

Memorandum

To: Adam Jokerst, PE, City of Greeley
From: Joel Barber, PE
Reviewed by: Cortney Brand, PG
Date: February 25, 2021
Project: 1229GRE20
Subject: Terry Ranch Groundwater Contamination Risk from Atlas D Missile Site #4 TCE Plume

Introduction

The purpose of this memorandum is to address claims presented on the *Save Greeley's Water* blog (<https://savegreeleyswater.com/updates/>) regarding the risk of contamination of Terry Ranch groundwater from the Atlas D Missile Site #4 Trichloroethylene (TCE) plume (**Appendix A**). The Atlas D Missile Site #4 is located in Laramie County, Wyoming, approximately 15 miles northwest of Terry Ranch. LRE's review of the relevant documents and data has found that the information presented in the blog is generally inaccurate, misrepresentative, and speculative in nature. The risk to Terry Ranch groundwater from the Atlas D Missile Site #4 TCE plume is very low and can be effectively managed with available technologies.

In this memorandum, LRE presents data from the U.S. Army Corps of Engineers (USACE) *Final Area-Wide Remedial Investigation Report* (RMC+SoundEarth, 2020) that contradicts the claims made in the *Save Greeley's Water* blog. In addition, LRE has conducted an expanded due diligence review of the data associated with the Atlas D Missile Site #4 TCE plume beyond the findings presented in our *Terry Ranch Groundwater Contamination Risk Assessment*, dated February 10, 2021. Conclusions and recommendations from the expanded due diligence review are summarized in this memorandum.

Responses to Claims

The "Terry Ranch Location" map presented in the *Save Greeley's Water* blog post is inaccurate and misleading in three significant ways. These inaccuracies are described below and illustrated in **Figures 1** through **3**.

1. The red arrows labeled “TCE Plume Path” on the blog’s “Terry Ranch Location” map are illustrative and depict the TCE plume migrating northeast, east, and southeast along Lone Tree Creek toward Terry Ranch. **Figure 1** illustrates the USACE-mapped extent of the plume and confirms that the plume is moving northeast and not southeast.
2. The blog post claims that paleo channels mimicking Lone Tree Creek will direct the plume towards Terry Ranch. **Figure 2** illustrates that the plume has moved past Lone Tree Creek without redirecting to the south. Additionally, published data from wells along Lone Tree Creek confirm that TCE concentrations in this area remain at constant low levels or non-detect, and in some cases are decreasing with time.
3. The blog’s “Terry Ranch Location” map labels the Terry Ranch groundwater resource as a “Uranium Contaminated Aquifer & Well Field”. As illustrated on **Figure 3** and described in LRE’s other due diligence deliverables, the Upper Laramie Aquifer underlying Terry Ranch has low levels of naturally-occurring uranium ranging from approximately 14 to 40 parts per billion (ppb). Thus, it is inaccurate and misleading to characterize the aquifer as “contaminated”.

The following section provides a dissection of the claims in the text of the subject blog post. We provide a quote of the claim and technical response to each.

Blog Post Quote: *The (TCE) plume emanating from [Atlas Site 4] is now 12 miles long and 3 miles wide, according to the Wyoming Department of Environmental Quality. Atlas Site 4’s TCE concentrations in the groundwater exceeds 240,000 parts per billion, well above Safe Drinking Act limit of 5 parts per billion.*

Response: This claim is misleading because: (1) the concentration of TCE was at one time 240,000 parts per billion (ppb) at the source, but is currently 170,000 ppb; and (2) this statement implies the entire plume has a TCE concentration of 240,000 ppb while in reality the concentration in a majority of the plume is less than 100 ppb. In Area B, the area closest to Terry Ranch, the TCE concentration is between 5 and 50 ppb, or less than 1/50,000th to 1/5,000th of the amount claimed. In the Expanded Study Area, TCE concentrations are non-detect except for directly east of Area B towards Cheyenne where concentrations are up to 10 ppb.

