Plume**: 2 locations; 3 wells
  - a) Completed Depths (Oct 2023)
    - i. RIN-2301A 111 ft
    - ii. RIN-2301B 155 ft
  - b) Completed Depth (Oct 2023)
    - i. RIN-2302A 106 ft
- **Propellant Burning Ground Plume (PBG)**: 2 locations; 6 wells
  - a) Completed Depths (May 2023)
    - i. PBN-2301B 120 ft
    - ii. PBN-2301C 180 ft
    - iii. PBN-2301D 252 ft
  - b) Obtaining ROE permission from property owner; install in 2024

➢ Wells are to be installed as nests, providing a vertical profile of the plume.

Gruber's Grove Bay Sediment RI Update

Gruber's Grove Bay (GGB) Update

Gruber's Grove Bay Sediment RI Update

October 19, 2023

Agenda

1. Summarize human health and ecological risk assessment findings
2. Summarize draft report recommendations
3. Next steps

Human Health and Ecological Risk Assessment

- **Current and potential human heath risk**
  - No human heath effects with possible exception of large sportfish consumers.
- **Current and potential ecological risks**
  - Bottom-dwelling benthic invertebrate effects, if present.
  - Possible sportfish effects

Draft Report Recommendations

- **Additional sampling** for mercury to identify limits of several hotspot areas.
- **Sediment management tests** to help identify the efficacy and feasibility of potential future remedial actions.
- **Characterization** of bottom-dwelling benthic invertebrates in gelatinous sediments of GGB.

Next Steps

Discuss progress at the next RAB meeting.

- **Summary of WDNR Review** of Draft Desktop RI findings and recommendations.

Thank you

QUESTIONS?

