



U.S. ARMY  
ENVIRONMENTAL  
COMMAND

# Status of Cleanup at the Former Badger Army Ammunition Plant (BAAP)

RAB Meeting

01-16-2025



- **Welcome and Opening Remarks**
- **Roll Call**
- **Review of the Minutes from October 2024 RAB**
- **Future Meeting Dates**
- **Explanation of Proposed Plan for Site-wide Groundwater at BAAP**
- **Questions on the Proposed Plan**
- **RAB Meeting will adjourn**
- **Proposed Plan public comment meeting begins**
- **Official Oral Public Comments for Proposed Plan**



# **Welcome/Opening Remarks**

## **Former Badger Army Ammunition Plant Restoration Advisory Board**

**January 16, 2025**



- 17 April 2025 (RAB Membership)
- 17 July 2025
- 16 October 2025
- 15 January 2026



# BAAP - Background



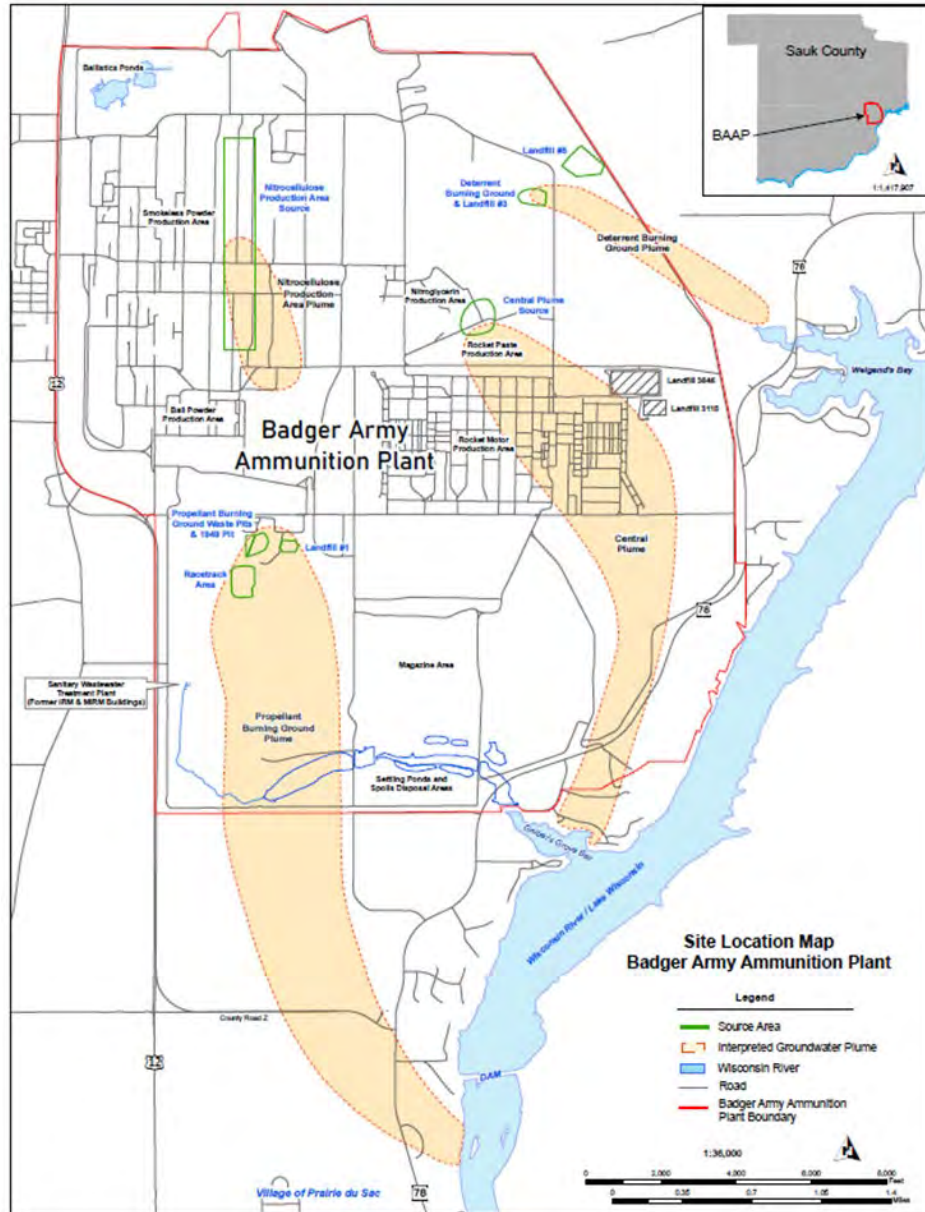
The Former Badger Army Ammunition Plant operated intermittently from 1942 until 1975.

The Army no longer owns land at BAAP. Ownership has been transferred to Bluffview Sanitary District, Ho-Chunk Nation, Town of Sumpter, USDA, WDNR, and Wisconsin DOT.

Historical releases of production related substances from BAAP to the groundwater occurred through production activities and various waste disposal practices.



# BAAP - Groundwater Plumes



The Remedial Investigation identified four known groundwater plumes at BAAP:

- Propellant Burning Ground (PBG) Plume
- Deterrent Burning Ground (DBG) Plume
- Central Plume
- Nitrocellulose Production Area (NC) Plume



## Current Contaminants Exceeding WDNR Groundwater Enforcement Standards

- Carbon tetrachloride (CTET) = 5.0 µg/L
- Ethyl ether = 1,000 µg/L
- Total Dinitrotoluene (DNT) = 0.05 µg/L
- 2,4-DNT = 0.05 µg/L
- 2,6-DNT = 0.05 µg/L
- Trichloroethylene (TCE) = 5.0 µg/L