Blog Post Quote: *It is quite possible that the TCE plume will turn South and follow the Lone Tree Creek geology to Terry Ranch and its Upper Laramie aquifer recharge area.*

Response: This statement is purely speculative as the USACE has fully defined the extent of the plume and has shown it is moving east-northeast towards Cheyenne. There is no evidence that the plume is migrating south or ever will migrate south.

Blog Post Quote: *[Because of the presence of paleochannels] the TCE plume would likely follow the Lone Tree Creek pathway and travel to the Terry Ranch.*

Response: This statement is misleading because, although paleo channels can act as preferential flow paths for groundwater and plume migration, the plume will still migrate in the direction of the regional groundwater gradient in the Ogallala Aquifer and White River Formation (WRF). The regional groundwater gradient is easterly towards Cheyenne and the regional drainage, which is Crow Creek and not Lone Tree Creek. Additionally, the plume has already moved past the point where Lone Tree Creek turns south. If Lone Tree Creek were a preferential flow path, then the USACE would have identified the plume migrating south. The following quote from the USACE's *Final Area-Wide Remedial Investigation Report* supports this:

East of the Intercept Area, the TCE plume begins to extend toward the northeast, within the eastern portion of Area B. The widest section of the plume is located in the eastern portion of Area B, with a north-south width of approximately 2 miles. The lateral expansion of the plume in this area is may be influenced by the geology and possibly pumping of stock, industrial, and municipal wells in the Borie Well Field..... Based on the results from the Fall 2019 LTM Event 14, the terminal end of the groundwater contaminant plume has been defined.

Blog Post Quote: *It would likely be incorrect, however, to simply consider the Brule a confining unit throughout the Site 4 study area.*

Response: This was a critical question that was thoroughly investigated by the USACE, and they determined that the Brule Formation "is composed largely of low-permeability

silty clays/clayey silts, siltstone and/or claystone that generally function as a regional low-permeability aquitard underlying the Ogallala in the study area.” The blog quote does not accurately represent the findings of the USACE. The USACE clearly demonstrates that the Brule Member is regional in extent and that the TCE plume is contained within the Ogallala and the upper portion (Brule Member) of the WRF.

Blog Post Quote: *The US Corps of Engineers (USACE) has been trying to model the trajectory of the TCE plume but is having difficulty producing a reliable model because of the complexity of the geological formations.*

Response: Although the USACE acknowledges the inherent uncertainty in geologic systems, and recommends continued site characterization and groundwater model refinement, this statement directly contradicts the USACE’s conclusions. A conclusion in the USACE’s *Final Area-Wide Remedial Investigation Report* states, “Contaminant-transport, mass flux, and matrix diffusion models, provide a reasonably accurate view of contaminant-transport mechanisms.” Although there is uncertainty in any modeling effort, the USACE believes the modeling that has been completed is reasonably accurate.

Blog Post Quote: *The expanded study area indicates that USACE believes the plume could possible head south to Terry Ranch. It is hard to ignore the US Corps of Engineers’ good judgement. However, Adam Jokerst, Deputy Director of the Greeley Water Department, seems more than willing to ignore this good judgment.*

Response: This statement misrepresents the USACE’s judgment. The USACE does not recommend avoiding groundwater development south of the TCE plume, and does not identify the Upper Laramie Aquifer as being at risk. According to the USACE’s *Final Area-Wide Remedial Investigation Report*, it is the USACE’s and its consultant’s judgment that the plume is migrating east-northeast towards Cheyenne, and is not migrating to the south. The extended monitoring area to the south was implemented to confirm the plume movement direction and for long-term monitoring purposes.

Literature Review Findings

LRE conducted an expanded search and review of publically available literature associated with the Atlas D Missile Site #4 TCE plume. We found that the recently

published *Final Area-Wide Remedial Investigation Report* (RMC+SoundEarth, 2020) provides the most current and complete summary of all plume characterization work. The findings presented below summarize the main findings published in this report.