USGS Groundwater Model Update

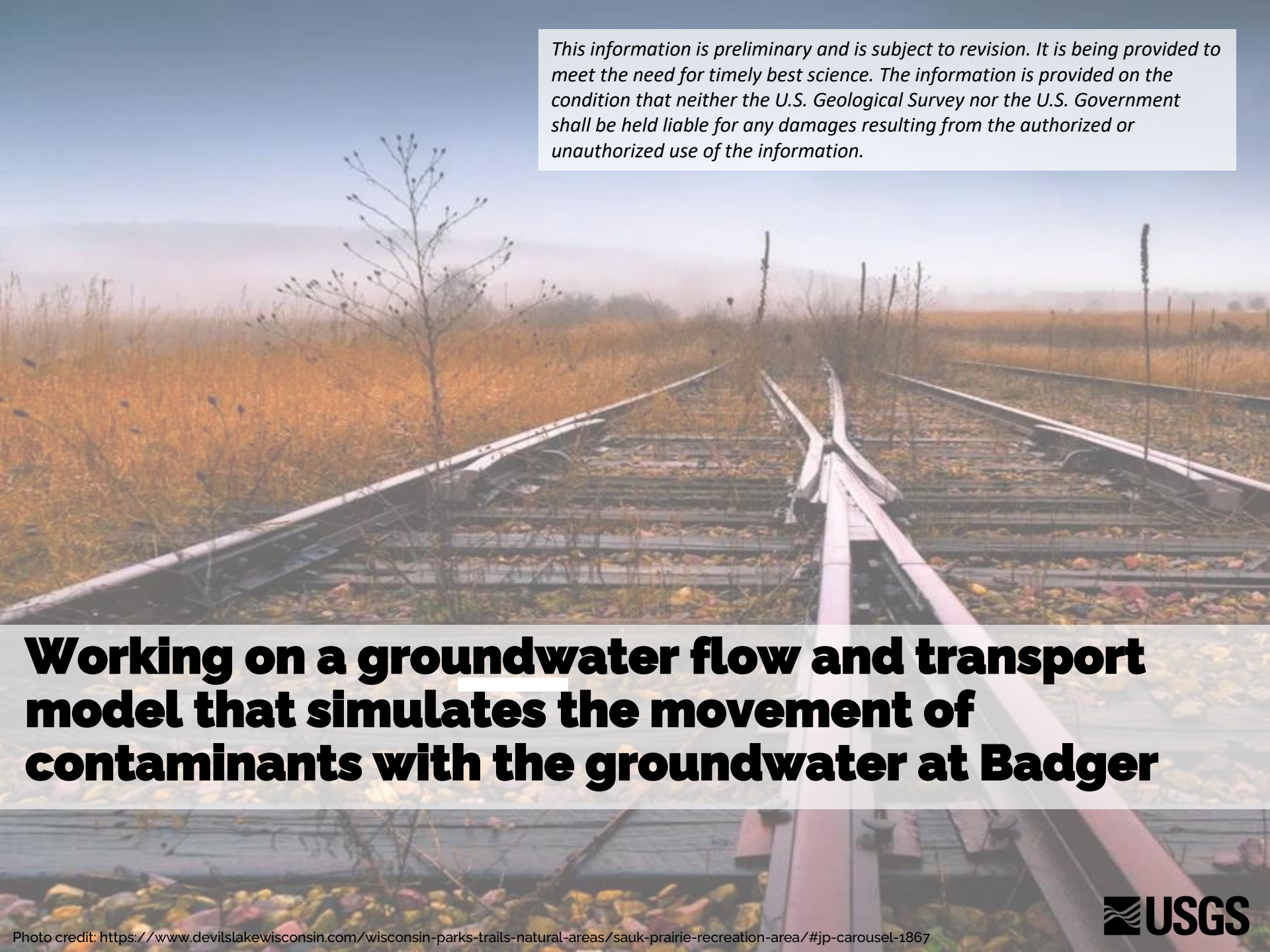
Groundwater Transport Model Overview

USGS Groundwater Modeling Team
Upper Midwest Water Science Center

Oct 2023 RAB Meeting

USGS

Photo Credit: https://www.devilslakewisconsin.com/wisconsin-parks-trails-natural-areas/sauk-prairie-recreation-area/#jp-carousel-1881



