Former Badger Army Ammunition Plant
Restoration Advisory Board (RAB) FINAL Meeting Minutes

Time: 6:00 PM; January 15, 2026.

Place: Conducted in-person at Sauk Prairie River Arts Center, Leola Hall location, 105 9th Street, Prairie du Sac, WI, 53578; streamed live and captured through Sauk-Prairie Indy YouTube channel http://www.youtube.com/@SaukPrairieIndy; a virtual Microsoft Teams option was available and used by some.

Attendees:

In-person RAB members: Luke Lampo (Wisconsin Department of Natural Resources), Jeremiah Yee (Wisconsin Department of Health Services), Jessica Parrott (Wisconsin Department of Health Services), Doug Gjertson (Town of Sumpter), Mike Gleason (Lake Wisconsin Alliance), Charles Wilhelm (at-large member), Michelle Hopp (Village of Merrimac).

In person attendees: Quang Nguyen (USAEC), Joel Janssen (Army Contractor, SpecPro), Mark Frey (videographer), Jeiwon Deputy (Army Contractor, Cherokee Federal), Jim Bickford, Nicholas Carson-Dosch (United States Geological Survey), Meg Haserodt (United States Geological Survey), Louis Garcia, Kaylie Maran (Wisconsin Department of Health Services), Matthew Deraet (Wisconsin Department of Health Services), Caroline Rice (Wisconsin Department of Natural Resources).

Virtual attendees: Xiaochun Zhang (Wisconsin Department of Natural Resources), Valerie McAuliffe (Sauk County Board), Lally Laksbergs (USAEC), Mike Farin, Randy Poelma (Ho-Chunk Nation), Laura Olah (CSWAB), Stephanie Brensike (Town of Merrimac), James Ashley (Army Contractor, Cherokee Federal).

Welcome and Opening Remarks (USAEC):

Opening remarks and roll call were conducted. Following roll call, the July 2025 RAB meeting minutes were adopted; they will be added to the public website. USAEC stated recent schedule impacts were influenced by a federal government shutdown and a Midwest team staffing reduction; USAEC thanked members for patience as projects catch up.

Agenda included 1) Groundwater Sampling Update, 2) Groundwater Sampling Plan, 3) Project Management Updates, 4) USGS Groundwater Transport Modeling Study, and 5) Future meeting dates.

The meeting presentation slides were circulated in advance of this meeting to the RAB. All will be available on the Army's website (https://aec.army.mil/baap/rab).

Groundwater Sampling Update (SpecPro)

Cleanup contractor SpecPro presented an update on groundwater sampling using analytical results for June, August, September and November 2025 sampling rounds.

- The Central Plume boundary for total Dinitrotoluene (DNT) in June 2025 is based on 43 annually sampled monitoring wells and one quarterly sampled residential well. The plume can be divided by an east to west line near the source area to reflect the zone requiring remediation (north of this line) above the NR 140 Enforcement Standard (ES), DNT concentrations have increased in the northern portion of the Central Plume. DNT concentrations south of the line have decreased, with regularly tested wells in the Water's Edge Subdivision showing no detection of DNT.

- The August 2025 residential well sampling effort encompassed 64 wells across three plumes. DNT was not detected in all 64 wells. NR 140 Preventive Action Limit (PAL) exceedances included Carbon Tetrachloride (CTET) in two wells within the Propellant Burning Ground (PBG) Plume and chloroform at two wells within the Central Plume at Water's Edge. WDNR requested that the sampling for the two PBG Plume residential wells with CTET detections be increased from annual to semi-annual.

- The September 2025 Deterrent Burning Ground (DBG) Plume sampling effort included 47 monitoring wells. DNT exceeded NR 140 ES or PAL in nine wells with the highest concentration (3.084 µg/L) in the DBG Waste Pit area. Concentrations decreased downgradient of this area.