1. The USACE concludes that it has successfully characterized the extent of the TCE plume in its 2019 and 2020 reports. **Figure 1** depicts the full extent of the TCE plume.
2. The TCE plume is migrating east-northeast toward Cheyenne, not to the south-southeast. The plume is currently East past the point where Lone Tree Creek turns south toward Colorado and Terry Ranch (**Figure 2**). If the TCE plume were migrating south, the USACE would have uncovered evidence of this, and there is no evidence that the plume has, or will in the future, turn south. Instead, the TCE plume is generally following the regional groundwater flow gradient and direction, which is toward the regional drainage, Crow Creek, not Lone Tree Creek.
3. The plume is spreading laterally at its eastern end likely due to a combination of the natural dominant groundwater flow direction and influences from well pumping in that area.
4. TCE concentrations are very low at the eastern edge of the plume (between 5 and 10 ppb). The plume, as illustrated in **Figure 1**, is the area where the observed TCE concentrations are greater than 5 ppb, the maximum contaminant level (MCL).
5. The plume is confined to the Ogallala, the Brule Member of the WRF, and shale layers of the WRF. **Figure 4**, a north-south cross section through the eastern portion of the plume, shows the frequency of laterally continuous claystone and shale layers in the WRF that prevent the downward migration of the plume. The USACE has monitored the full thickness of the WRF, as shown on **Figure 4**, and has not identified any instance where the TCE plume has migrated past the shale layers to the base of the WRF.

Figure 5, a cross section along the axis of the plume, shows that the plume is primarily isolated to the Ogallala and the very top of the WRF. The plume migrates downgradient along the slope of the Brule Member, which is to the east-northeast. The USACE has conducted geophysical logging, hydrophysical logging, and aquifer testing in the Brule Member, and has confirmed that it is of very low primary

permeability and functions as an aquitard. The USACE has found that the TCE plume may be migrating horizontally in the unit through fractures and bedding planes, but these features are not facilitating vertical migration.

6. The references to "paleochannels" in the USACE's *Final Area-Wide Remedial Investigation Report* are at the contact of the Ogallala and the WRF, and do not refer to paleochannels within the WRF. These features influence horizontal migration of the plume within and at the base of the Ogallala. The horizontal migration of the plume in the Brule Member is very slow, approximately 1 mile in 145 years.
7. The USACE is currently piloting treatment options downgradient of the TCE source, which will further limit plume migration. See **Appendix B** for details on the remedial methods the USACE will be piloting.
8. Lone Tree Creek is not a significant transport mechanism of TCE. TCE levels in the surface water are below the MCL, and the TCE plume is unlikely to reach Terry Ranch via Lone Tree Creek.
9. The USACE has not shown that TCE is naturally biodegrading or being retarded by organics, but they anticipate that "at the leading edge of the plume, the retardation effect may be more pronounced due to the lower dissolved concentrations and reduced equilibrium conditions."

LRE's expanded literature review efforts confirm that the risk to Terry Ranch groundwater from the Atlas D Missile Site #4 TCE plume is negligible, and the existence of the plume should not prevent Greeley from confidently moving forward with the Terry Ranch Project.