This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

Working on a groundwater flow and transport model that simulates the movement of contaminants with the groundwater at Badger

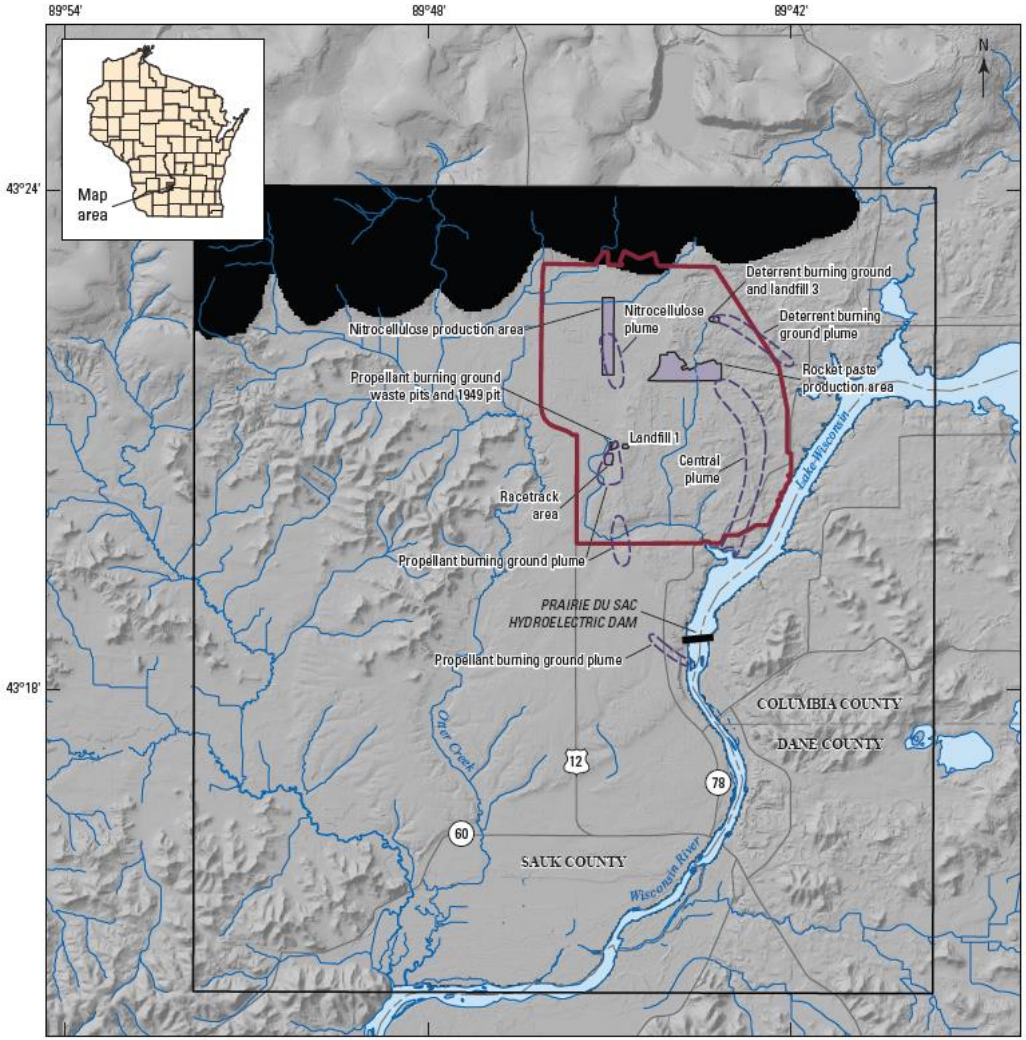
Photo credit: https://www.devilslakewisconsin.com/wisconsin-parks-trails-natural-areas/sauk-prairie-recreation-area/#jp-carousel-1867