- Seven monitoring wells were sampled in September 2025 to address the Nitrocellulose (NC) Plume. Three wells within the NC Plume showed NR 140 ES exceedances for total DNT. This is in the area where the Nitrocellulose pellets were manufactured. New monitoring wells are in discussion for targeting specific areas. The highest DNT concentration was 0.117 µg/L, which is twice the ES.

- In September 2025, a total of 80 monitoring wells were sampled within the Propellant Burning Ground (PBG) Plume. Of these, 16 wells had DNT above the ES and all located near the plant boundary and closer to the identified source areas. The maximum detected DNT concentration was 2.629 µg/L, measured near the PBG Waste Pits. This represents a decrease compared to historical concentrations and coincides with a lower-than-normal water table at the time of sampling. This area remains the primary focus for any future DNT remediation efforts.

    - CTET continues to exceed the ES both on-site and off-site within the plume. Off-site exceedances persist along Highway 78, including the area

near the Culver's office location. These CTET exceedances have been consistently tracked over multiple years.

- One well of particular concern, SWN-9103D, located along County Z between Highway 12 and Highway 78, continues to show elevated concentrations of ethyl ether. This is a deep monitoring well, positioned just above the bedrock interface. Ethyl ether concentrations at this location have remained stable, but continue to exceed the ES of 1,000 µg/L.

Questions (**Q**) and Responses (**R**)

- **Q: Will groundwater monitoring be part of the residual explosives in soils investigation in the Settling Ponds area beyond what is there right now?**

- **R**: At the moment, the Army needs to do a CERCLA Remedial Investigation (RI) of the soils, but that process does include a risk assessment of impacts to groundwater as a standard part of the process (SpecPro).

Groundwater Sampling Plan (SpecPro)

A comprehensive groundwater sampling plan was recently submitted, representing the first site-wide plan for the Badger property in several years. On January 6, comments were received from WDNR on the draft submission. Army is preparing a formal written response to those comments, after which the plan will be finalized and resubmitted. Overall, WDNR approved the majority of the submitted plan acceptable, and most elements will remain unchanged. Requested revisions focus primarily on supplemental sampling and adjustments to monitoring frequency rather than fundamental changes to the program.

Central Plume Monitoring

Several updates are planned for the Central Plume:

- A small number of existing shallow monitoring wells located within the interior of the installation will be added to improve coverage in the center of the plume.

- USDA farm wells will remain in the monitoring program. These include one on-site well used for cattle, and three high-capacity wells located near the active farm operations.

- Residential wells in the Water's Edge subdivision will continue to be sampled annually, with the exception of one well with a documented DNT history, which will remain on a quarterly sampling schedule.

- The Central Plume is predominantly characterized by DNT contamination, with VOCs (primarily chloroform) confined to the southern portion. No VOCs are currently detected in the northern portion.

Central Plume Boundary Delineation Wells

To better define plume boundaries, two additional monitoring wells are proposed on the east and west sides of the plume. These wells are intended to confirm the plume extent and identify areas of cleaner groundwater, consistent with prior WDNR requests to improve plume delineation.

The proposed monitoring well nests will include:

- A “B” well, approximately 100 feet deep, targeting the primary residential well depth where the highest historical DNT concentrations were observed.
- A “C” well, drilled deeper (approximately 170–180 feet), to evaluate whether contamination has migrated vertically.

This design mirrors the range of residential well depths in the area, which are typically around 100 feet, with some deeper wells and a limited number completed in bedrock. Continued annual monitoring of residential wells will help identify any plume migration toward the east or toward the river.

Deterrent Burning Ground (DBG) Plume Monitoring

All existing monitoring wells within the DBG plume will remain in the sampling program, though sampling frequencies will be adjusted based on risk.

- An off-site monitoring well nest previously sampled quarterly will be reduced to semi-annual sampling. This area presents lower risk due to declining concentrations and the replacement of a residential well with a clean supply.

- A newer monitoring well located downgradient toward residential areas will remain on a quarterly sampling schedule.