Recommendations

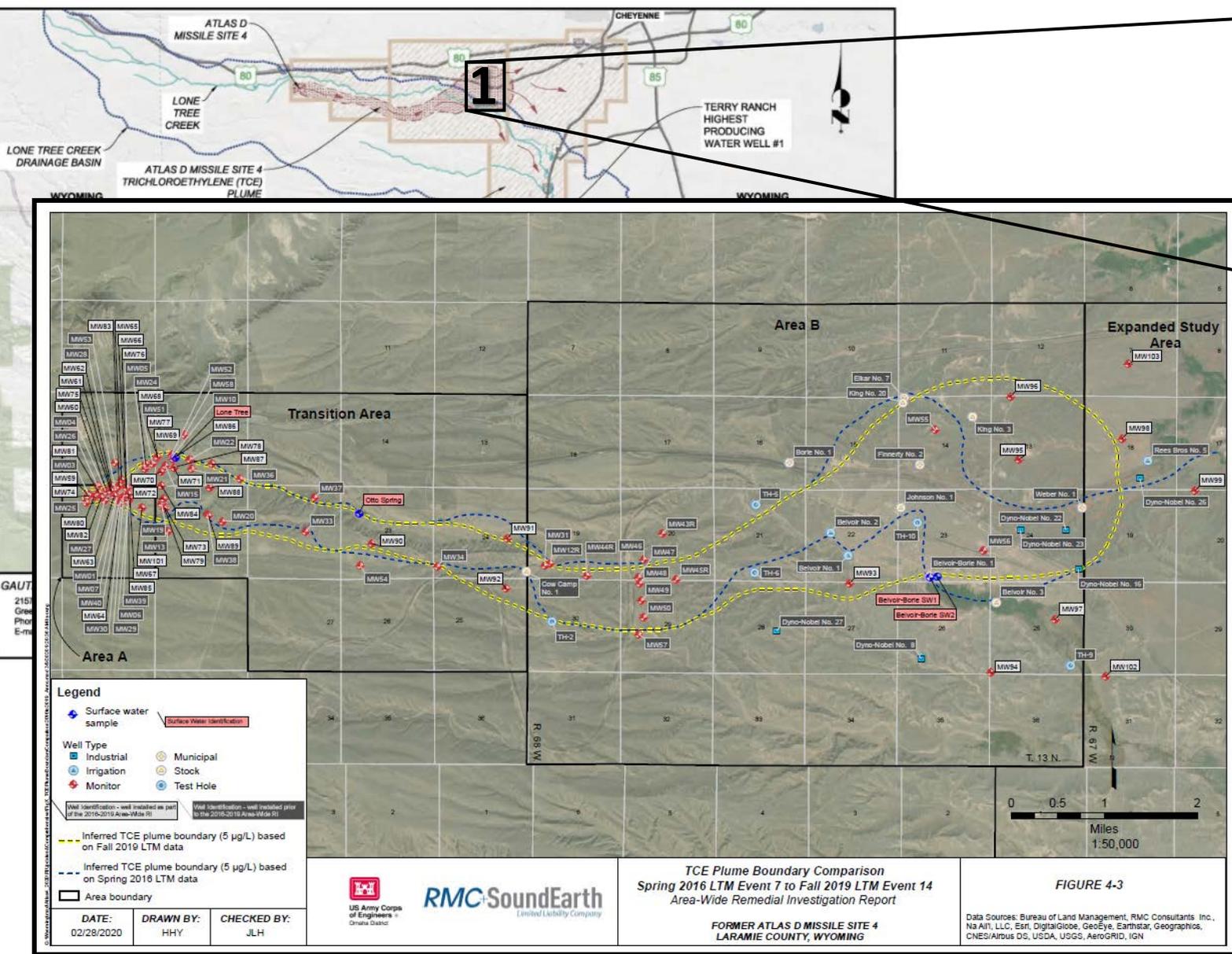
Although this effort confirms that the risks of groundwater contamination are low, it is prudent for Greeley to take measures to protect groundwater quality at Terry Ranch. To ensure the TCE plume will not impact Terry Ranch, LRE recommends the following:

1. Become an active stakeholder in the USACE's efforts to monitor and remediate the Atlas D Missile Site #4 TCE plume.

2. Regularly review USACE reports on the TCE plume monitoring to confirm the plume is not migrating south.
3. Install monitoring wells (sentinel wells) north of Terry Ranch to monitor for TCE and general groundwater quality. In the unlikely event that a portion of the TCE plume did migrate south, it could be detected well in advance for Greeley to engage with the USACE and implement proactive remedial measures.