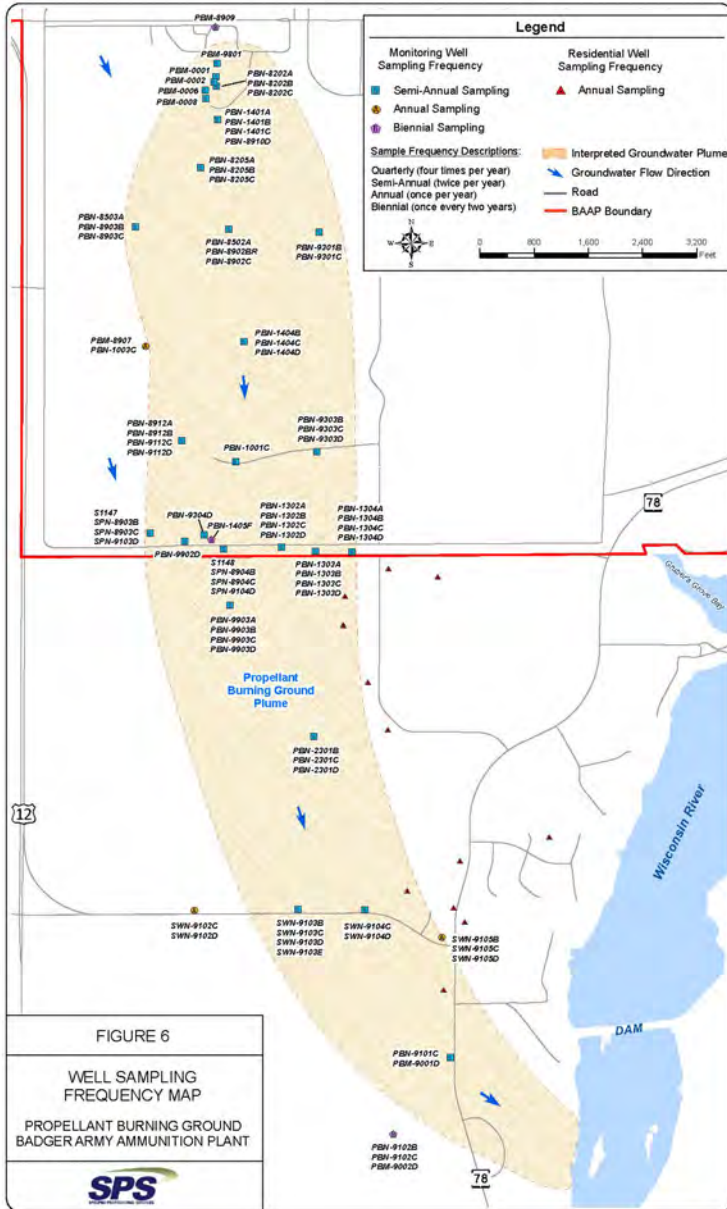


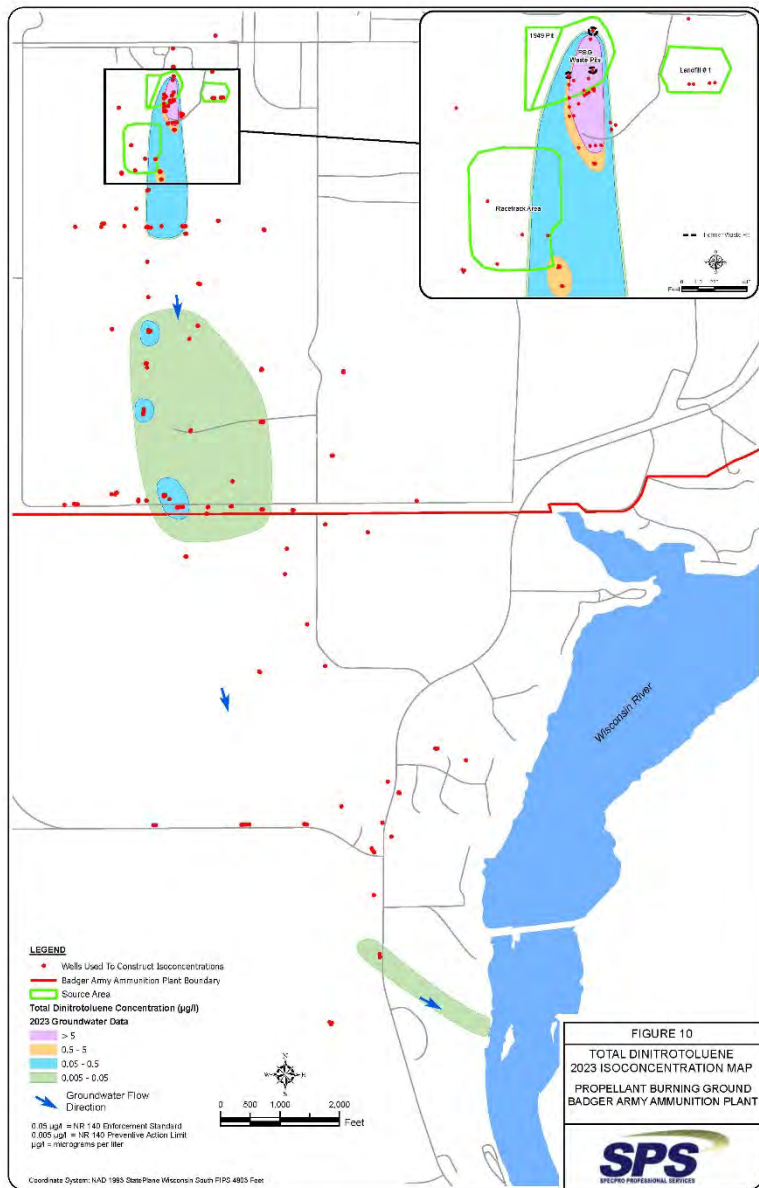
FIGURE 6

WELL SAMPLING FREQUENCY MAP

PROPELLANT BURNING GROUND BADGER ARMY AMMUNITION PLANT



# BAAP - PBG Plume Total DNT



Total DNT consists of six isomers:

- 2,3-DNT
- 2,4-DNT
- 2,5-DNT
- 2,6-DNT
- 3,4-DNT
- 3,5-DNT

Wisconsin NR 140 Groundwater Protection Standards for Total DNT

- Enforcement Standard (ES) = 0.05 µg/L  
(light blue shapes)
- Preventive Action Limit (PAL) = 0.005 µg/L  
(green shapes)

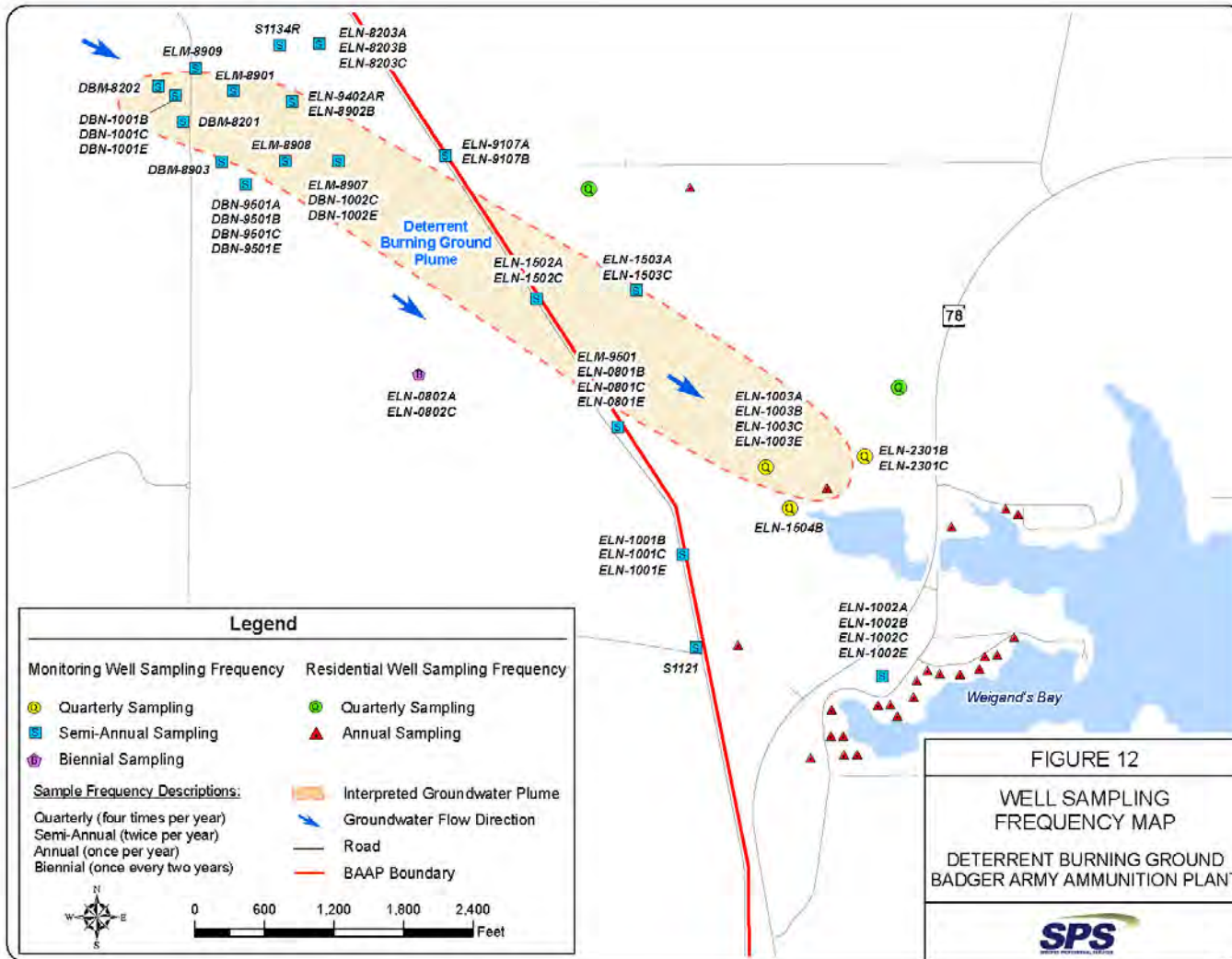
(µg/L is micrograms per liter or parts per billion)