In the Weigand’s Bay North area, where a single landowner controls much of the property and numerous sand-point wells exist:

- Three wells will continue to be sampled.
- Additional nearby residential and monitoring wells will remain on a quarterly schedule to provide early detection of any plume migration.

Monitoring wells located further south (ELN-1001 Nest, ELN-1002 Nest, and S1121) will continue to be sampled to ensure contamination is not migrating in that direction.

Questions and Responses

- **Q: A RAB member had asked previously for a review on a 2009 investigation conducted by the Army in the DBG Plume area that detected low concentrations of DNT in downgradient residential wells at Weigand's Bay South, and recommended that the Army continue private well testing.**

- **R**: The investigation involved a drilling program using a core barrel and temporary casing. Groundwater samples were collected at the water table and at multiple depth intervals as drilling progressed, similar to vertical profiling during well installation. No soil samples were collected, only groundwater samples. Some detections of DNT were reported in that investigation, including detections in two residential wells located outside the currently defined plume footprint.

  The 2009 investigation was both informative and limited in its outcomes. It was successful in demonstrating that DNT was migrating offsite, which at that time had not been fully characterized due to a lack of offsite monitoring wells. As a result of those findings, the Army expanded the monitoring network in 2010, installing numerous additional monitoring wells both on-site and off-site in areas now known to be impacted. This significantly improved plume delineation and understanding of offsite migration.

  However, some of the low-level DNT detections observed during the 2009 effort were difficult to interpret. Those detections were isolated, low concentration, and not supported by detections in intervening wells between the plume and those locations. This raised questions about data reliability and whether those detections represented true plume migration.

  Follow-up actions addressed these uncertainties. Monitoring wells were later installed in the same general locations, and no repeatable DNT detections have occurred since. Two residential wells in the area have been sampled annually from 2009 through 2025, along with additional wells near Weigand's Bay South. Only one detection occurred in 2012 and a minor detection in 2015, neither of which was repeatable. No persistent or expanding plume has been identified in this area.

  Additional clarification was provided regarding how this information is documented in the groundwater sampling plan. A summary table within the plan compiles historical results, and the full database (available online or through project records) contains detailed sampling data spanning the past 15–20 years for all residential and monitoring wells in the area.

  A detection summary covering approximately 15–17 years of data shows that DNT detections in any of the residential wells are rare, isolated, and non-repeatable. In total, 19 residential wells within the area of concern (yellow box on Slide 12) have been sampled regularly since approximately 2007, and the data

do not support an active or sustained DNT source impacting these wells from Badger.

Monitoring indicates that groundwater movement and plume migration in this region is directed toward the northern section of Weigand's Bay North, not toward the southern residential areas. This conclusion is further supported by the fact that a residential well located north of the area showed DNT contamination and required replacement, while no comparable impacts have been observed to the south.

Some historical VOC detections, particularly TCE, were also discussed. Investigations determined that certain detections were attributable to jet pump components, not groundwater contamination. In multiple cases, water samples collected after pump removal showed no VOCs, while samples collected through the pump showed TCE, indicating contamination from pump materials rather than the aquifer.

This issue was identified in several locations, including Weigand's Bay North (near E12649B and E12655) and Gruber's Grove Bay. Although minor VOC detections have occurred historically in residential wells, extensive upgradient and plume-area monitoring has confirmed that there is no TCE plume originating from Badger affecting these areas.

All of this historical information (including VOC findings, pump-related artifacts, and DNT sampling results) has been documented and summarized within the proposed groundwater sampling plan (SpecPro).

- **Q: A RAB member asks if anything detected in one of her neighbor's residential wells.**

- **R**: Nothing found in that well. That was a new well that was drilled and tested for DNTs and VOCs (SpecPro).