References

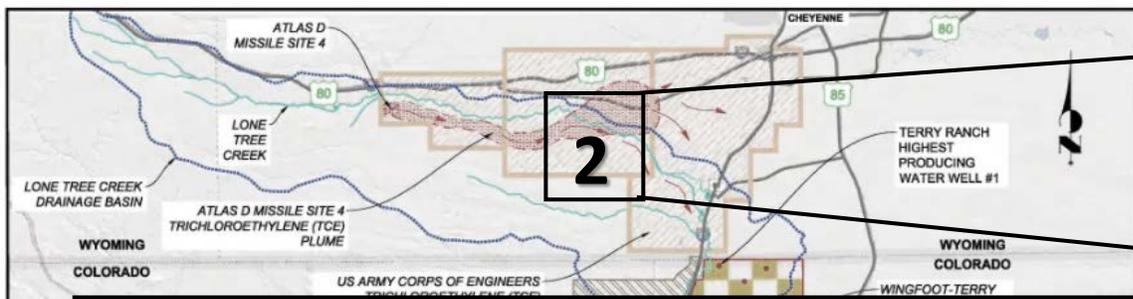
RMC+SoundEarth. "Final Area-Wide Remedial Investigation Report. Former Atlas D Missile Site 4. Laramie County, Wyoming. Contract No. W9128F-13-D-0004, 0001," prepared for the U.S. Army Corp of Engineers, Omaha District. 2020.



1. Data collected during the fall 2019 long term monitoring report (LTM) has been used to determine and refine the lateral and vertical extent of contamination, rate of migration and groundwater gradients in the Former Atlas D Missile Site 4. The LTM data has inferred the TCE boundary to be migrating northeast. The USACE has also stated the following, “[t]he eastern extent and terminal end of the groundwater contaminant plume has been defined in the Expanded Study Area.”