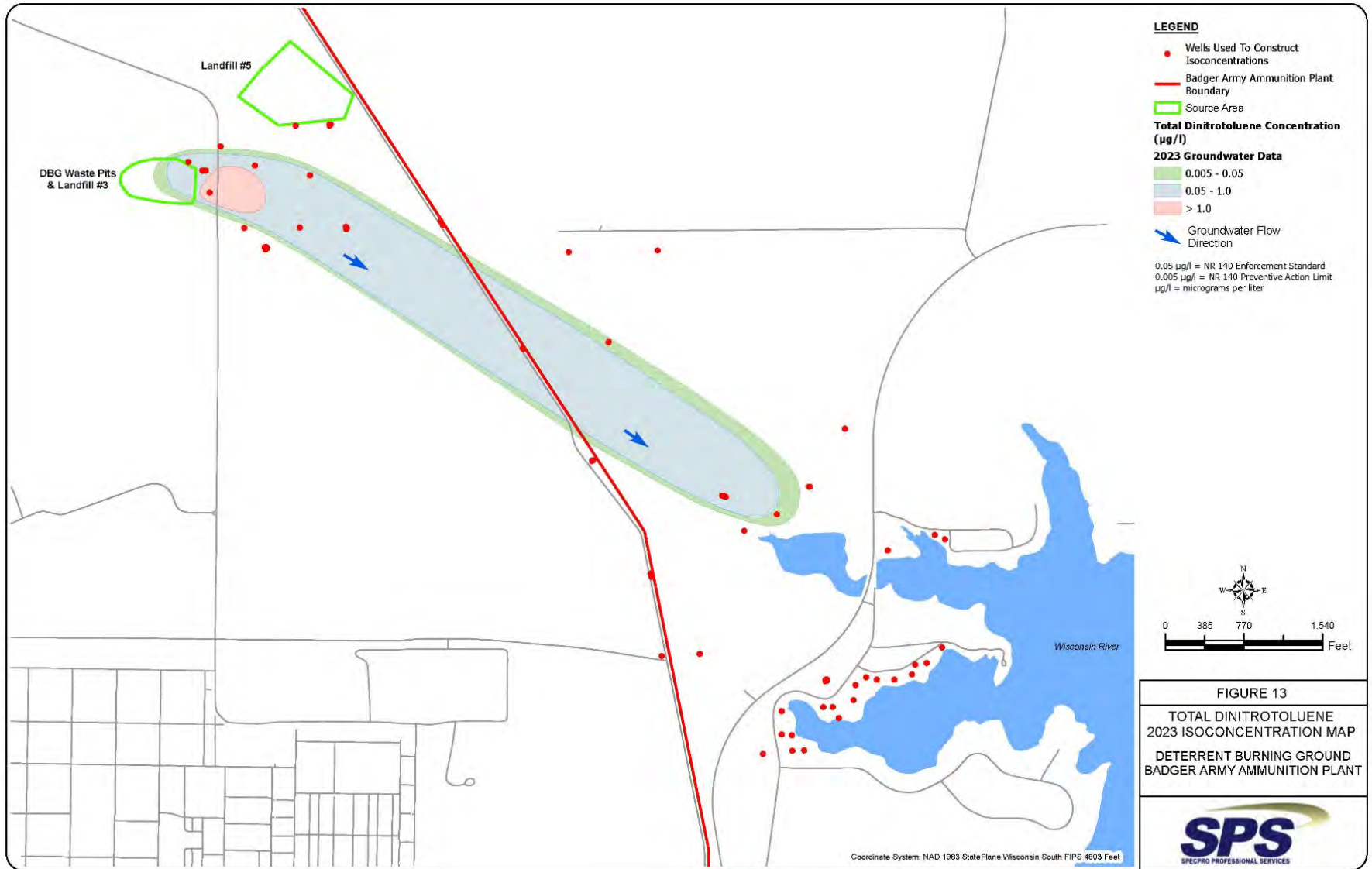


Current Contaminants Exceeding WDNR Groundwater Enforcement Standards

- Total DNT = 0.05 µg/L
- Sulfate = 250 mg/L



# BAAP - DBG Plume Total DNT



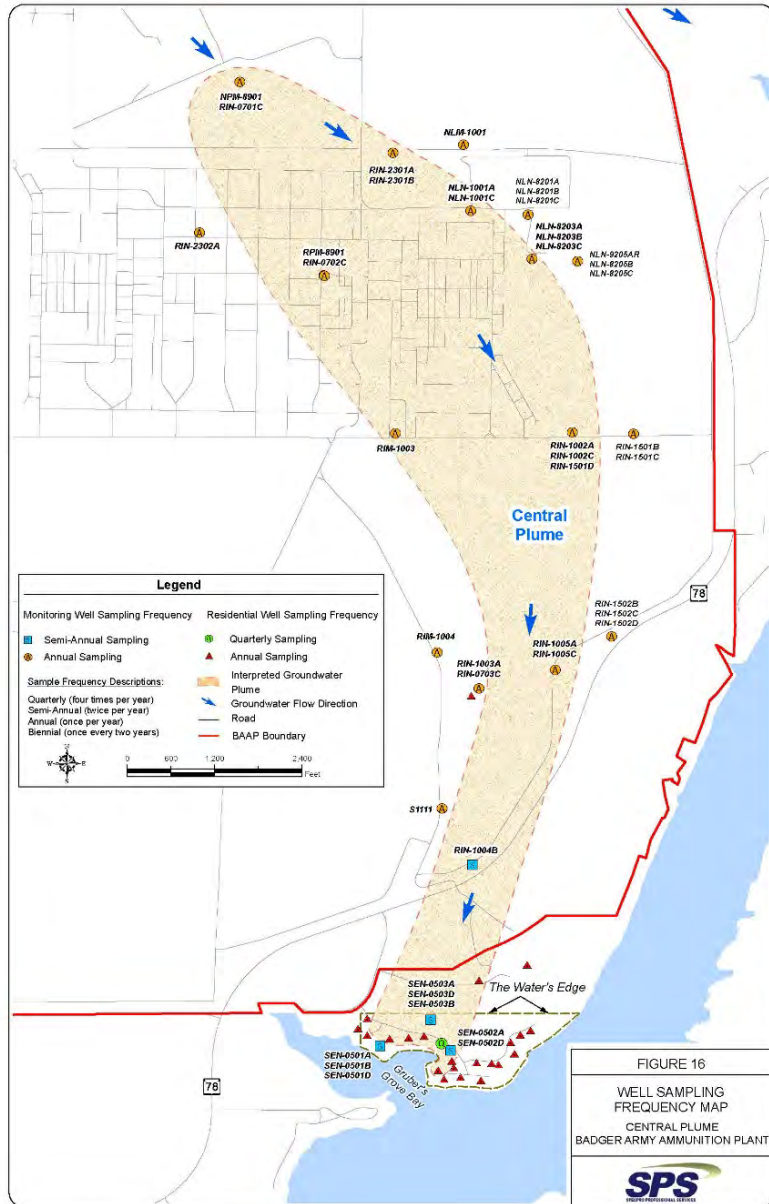
**FIGURE 13**  
 TOTAL DINITROTOLUENE  
 2023 ISOCONCENTRATION MAP  
 DETERRENT BURNING GROUND  
 BADGER ARMY AMMUNITION PLANT