USGS

Why make a groundwater model for Badger?

A tool to help assess remediation efforts at the Badger site and help answer questions like:

1. What is the likely plume footprint at a future date if current remedial actions are continued?
2. How might the plume footprin change if bioremediation is implemented?
3. What are optimal bioremediation well configurations to achieve greatest plume reductions while controlling for other factors like cost?



USGS

What is a groundwater flow model?

A bunch of math equations to calculate how water is moving underground.

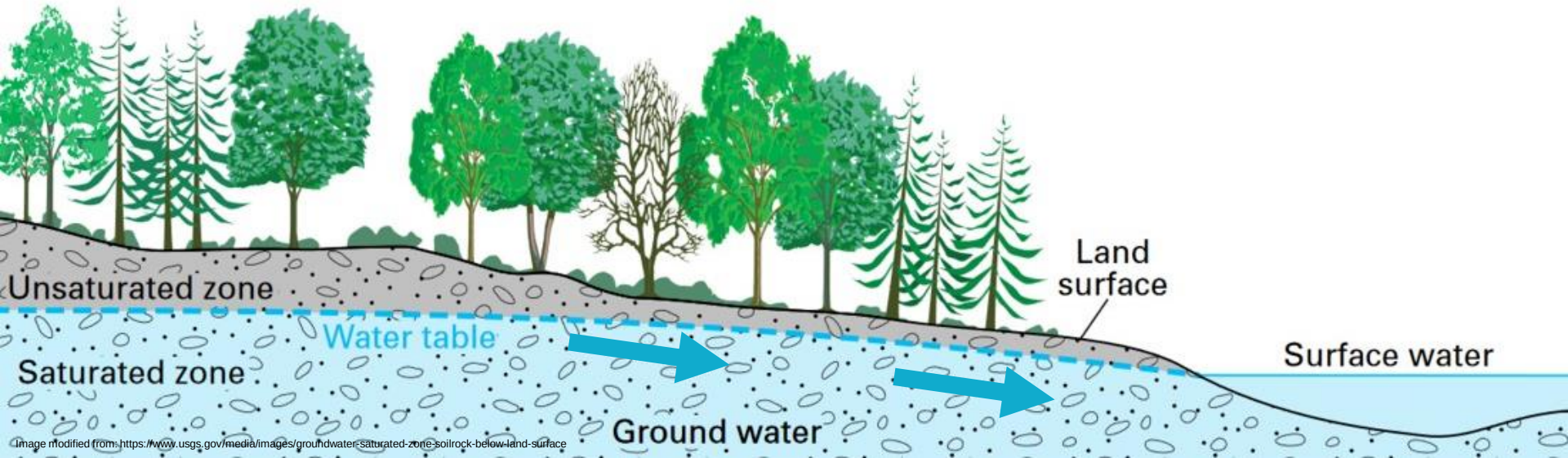
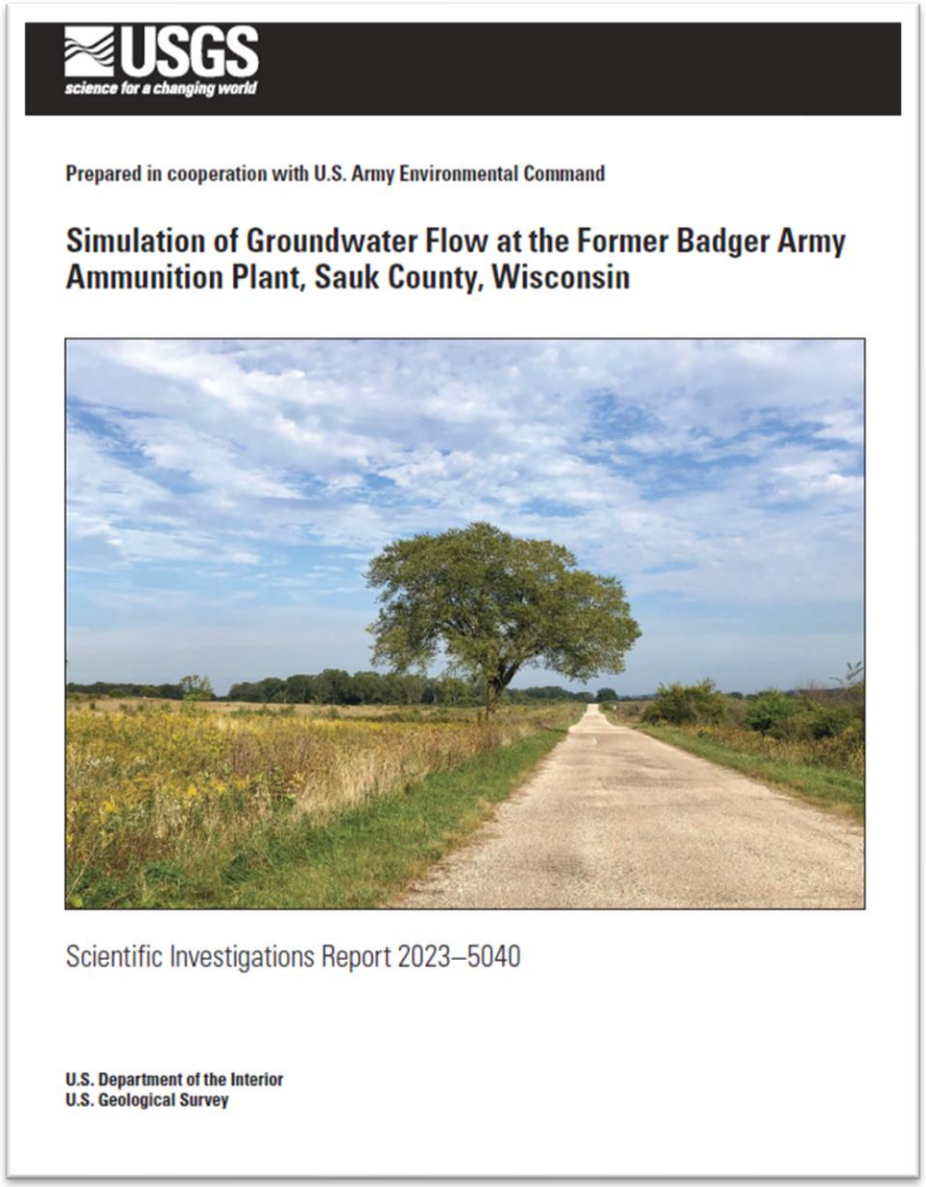


Image modified from: https://www.usgs.gov/media/images/groundwater-saturated-zone-soilrock-below-land-surface

USGS Groundwater Flow Model



Where is groundwater moving at Badger?

https://pubs.usgs.gov/publication/sir20235040

USGS

What is a groundwater transport model?

A bunch of math equations to calculate how a contaminant is moving underground with the groundwater and interacting with the aquifer.