- **Comment: I am thinking ahead to when these injections into groundwater might happen and the potential to mobilize PFAS if it's present. I am concerned about not having continuity and data before, during and after the pilot test and the full-scale implementation, because I think that it is going to be too difficult to guesstimate this (RAB Member).**

- **R**: When those injections take place, they would be up to the northwest and away from Highway 78. And there will definitely be monitoring during the injections to make sure that there is no mobilization of anything within several hundred feet. We have a residential well that we're quarterly sampling in the Highway 78 area. We have made that a top priority. We will automatically change course and move to either increase sampling or go back to some residential sampling if we do detect something (SpecPro).

- **Q: Looking at the 2024 data at the ELN-1001 well nest. Is there a finger coming off that plume or is that detection from another source?**

- **R**: Nothing found to the north of this well nest to show that the plume would be sliding to the south yet, but that would definitely be something we're going to mention if we start to see something like that in the future. During 2025, DNT wasn't found down in the ELN-1001 well nest area (SpecPro).

- **Comment: A RAB member emphasized that results from monitoring wells and nearby drinking water wells can differ significantly, even when they are located on the same property. They noted the importance of recognizing that current conditions are relatively static, with no new inputs being introduced into the groundwater system. Given this context, they stressed the need for comprehensive monitoring (not only at the plant boundary, but also in off-site residential areas) to fully understand groundwater conditions and ensure community protection.**

Nitrocellulose (NC) Plume

For the Nitrocellulose Plume, which is located on-site, the Army and WDNR have identified a need for additional monitoring wells along the southern downgradient portion of the plume. Historically, a monitoring well existed in this area, but it was abandoned more than a decade ago during a large-scale well abandonment effort, at a time when the NC Plume was not considered a significant concern. As a result, current data are insufficient to confidently define the downgradient extent of the plume.

- The intent is to install a new monitoring well in this southern area to determine whether the NC Plume has migrated further downgradient. WDNR has noted that the current plume boundary is uncertain, and it was agreed that the boundary has effectively been inferred rather than confirmed. Additional monitoring would allow the plume extent to be better defined.

- To the north, groundwater enforcement-standard exceedances for DNT remain present. The Army is considering the WDNR request to install a monitoring well nest in this area to evaluate whether DNT is still present further upgradient. This area historically contained numerous production buildings, and remediation activities identified DNT contamination associated with former manufacturing processes. These historical conditions likely explain the presence of a small, localized plume associated with nitrocellulose-related operations.

- At this time, there is no active contract in place to install these new wells. While the Army anticipates future drilling, subject to availability of federal funding.

Propellant Burning Ground (PBG)

The Army continues to propose installing three monitoring wells near the dam at the PBG. These wells have been discussed at multiple meetings over the past several years. Progress has been delayed due to property access and permitting challenges. While operational staff at the dam have been cooperative, property management requirements have been difficult to resolve. The Army will continue working through these issues to enable future installation of the wells, which are intended to assess potential plume interaction with the Wisconsin River.

Expanded monitoring in The Windings subdivision area is under consideration. Eight existing monitoring wells in this area, which have not been sampled for approximately five years, will be brought back into the sampling program. Long-term monitoring indicates that the plume has gradually shifted eastward over the past 20 years, prompting increased use of existing monitoring wells on the eastern side of the plume.

The location of Final Creek and the Settling Ponds was referenced to provide context. Monitoring wells are located both north and south of Settling Ponds 1 through 4. While the primary focus remains the PBG Plume, monitoring of wells downgradient of the Settling Ponds will continue, as required under the terms of site closure. Continued groundwater sampling was a condition of the Settling Ponds' WDNR closure and remains in effect.

Additional sampling adjustments at the PBG plume include:

- Increased testing at the source area, including three wells previously clean (well nest PBN13014A,B,C), to ensure the PBG plume boundaries remain well defined.

- Increased sampling density along the central portion of the PBG plume to improve long-term trend analysis prior to any remediation activities.