# BAAP - Central Plume

Current Contaminants Exceeding  
WDNR Groundwater Enforcement  
Standards

- Total DNT = 0.05 µg/L

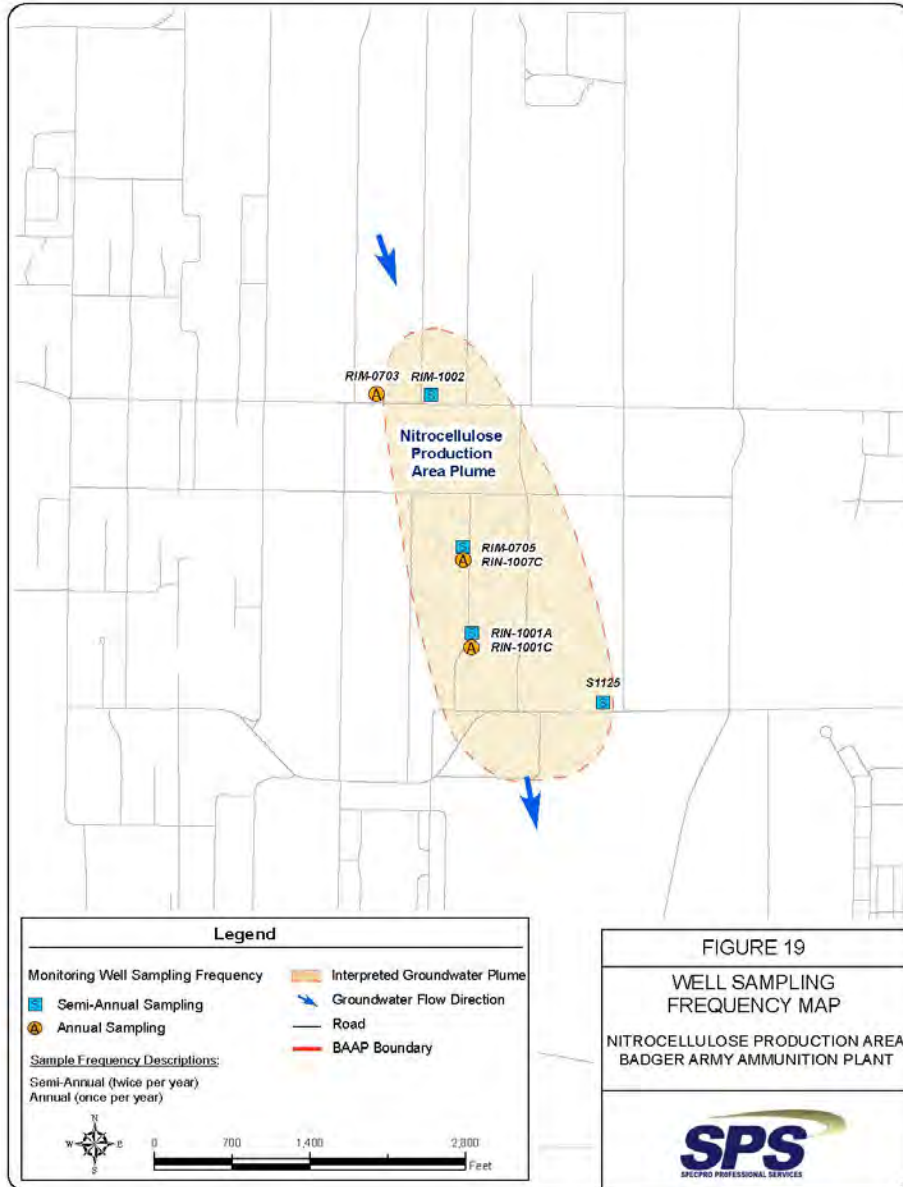


# BAAP - Central Plume Total DNT

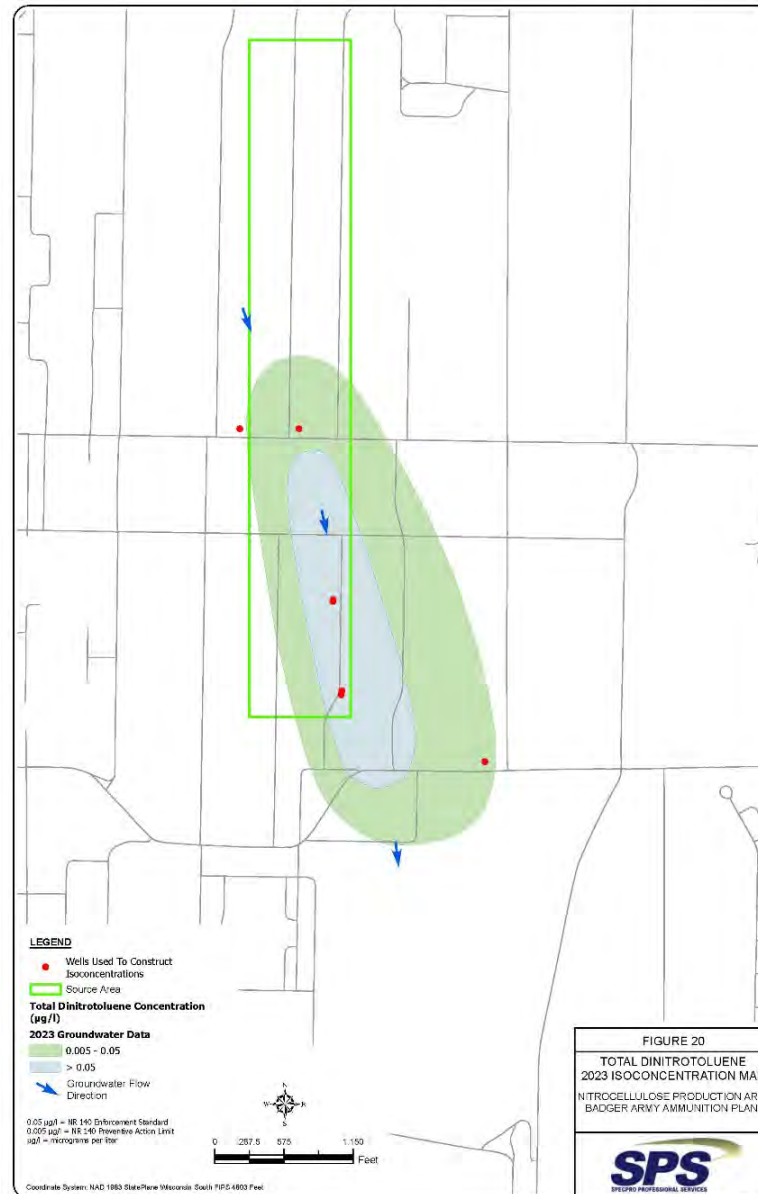


Current Contaminants Exceeding  
WDNR Groundwater Enforcement  
Standards

- Total DNT = 0.05 µg/L



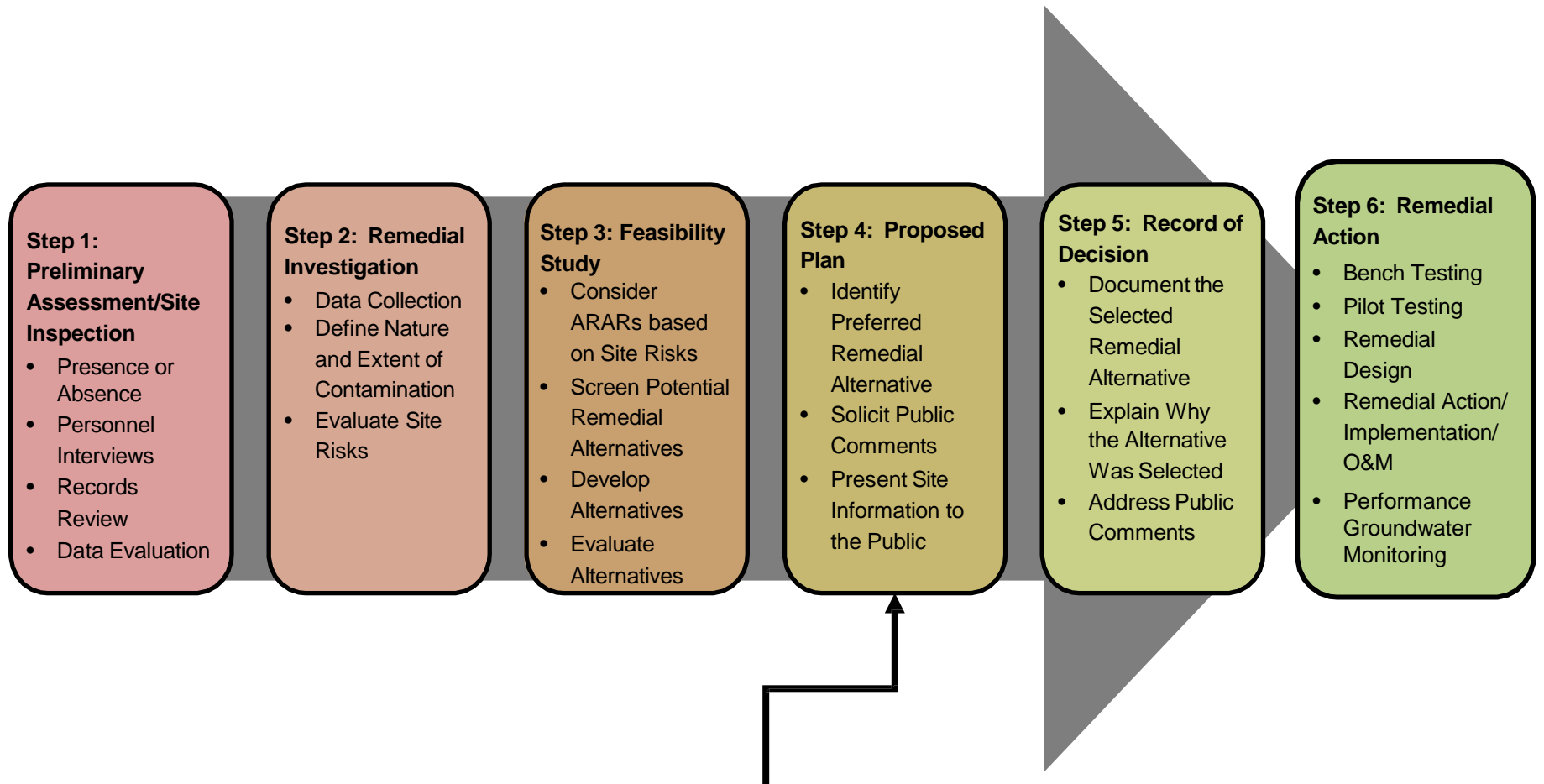
# BAAP - NC Plume Total DNT



## Past Army response actions of varying intensity based on risk:

- Soil remedial actions ranged from active treatment (Excavation, Bioremediation, Soil Vapor Extraction) and capping/covering to minimize surface exposure and leaching to groundwater
- Groundwater interim remedial action for the PBG Plume consisted of extraction and treatment to reduce contaminant levels and minimize further off-post transport
- Residential well replacement
- Land Use Controls implemented including site access, excavation and groundwater use restrictions





Currently soliciting public comments on Proposed Plan





# BAAP - CERCLA Background

1980 - The Army began conducting remedial investigations for groundwater contamination at BAAP.

2011 - The Army submitted a Revised Alternative Feasibility Study, Groundwater Remedial Strategy report to the WDNR; however, no human health risk assessment was conducted. CERCLA process was not followed. The selected groundwater remedy was Monitored Natural Attenuation (MNA) and included the construction and operation of a municipal drinking water system.

2017 - The Army coordinated with the WDNR and informed the public regarding the need to reevaluate the groundwater remedy at BAAP to comply with Army legal policies and funding authorities.



# BAAP - CERCLA Background (Cont.)

2018 - The Human Health Risk Assessment (HHRA) was completed. The HHRA evaluated whether groundwater contamination originating from the BAAP posed a current or hypothetical future risk to human health.