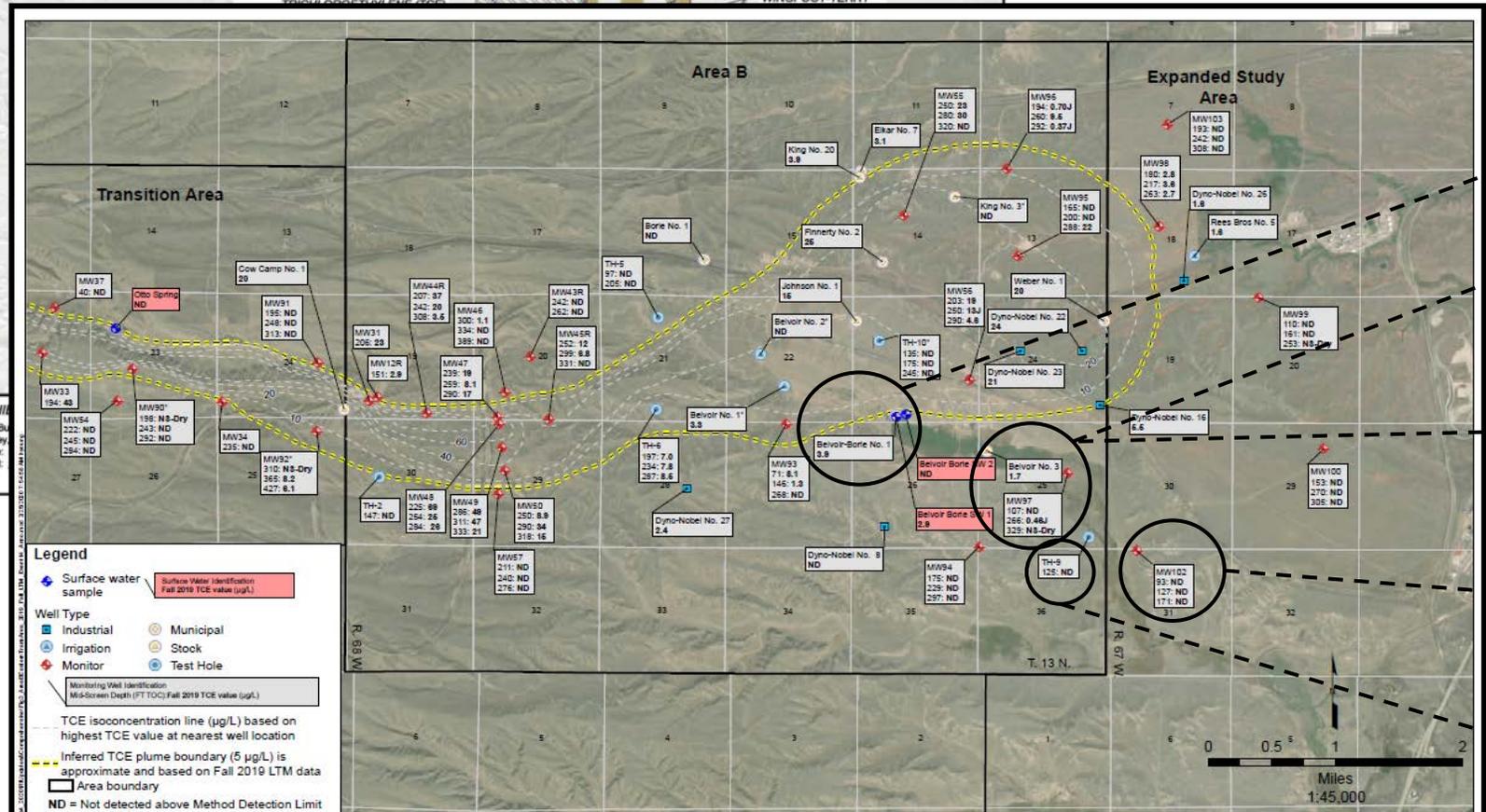
1. Movement of TCE plume

Figure 1. USACE and RMC+SoundEarth, TCE Plume Boundary Comparison Spring 2016 LTM Event 7 to Fall 2019 LTM Event 14. Adapted from “Final Area-Wide Remedial Investigation Report. Former Atlas D Missile Site 4. Laramie County, Wyoming. Contract No. W9128F-13-D-0004, 0001,” prepared for the U.S. Army Corp of Engineers, Omaha District. 2020. p. 415. Copyright 2020 by USACE [1].



2. Over the past five years, semi-annual groundwater sampling has found low concentrations of TCE along Lone Tree Creek, in fact, TCE concentrations along the creek have been decreasing throughout time.

2. Sampling and Monitoring



Belvoir-Borie No.1 TCE concentrations in ug/L.
 2016 Spring: 5.0 Fall: 4.8
 2017 Spring: 4.9 Fall: 4.6
 2018 Spring: 3.9 Fall: 4.5
 2019 Spring: 3.9 Fall: 3.9

Belvoir No.3 TCE concentrations in ug/L.
 2016 Spring: 2.3 Fall: 2.8
 2017 Spring: 2.7 Fall: 2.8
 2018 Spring: 2.0 Fall: 2.4
 2019 Spring: 2.7 Fall: 1.7

MW97 TCE concentrations in ug/L.
107 feet:
 2018 Fall: ND
 2019 Spring: ND Fall: ND
MW97 TCE concentrations in ug/L.
266 feet:
 2017 Fall: 0.7
 2018 Spring: 0.77 Fall: 0.35
 2019 Spring: 0.57 Fall: 0.46
 ND= Not Detected

MW102 TCE concentrations in ug/L.
93 feet
 2019 Fall: ND
127 feet
 2019 Fall: ND
171 feet
 2019 Fall: ND
 ND= Not Detected

TH-9 TCE concentrations in ug/L.
 2016 Spring: ND Fall: ND
 2017 Spring: ND Fall: ND
 2018 Spring: ND Fall: 2.4
 2019 Spring: ND Fall: ND
 ND= Not Detected

US Army Corps of Engineers
RMC+SoundEarth Limited Liability Company
TCE Concentrations in Eastern Transition Area, Area B, and Expanded Study Area Water Samples - Fall 2019 LTM Event 14
Area-Wide Remedial Investigation Report
FORMER ATLAS D MISSILE SITE
4 LARAMIE COUNTY, WYOMING