- Reduced sampling frequency (not elimination) for monitoring wells along the far western edge, where plume migration risk is lower. Some wells will shift from semi-annual to annual sampling, while some eastern wells may be sampled every two years.

There are no reductions in residential well testing. Residential monitoring was expanded in recent years and will continue. As the plume shifts eastward, deeper residential wells (particularly bedrock wells) have been added to higher-frequency sampling. These include wells near Highways 78 and County Z, such as cooperative and farm wells, as well as a bedrock well across the road from The Windings subdivision.

- Monitoring will continue for residential wells near the Windings subdivision that have had historical detections of CTET, DNT, or ethyl ether. Some bedrock wells in The Windings area have previously shown ethyl ether detections, and ongoing testing for both DNT and VOCs [including ethyl ether] will be conducted, even where contamination is not directly associated with the current PBG Plume.

- It was noted that contamination attributable to Badger has been detected in the Winding(s) area more than 20 years ago, though it does not directly align with the current plume configuration. Residents will be informed of results following completion of a full sampling round.

- All wells within the PBG plume were sampled once in 2020, providing relatively recent baseline data. That dataset was used extensively to support the remedial investigation planning and plume mapping. A large, one-time expansion of sampling (approximately 100 additional monitoring wells) was conducted to inform development of the current sampling strategy. Those results guided decisions on where to increase, reduce, or shift monitoring locations.

Going forward, the strategy is to remain ahead of plume movement, particularly to the east, by leveraging existing wells rather than installing new ones unless necessary (SpecPro).

Questions and Responses

- **Q: Referring back to the slide on residential well testing, there are four households with PAL exceedances. Can you clarify how residents are notified of their results? Do they receive something in the mail, or how do they generally learn about the findings?**

- **R**: The results are sent to residents by mail after WDNR receives them. Additionally, Army's contractor coordinates directly with residents to schedule sampling (which often requires phone calls or entering their homes) and many one-on-one conversations over the years explaining what the results mean, especially when people move in or switch residences. Overall, Army makes an ongoing effort to explain what we're finding.

  Slow upward trends in contaminants, particularly CTET, in two residential wells on Keller Road in the Town of Sumpter. This same trend appears first in nearby monitoring wells located north of the residences along the fence line near the Settling Ponds. Those monitoring wells act as an early indicator, showing plume migration toward the residential wells before it shows up there. Eventhough this movement was anticipated, concentrations remain below groundwater enforcement standards and are limited to PAL exceedances.

  For example, CTET has a PAL of 0.5 µg/L and an enforcement standard of 5 µg/L. Current concentrations are still well below enforcement levels but the trend is upward, which indicates the plume continues to move. Because enforcement standards have not been exceeded, the Army does not currently have the legal authority to replace the residential wells. The Army will evaluate actions required if levels continue to rise. These two wells will be sampled more frequently (twice a year) at WDNR's request (SpecPro).

- **Q: Are residents concerned about these findings?**

- **R**: Some residents do ask questions, particularly about contaminants that are new to them or that they weren't previously aware of (SpecPro).

- **Q: If residents want health-related information about contaminants like CTET or chloroform, where should they go? Can we help them access information so they can make informed decisions?**

- **R**: We could certainly provide informational resources, such as links from the WDNR website or related public health sources (WDNR).

- **Closing Comment from a RAB member**: Providing residents with clear, accessible information would help them feel informed and empowered. Even though the Army isn't required to take action yet because enforcement standards haven't been exceeded, people naturally want to understand potential health implications and whether it's safe to use their water. If this were my well, I'd be asking the same questions. Sharing more information would likely be beneficial.

Project Management Updates (USAEC)

Proposed Plan for Site-Wide Groundwater

As mentioned in the previous RAB meetings, Army is still considering to conduct a bench and pilot scale testing of the proposed emulsified vegetable oil (EVO), subject to funding availability. The bench and pilot tests were based on comments that Army received from during the public comment period for the proposed plan. Since the last RAB meeting in July 2025 the Army has provided those responses to those comments received and we have distributed that to the RAB members. Army still working on including those comments into the administrative records and hopefully we will have that completed very soon (USAEC).