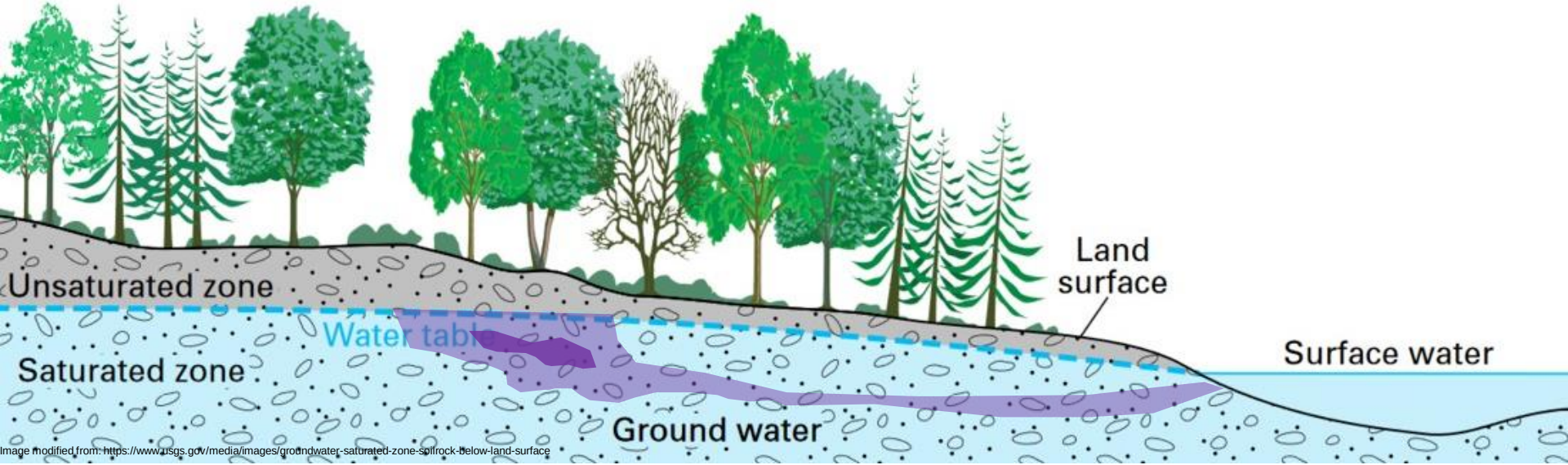


Image modified from: https://www.usgs.gov/media/images/groundwater-saturated-zone-soilrock-below-land-surface

A model is a necessarily simplified version of the natural world…

Real World

Model World

What type of animal is this?

- Both models can answer that.

Does this animal have whiskers?

- One of the models answers that.

What color is the animal's fur?

- Neither model can answer that.

…but it can have enough detail to inform the right type of question.

USGS

Dog images from: http://www.artgraphica.net/free-art-lessons/drawing-and-sketching/how-to-draw-a-dog.html