2021 - Remedial Investigation/Feasibility Study (RI/FS)

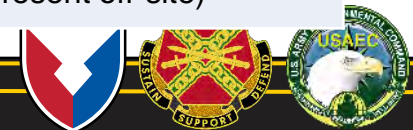
2023 - At the request of the WDNR, the HHRA was updated with current groundwater data

2024 - Proposed Plan



# BAAP - Calculated Risk Summary

<b>Propellant Burning Ground</b>	<b>Cumulative Cancer Risk</b>	<b>Non-cancer Hazard Index (HI)</b>	<b>Contaminants of Concern</b>
On-Site (Hypothetical Future Risk)	$1 \times 10^{-2}$	120	2,4-DNT • 2,6-DNT • Total DNT Benzene • Ethyl Ether • Trichloroethene
Off-Site (Current Risk)	$1 \times 10^{-4}$	7	2,6-DNT • Carbon Tetrachloride Chloroform • Trichloroethene
<b>Deterrent Burning Ground</b>	<b>Cumulative Cancer Risk</b>	<b>Non-cancer Hazard Index (HI)</b>	<b>Contaminants of Concern</b>
On-Site (Hypothetical Future Risk)	$4 \times 10^{-5}$	5	1,1,2-Trichloroethane
Off-Site (Current Risk)	$5 \times 10^{-6}$	1	Total DNT • Chloroform
<b>Central Plume</b>	<b>Cumulative Cancer Risk</b>	<b>Non-cancer Hazard Index (HI)</b>	<b>Contaminants of Concern</b>
On-Site (Hypothetical Future Risk)	$3 \times 10^{-6}$	0	None
Off-Site (Current Risk)	$1 \times 10^{-5}$	0	Total DNT • Chloroform
<b>Nitrocellulose Production Area Plume</b>	<b>Cumulative Cancer Risk</b>	<b>Non-cancer Hazard Index (HI)</b>	<b>Contaminants of Concern</b>
On-Site (Hypothetical Future Risk)	$2 \times 10^{-6}$	0	None
Off-Site (Current Risk)	NA	NA	(Plume not present off-site)



## Groundwater RAOs for the PBG, DBG, and Central Plumes:

- Protect human health - prevent human exposure to contaminated groundwater
- Restore the groundwater aquifer to beneficial use
- Minimize the impact of contaminated groundwater on the environment
- RAOs will be achieved when the risk-based groundwater Contaminants of Concern are below the groundwater cleanup levels (EPA Maximum Contaminant Levels or Wisconsin NR 140 Enforcement Standards)