Gruber's Grove Bay Data Gap Investigation.

The Army provided an update on the Gruber's Grove Bay data gap investigation, which involves characterizing conditions of the bay to support future remedial decisions. In response to WDNR comments, the Army submitted a set of responses on December 12. As of last week, WDNR has approved those responses. The Army expects to transmit the finalized document to WDNR imminently, if it has not already been sent. The next major step following this effort will be the development of feasibility studies in future years.

Questions and Responses

- **Q: Can you clarify what you mean by WDNR accepting the comments?**

- **R**: WDNR formally approved and accepted the Army's responses submitted on December 12. (USAEC)

PFAS Remedial Investigation.

The Army still plans to conduct a remedial investigation (RI), subject to availability of funding. A Preliminary Assessment/Site Inspection (PA/SI) was completed in November 2022, and since then, the Army has put contracting mechanisms in place to perform the RI. However, without additional funding ("plus-up") specifically allocated for PFAS work, the RI is not expected to occur until approximately FY2027 at the earliest, or possibly later. The Army will continue to keep stakeholders informed of any changes in funding status.

Questions and Responses

- **Q: Would a state requirement or regulatory directive to conduct PFAS testing help elevate the priority or funding for this work?**

- **R**: Regulatory directives generally help increase funding priority. One of the comments received from WDNR on the groundwater sampling plan already touches on PFAS considerations. In general, any concerns raised by regulators or community members are communicated transparently to Army leadership to ensure they are fully aware of those issues (USAEC).

Settling Pond Site Inspection

The Army reminded the group that it presented the scope and status of Settling Pond fieldwork at the April 2025 RAB meeting, followed by a summary of sampling results at the July 2025 RAB meeting. A Site Inspection (SI) Report was submitted to the WDNR on November 21, 2025. The Army plans to provide a more detailed presentation at a future RAB meeting once WDNR comments are received. The draft report can be found at the WDNR website.

Questions and Responses

- **Q: For closure of the Settling Ponds (which have not yet been fully investigated) does WDNR have responsibility as the landowner, separate from its regulatory role?**

- **R**: Not directly, as far as understand. The Settling Pond site itself had previously been closed. However, the event in 2020 involving burning activity in Settling Pond 2 prompted the Army to re-evaluate the site, leading to the current expanded investigation. (SpecPro).

The Army also provided an update on the long-term management contract. At the previous RAB meeting, the Army reported that it was developing a follow-on contract to continue land use inspections, sampling, and groundwater monitoring currently being conducted by SpecPro. The Army confirmed that this contract process has now been completed. The follow-on contract was funded and awarded in September 2025, with a five-year period of performance, and SpecPro was selected to continue providing these services.

Questions and Responses

- **Comment**: A RAB member noted that the prior meeting minutes state that WDNR is the property owner of certain Settling Pond areas and that closure of those areas would be up to WDNR. The minutes also indicated that earlier sampling efforts were more limited. This clarification helped resolve confusion about what "closure" referred to.

- **R**: "Closure" in this context may refer to WDNR's internal property management decisions (such as whether to restrict access to the parcel) rather than regulatory closure related to environmental cleanup (WDNR).

- **Q: So "closure" could mean fencing or restricting access?**

- **R**: Yes, that's correct; things like fencing, signage, and access control. (WDNR).

Summary of USGS Groundwater Transport Modeling Study (USGS)

The United States Geological Survey (USGS) presented an explanation of the groundwater flow and transport models that are being created across the full range of plumes at Badger:

Purpose of the Study

- **Developed groundwater flow and transport models for the Badger site to understand:**
    - Groundwater movement and interaction with the Wisconsin River.
    - How groundwater flow controls contaminant plume movement.
- **Supports long-term cleanup planning and monitoring network evaluation.**

Modeling Approach

- **Groundwater Flow Model:** Foundation for transport modeling; simulates water movement through aquifers. Previously published - Haserodt and others, 2023(https://doi.org/10.3133/sir20235040)

- **Transport Model:** Predicts contaminant movement (2,4-DNT, 2,6-DNT, TCE) and interactions with aquifer materials.