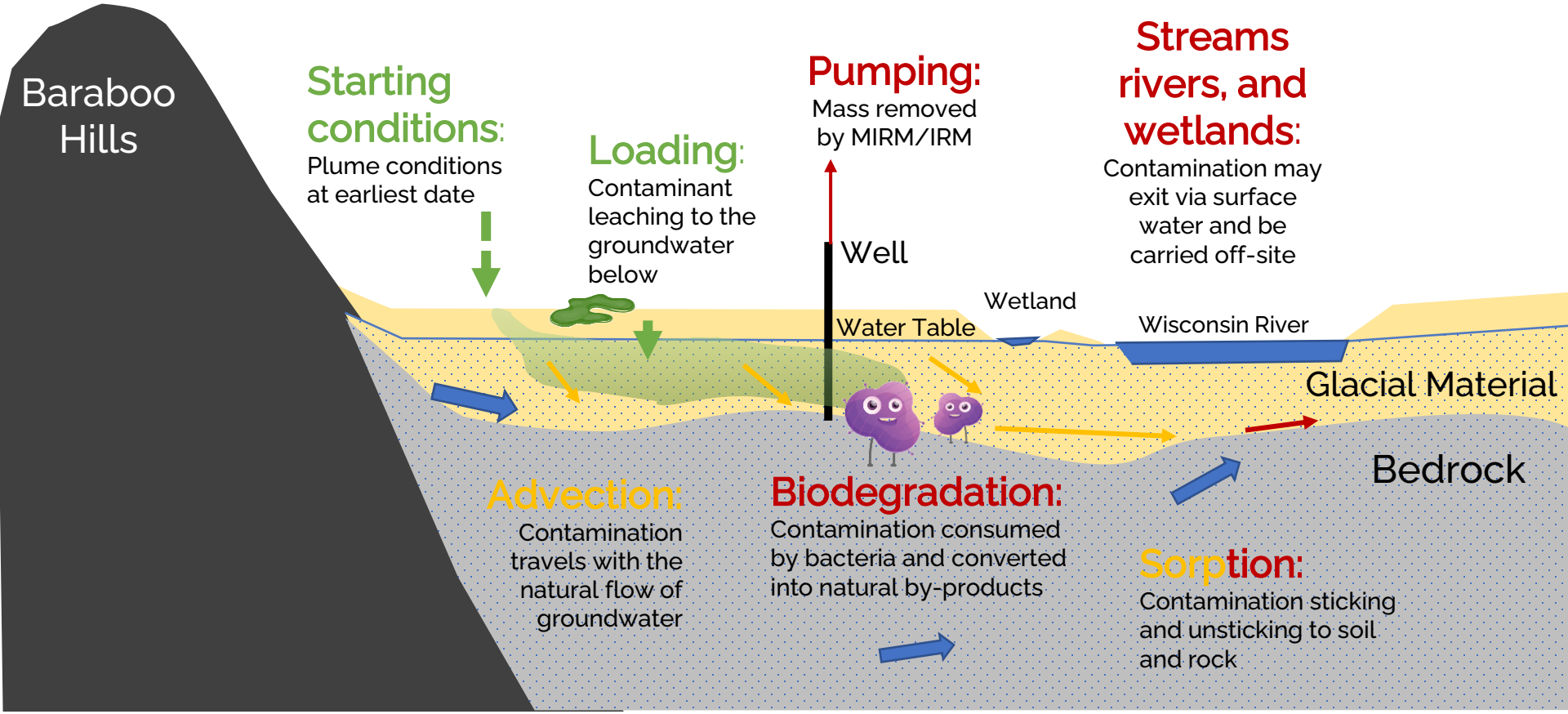
How are we modeling groundwater transport at Badger and what types of questions can we ask this model?

USGS

Photo credit: https://www.devilslakewisconsin.com/wisconsin-parks-trails-natural-areas/sauk-prairie-recreation-area/

Overview of transport processes

Yellow = Transport Green = Contaminant in Red = Contaminant out



Vertical scale has been greatly exaggerated to illustrate the flow system.

USGS

Modeling groundwater transport

There are many factors that control the movement and fate of groundwater contamination

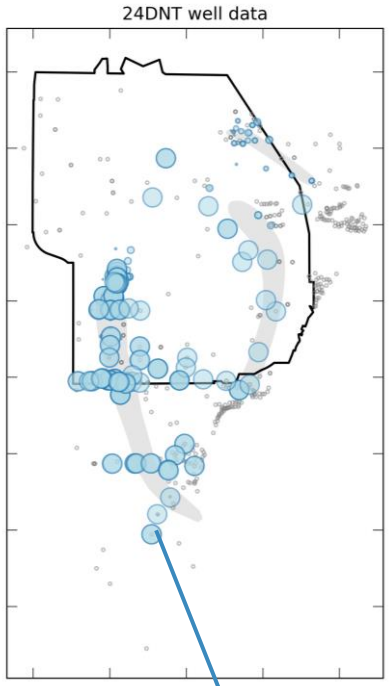
- Starting conditions
- Loading
- Sorption (soil and rock properties)
- Biodegradation
- Mass removal through discharge
- Advection and dispersion

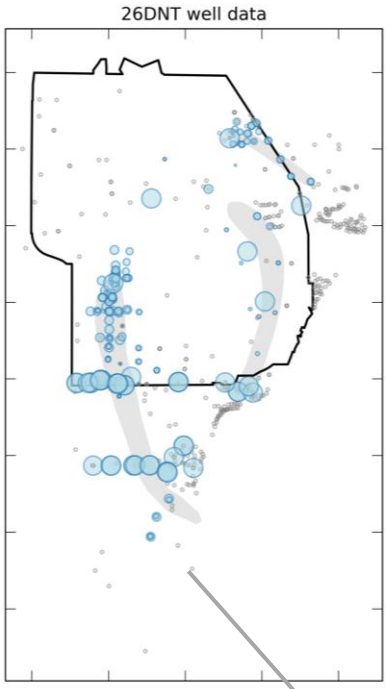
The model uses equations to represent each of these factors.