# BAAP - Remedial Alternatives

Alternative	Remedial Alternative Evaluated	PBG Plume	DBG Plume	Central Plume
1	No Action*	✓	✓	✓
2	Monitored Natural Attenuation (MNA) and Alternate Water Supply (Groundwater LUCs and Sampling)	✓	✓	✓
3	Active Groundwater Remediation – Pump and Treat (Alternate Water Supply, MNA, Groundwater LUCs and Sampling)	✓	✓	✓
4	Active Groundwater Remediation – Anaerobic Bioremediation (Alternate Water Supply, MNA, Groundwater LUCs and Sampling)	✓	✓	✓
5	Well Replacement – Plume Area (MNA, Groundwater LUCs and Sampling)	✓	✓	✓
6	Source Area Treatment (Alternate Water Supply, MNA, Groundwater LUCs and Sampling)	✓	✓	

\*No Action retained for comparison only



# BAAP - Alternative Comparison

EPA's nine criteria established by CERCLA for evaluation of remedial alternatives:

<b>Threshold Criteria</b>	Overall protection of human health and the environment
	Compliance with applicable or relevant and appropriate requirements (ARARs)
<b>Balancing Criteria</b>	Long-term effectiveness and permanence
	Reduction of toxicity, mobility, and volume through treatment
	Short-term effectiveness
	Implementability
	Cost
<b>Modifying Criteria</b>	State acceptance
	Community acceptance



# BAAP - Evaluation of Alternatives PBG Plume

Alternative	Evaluation Criteria									Cost Evaluation
	Overall Protection to Human Health & Environment	Compliance with ARARs	Long-Term Effectiveness & Permanence	Reduction in Toxicity, Mobility & Volume Through Treatment	Short-Term Effectiveness	Implementability	State Acceptance	Community Acceptance	Total Cost <sup>(1)(2)</sup>	
Alternative 1 – No Action • Groundwater access restrictions	L	N	N	N	N	H	TBD	TBD	\$0	N
Alternative 2 – MNA and Alternate Water Supply • Groundwater access restrictions • Groundwater monitoring • Alternate water supply	M	L	M	L	M	H	TBD	TBD	\$4.9	H
Alternative 3 – Pump and Treat <sup>(3)</sup> • Extraction wells (four) • Mobile treatment units (four)	H	H	H	H	M	M	TBD	TBD	\$12.7	L
Alternative 4 – Anaerobic Bioremediation <sup>(3)</sup> • Permanent injection wells (nine) • Temporary injection points (150)	H	H	M	H	M	M	TBD	TBD	\$9.6	M
Alternative 5 – Well Replacement <sup>(4)</sup> • Replacement of residential wells (47)	M	M	H	L	M	M	TBD	TBD	\$7.9	M
Alternative 6 – Source Area Treatment <sup>(3)</sup> • Permanent injection wells (nine)	M	M	M	M	H	M	TBD	TBD	\$5.2	H

Costs were based on 2021 estimates

H - High preference  
M - Moderate preference  
L - Low preference  
N - None  
TBD - To be determined

Notes: H – High, L – Low, M – Moderate, N – None, TBD – To Be Determined.

- (1) Cost in millions of dollars & includes direct capital, indirect capital and annual operation and maintenance costs.
- (2) Based on current rates and does not include inflation.
- (3) Alternative includes groundwater access restrictions, groundwater monitoring and alternate water supply.
- (4) Alternative includes groundwater access restrictions and groundwater monitoring.



Alternative	Evaluation Criteria									Cost Evaluation
	Overall Protection to Human Health & Environment	Compliance with ARARs	Long-Term Effectiveness & Permanence	Reduction in Toxicity, Mobility & Volume Through Treatment	Short-Term Effectiveness	Implementability	State Acceptance	Community Acceptance	Total Cost <sup>(1)(2)</sup>	
Alternative 1 – No Action • Groundwater access restrictions	L	N	N	N	N	H	TBD	TBD	\$0	N
Alternative 2 – MNA and Alternate Water Supply • Groundwater access restrictions • Groundwater monitoring • Alternate water supply	M	L	M	L	M	H	TBD	TBD	\$4.2	H
Alternative 3 – Pump and Treat <sup>(3)</sup> • Extraction wells (three) • Mobile treatment units (three)	H	H	H	H	M	M	TBD	TBD	\$12.5	L
Alternative 4 – Anaerobic Bioremediation <sup>(3)</sup> • Biochemical injection points (406)	H	H	M	H	M	M	TBD	TBD	\$12.5	L
Alternative 5 – Well Replacement <sup>(4)</sup> • Replacement of residential wells (57)	M	M	H	L	M	M	TBD	TBD	\$7.1	M
Alternative 6 – Source Area Treatment <sup>(3)</sup> • Temporary injection points (56)	M	M	M	M	H	M	TBD	TBD	\$5.2	H

Costs were based on 2021 estimates

H - High preference  
M - Moderate preference  
L - Low preference  
N - None  
TBD - To be determined

Notes: H – High, L – Low, M – Moderate, N – None, TBD – To Be Determined.

- (1) Cost in millions of dollars & includes direct capital, indirect capital and annual operation and maintenance costs.
- (2) Based on current rates and does not include inflation.
- (3) Alternative includes groundwater access restrictions, groundwater monitoring and alternate water supply.
- (4) Alternative includes groundwater access restrictions and groundwater monitoring.





# U.S. ARMY BAAP - Evaluation of Alternatives Central Plume

Alternative	Evaluation Criteria									Cost Evaluation
	Overall Protection to Human Health & Environment	Compliance with ARARs	Long-Term Effectiveness & Permanence	Reduction in Toxicity, Mobility & Volume Through Treatment	Short-Term Effectiveness	Implementability	State Acceptance	Community Acceptance	Total Cost <sup>(1)(2)</sup>	
Alternative 1 – No Action • Groundwater access restrictions	L	N	N	N	N	H	TBD	TBD	\$0	N
Alternative 2 – MNA and Alternate Water Supply • Groundwater access restrictions • Groundwater monitoring • Alternate water supply	M	L	M	L	M	H	TBD	TBD	\$2.4	H
Alternative 3 – Pump and Treat <sup>(3)</sup> • Extraction wells (eight) • Mobile treatment units (eight)	H	H	H	H	M	M	TBD	TBD	\$18.0	L
Alternative 4 – Anaerobic Bioremediation <sup>(3)</sup> • Biochemical injection points (988)	H	H	M	H	M	M	TBD	TBD	\$23.7	L
Alternative 5 – Well Replacement <sup>(4)</sup> • Replacement of residential wells (23)	M	M	H	L	M	M	TBD	TBD	\$3.3	H

Costs were based on 2021 estimates

H - High preference  
M - Moderate preference  
L - Low preference  
N - None  
TBD - To be determined

Notes: H – High, L – Low, M – Moderate, N – None, TBD – To Be Determined.

- (1) Cost in millions of dollars & includes direct capital, indirect capital and annual operation and maintenance costs.
- (2) Based on current rates and does not include inflation.
- (3) Alternative includes groundwater access restrictions, groundwater monitoring and alternate water supply.
- (4) Alternative includes groundwater access restrictions and groundwater monitoring.