- Used history matching to align model outputs with field data and estimate transport parameters

- Addressed non-uniqueness by using an ensemble of models to represent uncertainty.
- Forecast future conditions with uncertainty for three remediation scenarios.

Bioremediation Analysis

- Tested conceptual treatment layout from the Proposed Plan for Site-wide Groundwater report.

- Ran three treatment scenarios forecasting plume conditions 20 years into the future:

    - Natural attenuation (no bioremediation)

    - Low-effectiveness bioremediation

    - High-effectiveness bioremediation

- Results vary due to:

    - Source loading assumptions.

    - Uncertain degradation rates.

    - Configuration of treatment system

- Highly effective bioremediation could remove ~5× more DNT mass than low-effectiveness scenario over 20 years.

Limitations & Next Steps

- Source loading and COC degradation rates remain uncertain.

- Pilot study recommended to refine predictions and optimize treatment design.

- Model simulates only two main DNT isomers, potentially underestimating total DNT contamination in some down-gradient areas of the DBG and central plume.

Key Findings

- Current Conditions:
    - Plumes persist due to assumed ongoing source loading.
    - Greatest uncertainty in the central plume and DBG due to limited data and uncertain transport properties.
- Probability Mapping:
    - Shows areas likely to exceed cleanup thresholds (PAL).
    - Useful for assessing monitoring well coverage.
- Future Projections:
    - Without remediation: Minimal reductions over 20 years.
    - With bioremediation:
        - High-effectiveness scenario could meaningfully reduce contamination, especially in DBG and central plume.
        - Lower-effectiveness scenario shows smaller but notable improvements compared to natural attenuation.
        - Effectiveness depends on degradation rates—pilot study needed.

Key Takeaways

- Model supports risk-based decision-making by explicitly representing uncertainty.
- Useful for evaluating monitoring networks and designing remediation strategies.
- Report has completed internal review and will be published soon, along with transport model and supporting data.

Questions and Responses

- **Q: Why does the model show remediation occurring, but with limited apparent plume reduction, in some cases?**
- **R1**: Several assumptions influence these results. One key assumption is continued source loading. Historical model calibration required some ongoing contribution from source areas to sustain observed concentrations at monitoring wells. As a result, future simulations assume continuous loading from source

zones, which means plumes do not fully disappear even with bioremediation applied downgradient.

The treatment zones were modeled slightly downgradient of the source areas, so contamination persists at the source while attenuation occurs further downgradient. Additional scenarios without source loading (showing substantially smaller plumes) will be included in the report. Actual site conditions likely fall somewhere between these extremes.

The nature of source loading is uncertain and may be continuous, episodic, or driven by water-table fluctuations intersecting contaminated soils, particularly in the PBG.

Degradation rates are also highly uncertain and vary based on contaminant concentration, aquifer chemistry, and position along the flow path. A pilot study would provide site-specific degradation rates that could be incorporated into the model to improve future projections (USGS).

- **R2**: The pilot study is critical because the modeled scenarios represent very different outcomes. Literature-based degradation rates span a wide range, and it is unclear where Badger would fall within that range. A pilot study would help determine whether site conditions support rapid degradation, limited degradation, or something in between.

  Evidence from field data suggests that rapid degradation can occur when concentrations are high, as shown by observed concentration spikes followed by rapid declines. However, degradation appears slower at lower concentrations, which contributes to the long plume “tails” observed for DNT. A pilot study would help clarify how these dynamics play out under engineered remediation (USGS).