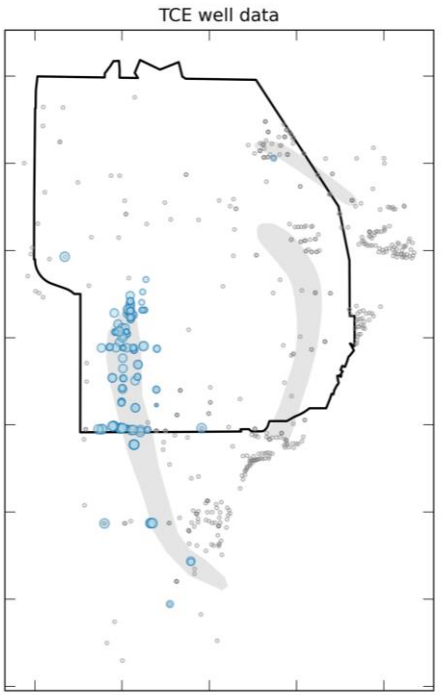
USGS

Using data from Badger to improve the model

- Rich history of well concentration measurements
- Compare model with reality in both space and time







Wells with detections

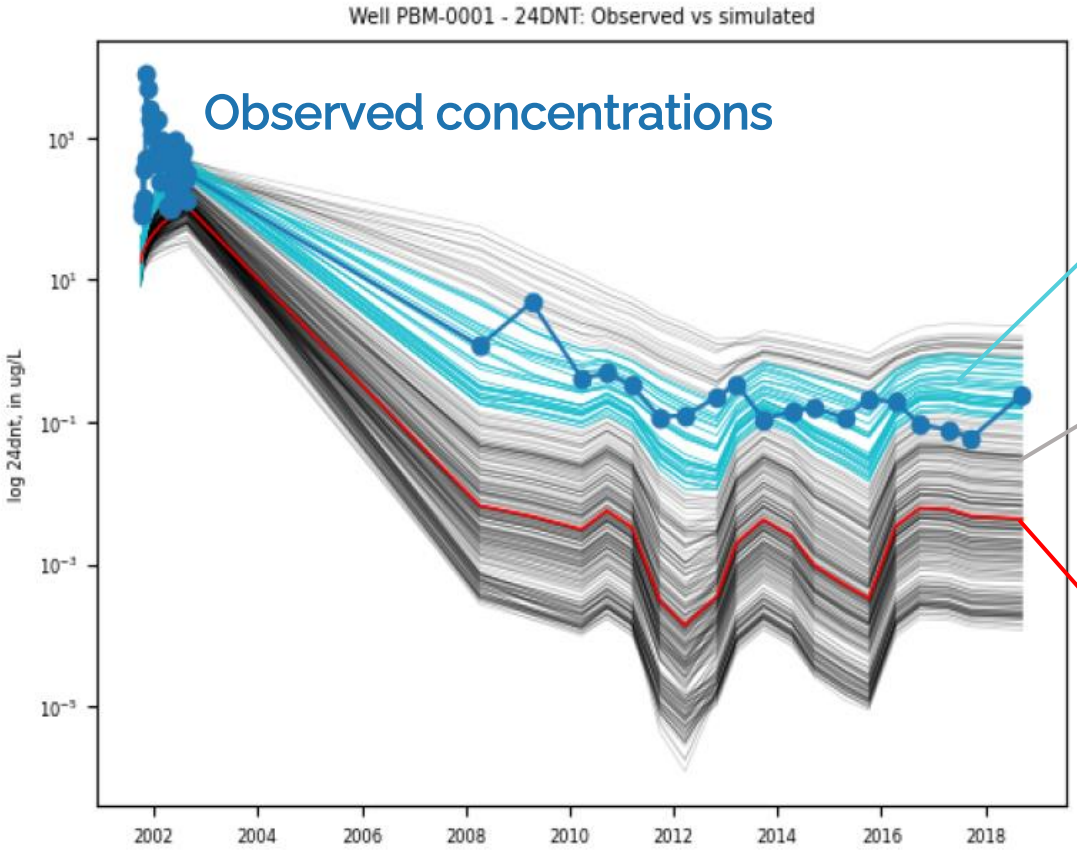
Wells without detections

Preliminary Information-Subject to Revision.
Not for Citation or Distribution.