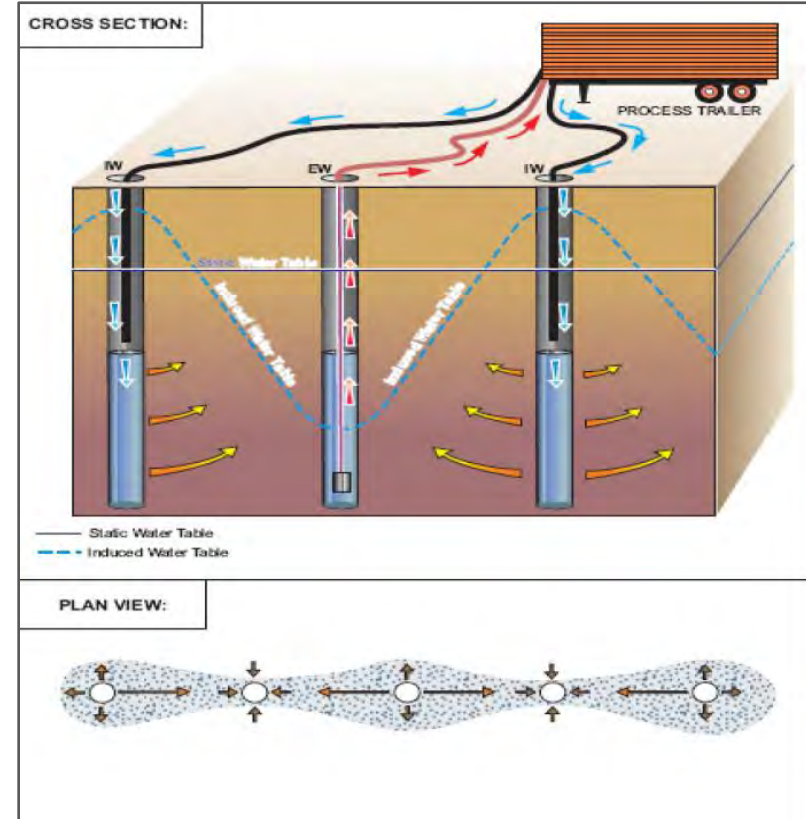
## Active Groundwater Remediation – In-Situ Anaerobic Bioremediation

### Implementability

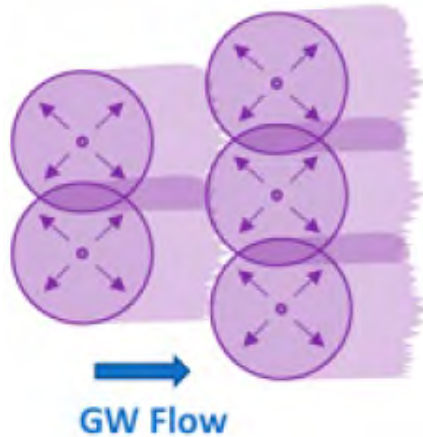
- Requires drilling and construction activities
- Readily implementable using standard construction equipment
- In-situ injection of the biochemical product may be challenging due to varying soil conditions at depth

### Effectiveness

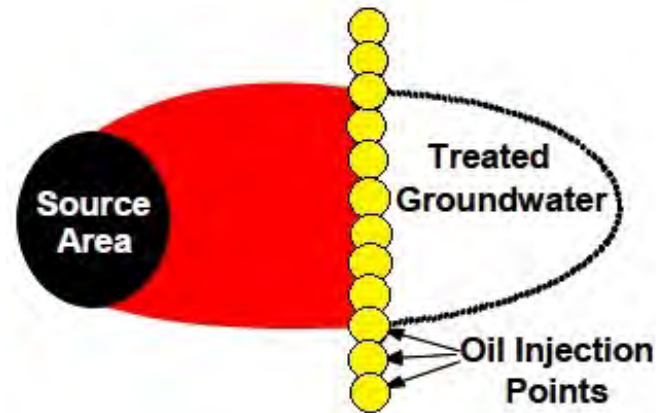
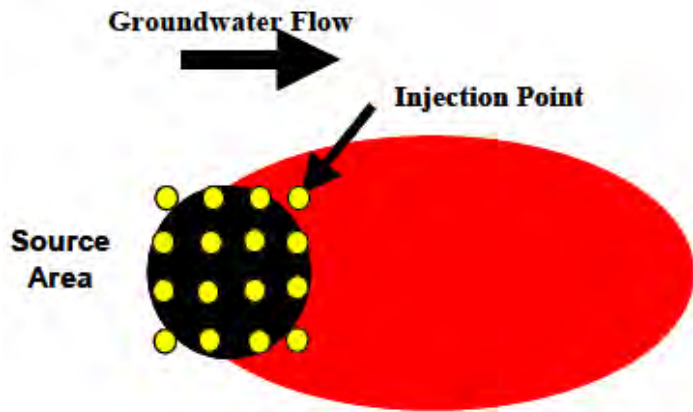
- Alternative 4 (In-Situ Anaerobic Bioremediation) would reduce DNT concentrations through in-situ anaerobic biodegradation
- The bioremediation process permanently destroys the groundwater contaminants
- Alternative 4 would be both long-term effective and the most permanent for treatment of DNT contaminated groundwater



## Active Groundwater Remediation – In-Situ Anaerobic Bioremediation



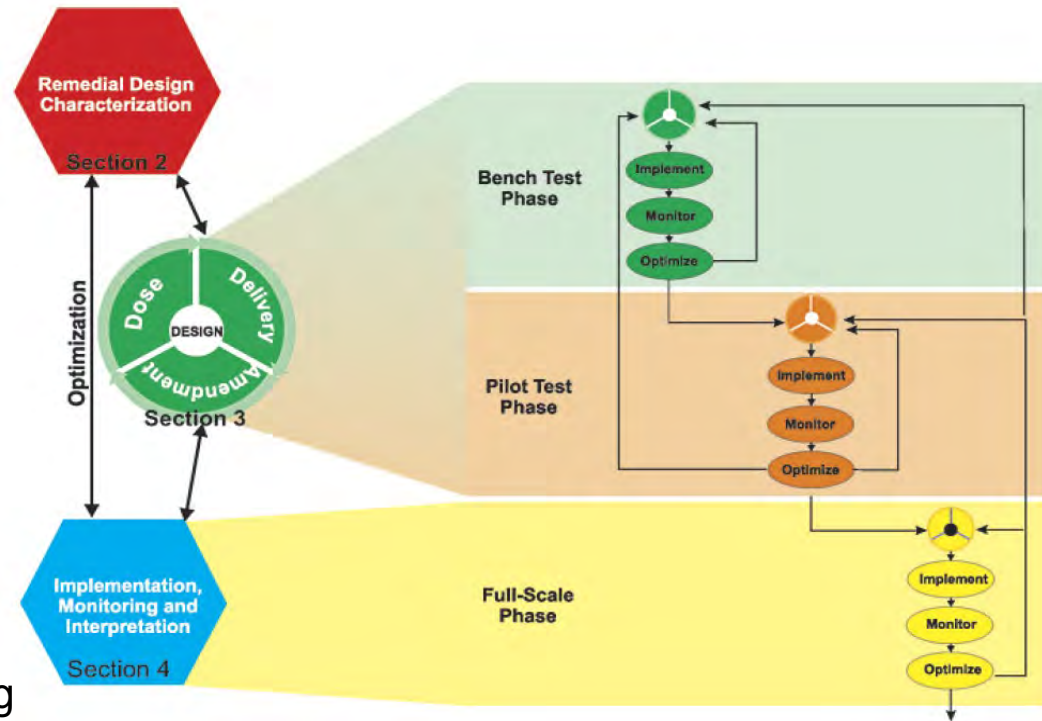
- The biochemical product (amendment) would consist of a nutrient-enriched emulsified vegetable oil (EVO)
- EVO is distributed into groundwater using food-grade oil, surfactants and clean water. Surfactants are widely used in the food industry to lower surface tension
- In-Situ with EVO is considered green remediation



## Active Groundwater Remediation – In-Situ Anaerobic Bioremediation

- Remediation must consider amendment, delivery method & dose together during the Remedial Design, Implementation & Monitoring phases.
- Bench tests are laboratory treatability studies conducted in a controlled environment. They involve mixing the amendment, groundwater, and soil together to determine treatment effectiveness and amendment dosage. They help improve the field in-situ injections.
- Pilot tests are small scale field in-situ injections. They evaluate how the treatment will work in the ground. Pilot tests represent what may happen during full-scale remediation and help optimize field operations.