- **Q: How does the model account for sorption and matrix interactions?**

- **R**: The model includes sorption using layer-based assumptions tied to estimated organic carbon content, based on literature values from similar sites. Site-specific organic carbon measurements are limited, but aquifer materials appear to be relatively clean outwash sands with low organic content, suggesting limited sorption overall. Matrix diffusion is not explicitly represented. However, sensitivity testing indicates that sorption in upper aquifer layers has an important influence on model outcomes and may warrant further evaluation during future treatability studies (USGS).

- **Q: Why do some areas (particularly residential zones) show minimal changes in exceedance probability?**

- **R**: In some areas, baseline exceedance probabilities are already very low, so changes are numerically small and may not be visually apparent. Larger decreases are more evident in the central plume and parts of the DBG. In the

PBG, modeled treatment zones were relatively narrow, so broader reductions might be achieved with wider or differently positioned treatment lines (USGS).

- **Q: Why does the PBG plume show limited change even under effective bioremediation?**

- **R**: This reflects the specific treatment configuration tested, which was intended only as a proof of concept. The modeling framework is designed to allow iteration—adjusting treatment placement, width, or orientation—to explore alternative designs and optimize outcomes. One takeaway is that the tested configuration may not sufficiently intercept key plume areas, highlighting the model's utility as a design tool (USGS).

- **Comment**: A RAB member raised concerns that the model uses total DNT approximated from 2,4- and 2,6-DNT, while field data show that other isomers (e.g., 2,3- or 3,4-DNT) dominate in some areas, particularly downgradient and at the DBG. Some of these isomers degrade differently and can serve as tracers.

- **R**: This is a valid concern. The exclusion of lesser isomers likely leads to underrepresentation of downgradient plume extent, especially in the central plume and DBG. These isomers were excluded due to limited historical data, which constrained calibration. Incorporating them would require assumptions about transport and degradation behavior, but future data from treatability studies could support updating the model (USGS).

- **Comment**: Participants emphasized that this issue has implications beyond Badger, as many sites and regulatory frameworks focus only on 2,4- and 2,6-DNT despite evidence that other isomers contribute to exposure and health risk.

Key Takeaways from the Model

- The model integrates extensive field data to estimate groundwater contamination and supports evaluation of monitoring networks and unsampled areas.

- Prediction uncertainty is explicitly represented, enabling risk-based decision-making.

- Some continued source loading is required to match observed data, suggesting plumes may persist or re-develop.

- Source loading remains highly uncertain and may warrant additional study.

- Model uncertainty is greatest in the central plume and parts of the DBG due to limited data and incomplete representation of DNT isomers.

- Without remediation, only minimal plume reductions are projected over 20 years, depending on source assumptions.

- Bioremediation outcomes are highly dependent on achievable degradation rates, which a pilot study could better define.

- The proof-of-concept analysis demonstrates that the model can be used to optimize bioremediation design and evaluate alternative layouts.

The report has completed internal review, comments are being addressed, and it will proceed to publication. The model and report are expected to be publicly released in the coming months.

Questions and Responses

- **Q: Which plumes are of greatest concern regarding continued source loading?**

- **R**: The PBG shows episodic concentration spikes that may indicate residual contamination above the water table, potentially protected by caps but mobilized during water-table rises. The central plume is also highly uncertain, as its source area is poorly constrained. These represent the greatest source-related uncertainties in the model (USGS).

- **Q: What would continued study involve?**

- **R**: Future work could incorporate degradation rates derived from a treatability study into revised forecasts and support iterative testing of alternative bioremediation designs in coordination with system designers (USGS).

Closing Remarks

The next RAB meeting is scheduled for April 16th of this year. Other dates representing the normal quarterly schedule are presented below. Any follow-up questions are welcome and can be submitted to USAEC by email.

Future RAB Meeting Dates (USAEC)

- 16 April 2026
- 16 July 2026
- 15 October 2026
- 14 January 2027

The RAB meeting was adjourned at 7:49 PM.