Data from SpecPro and Pajerowski and others (2021); https://doi.org/10.3133/sir20205106

USGS

Evaluate model parameter combinations that best fit the site data



Best models

Models with alternate parameter values

Model with initial parameter values

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

USGS

Where are we headed with the model and what can we ask it – THIS YEAR?

Base Transport Model

- How might the plume footprint change over time under current site conditions?
- What about with a generic bioremediation system?
  - One challenge is that literature bioremediation values for DNT have large ranges
    - Run many versions of the model within these ranges to explore range of plume outcomes
    - Can help inform what parameters to include in a pilot study

Dog images from: http://www.artgraphica.net/free-art-lessons/drawing-and-sketching/how-to-draw-a-dog.html

USGS

Where are we headed with the model and what can we ask it – FUTURE?

Dog images from: http://www.artgraphica.net/free-art-lessons/drawing-and-sketching/how-to-draw-a-dog.html

Updated Transport Model

- Update model bioremediation parameters with pilot study data (if applicable)
- Use model to optimize the general placement of bioremediation well groups.
  - For example: Should all the wells be near the source area? How many wells should be used to get desired outcome given other design constraints?

USGS

Questions?

USGS Upper Midwest Water Science Center
Groundwater Modeling Team
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Howard Reeves: hwreeves@usgs.gov

USGS

Project Management Updates

Proposed Plan (PP) for the Site-Wide Groundwater

- Strategy is to install injection wells for placement of emulsified vegetable oil (EVO) at numerous locations along the plumes to reduce the groundwater concentrations of both volatile organic compounds (VOCs) and DNT.
- The Draft Final PP with Army's response to comments (RTC) was sent to WDNR on August 8, 2023.
- Once the all the comments to Draft-Final PP has been reviewed and accepted by WDNR, a Final PP notification for a 60 days public comment period will commence.

2nd Five-Year Review (FYR)

- Draft-Final FYR was delivered to USAEC on September 11, 2023.
- Currently undergoing internal review.
- Second Five Year Review anticipated to be published and available to the RAB and community in November 2023.

Badger AAP Installation Action Plan (IAP)

- Final IAP published USAEC Badger AAP website on September 20, 2023
- https://aec.army.mil/application/files/4716/9521/2289/FY23IAP-WI-BAAP.pdf

Project Management Updates

Key FY24 Contracting Actions

- **Settling Pond Expanded Site Inspection**
  - Includes Final Creek, Settling Ponds 1 & 3, & Spoils Disposal Areas I, II, III, IV, & V.
  - Site-Wide Groundwater Monitoring Plan.
  - Project anticipated to be awarded in Fall 2023.
    - The Mission Installation Contracting Command (MICC) completed a legal review on August 30, 2023.
    - A cost proposal solicitation was issued on September 7, 2023.
    - Currently addressing questions and clarifications to the proposal.

- **PFAS Remedial Investigation for Propellant Burning Ground**
  - Multi-site PFAS Performance Work Scope (PWS) completed internal USAEC technical reviews on September 27, 2023. Currently revising the package accommodate administrative internal reviews. The contract package will include Badger AAP.
  - The PFAS RI contract is planned for a FY24 award.

Project Management Updates

Landfill #5 - Repair of Settled Areas

- Repairs to Landfill #5 began on October 2, 2023. Work complies with the 1986 Continued Use and Closure Plan and the Wisconsin Statute for Solid Waste Facilities §289.41 paragraph 11 on Closure, Long-Term Care, and Corrective Action.
- Surface grading work completed on October 10, 2023.
- Hydoseeding surface completed on October 11, 2023
- All work for the landfill has been completed.

Future meetings

- **Future Meetings**
  - Agenda Items
  - Dates
    - January 18, 2024
    - April 18, 2024
    - July 18, 2024
    - October 17, 2024

Questions??

Public Comments

Closing Remarks