In-Situ Implementation and Optimization Process (1)



(1) Optimizing Injection Strategies and In situ Remediation Performance. ITRC (Interstate Technology & Regulatory Council). 2020.



# BAAP - Preferred Alternative (PBG Plume)



## Total DNT > 0.05 µg/L (ES)

- The injection locations will be further defined during the Remedial Design



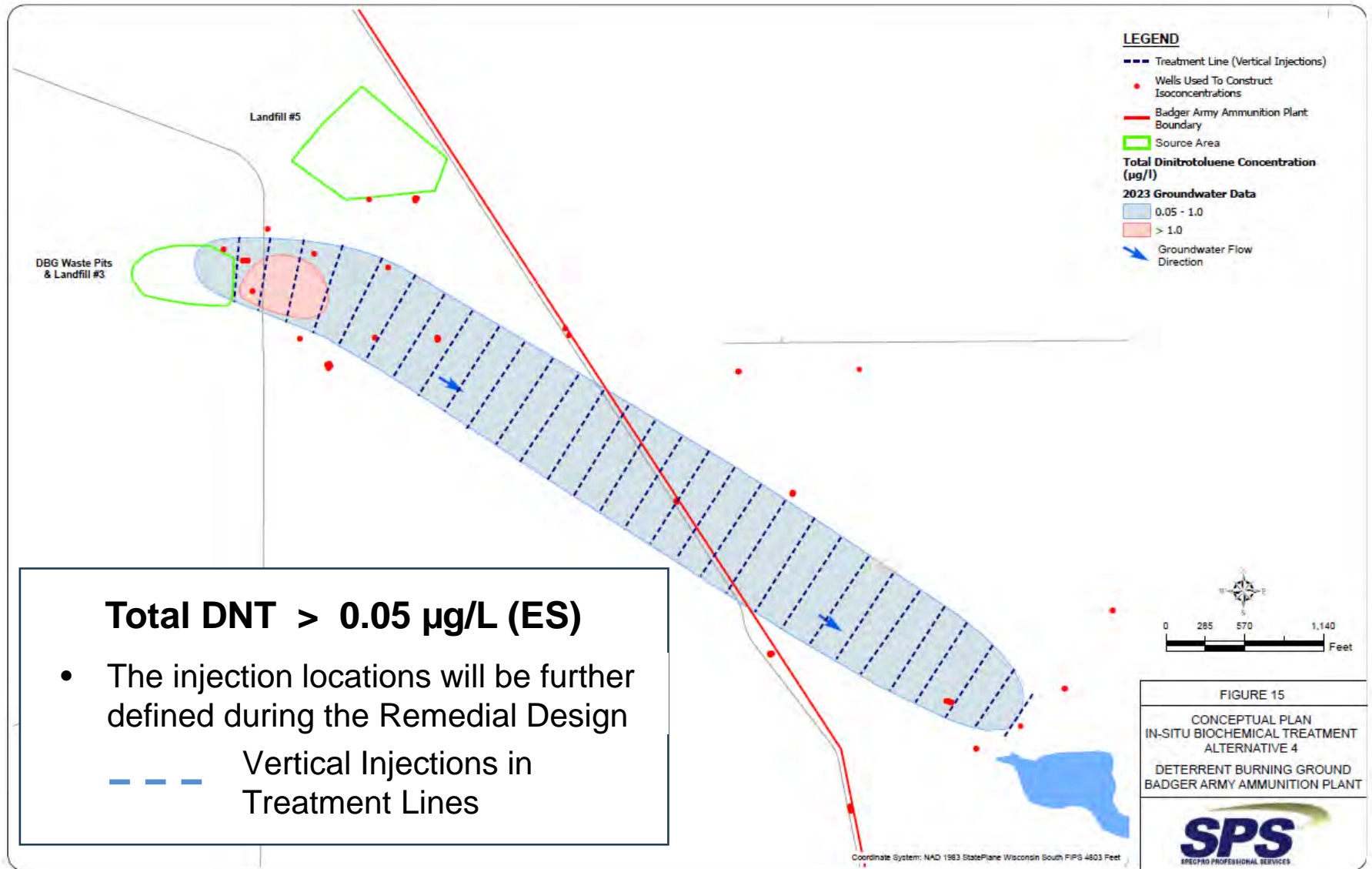
 Vertical Injections in Treatment Lines

FIGURE 11  
CONCEPTUAL PLAN  
IN-SITU BIOCHEMICAL TREATMENT  
ALTERNATIVE 4  
PROPELLANT BURNING GROUND  
BADGER ARMY AMMUNITION PLANT  




# BAAP - Preferred Alternative (DBG Plume)



**Total DNT > 0.05 µg/L (ES)**

- The injection locations will be further defined during the Remedial Design

--- Vertical Injections in Treatment Lines

FIGURE 15  
 CONCEPTUAL PLAN  
 IN-SITU BIOCHEMICAL TREATMENT  
 ALTERNATIVE 4  
 DETERRENT BURNING GROUND  
 BADGER ARMY AMMUNITION PLANT

**SPS**  
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# BAAP - Preferred Alternative (Central Plume)



## Total DNT > 0.05 µg/L (ES)

- The injection locations will be further defined during the Remedial Design

--- Vertical Injections in Treatment Lines



- Proposed Plan – complete public comment period
- Consider Public Comments and Develop Response to Comments
- Record of Decision – will document selected alternative and the responsiveness summary
- Remedial Action – will include remedial design, construction, operation, and reporting







# Questions??





Public Comment Period – **December 16, 2024 – February 28, 2025**

Administrative Record and Information Repository available at:

Ruth Culver Community  
Library  
540 Water Street  
Prairie du Sac, Wisconsin

or

George Culver Community  
Library  
615 Phillips Blvd,  
Sauk City, Wisconsin

Electronic copies of the Proposed Plan can be provided by email and are available for download at:

<https://aec.army.mil/baap>

Point of Contact for Questions:

Cathy Kropp

USAEC Public Affairs

Phone: (443) 243-0313 or (520) 684-3758

Email: [Cathryn.L.Kropp.civ@army.mil](mailto:Cathryn.L.Kropp.civ@army.mil)



# U.S. ARMY **How to Submit Comments on Proposed Plan**

The public comment period began **December 16, 2024**

Written comments should be submitted no later than **February 28, 2025**, and directed to:

Mail:    ATTN: Mailstop 112, AMIM-AEC-M (Nguyen)  
          U.S. Army Environmental Command  
          2455 Reynolds Road  
          JBSA Fort Sam Houston, TX 78234-7588

Email: [usarmy.jbsa.imcom-aec.mbx.public-mailbox@army.mil](mailto:usarmy.jbsa.imcom-aec.mbx.public-mailbox@army.mil)

We are going to adjourn this RAB meeting and you may submit oral comments for the record.

**NOTE** – If you are submitting written comments, verbal comments are not necessary.

If you are submitting oral comments, written comments are not necessary.