FIGURE 4-2

Data Sources: Na AIT, LLC, Bureau of Land Management, Esri, DigitalGlobe, GeoEye, Earthstar, Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN

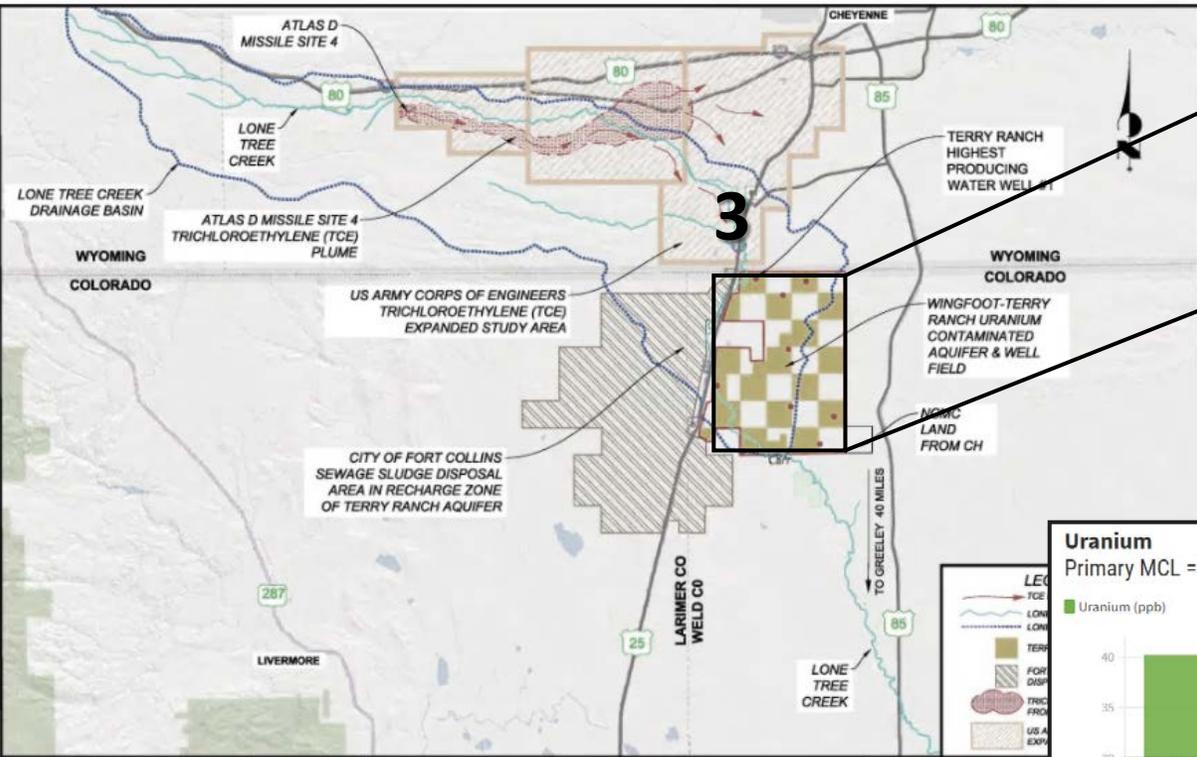
DATE:	DRAWN BY:	CHECKED BY:
01/31/2020	HHY	JLH

Figure 2. USACE and RMC+SoundEarth, TCE Concentrations in Eastern Transition Area, Area B and Expanded Study Area Water Samples – Fall 2019 LTM Event 14. Adapted from "Final Area-Wide Remedial Investigation Report. Former Atlas D Missile Site 4. Laramie County, Wyoming. Contract No. W9128F-13-D-0004, 0001," prepared for the U.S. Army Corp of Engineers, Omaha District. 2020. p. 414. Copyright 2020 by USACE [1].



3. Terry Ranch Described as “Uranium Contaminated”

3. Terry Ranch has low levels of naturally occurring uranium due to the natural geology and geochemistry. Water quality sampling determined that only one well had uranium concentrations above the EPA primary MCL of 30 ppb.



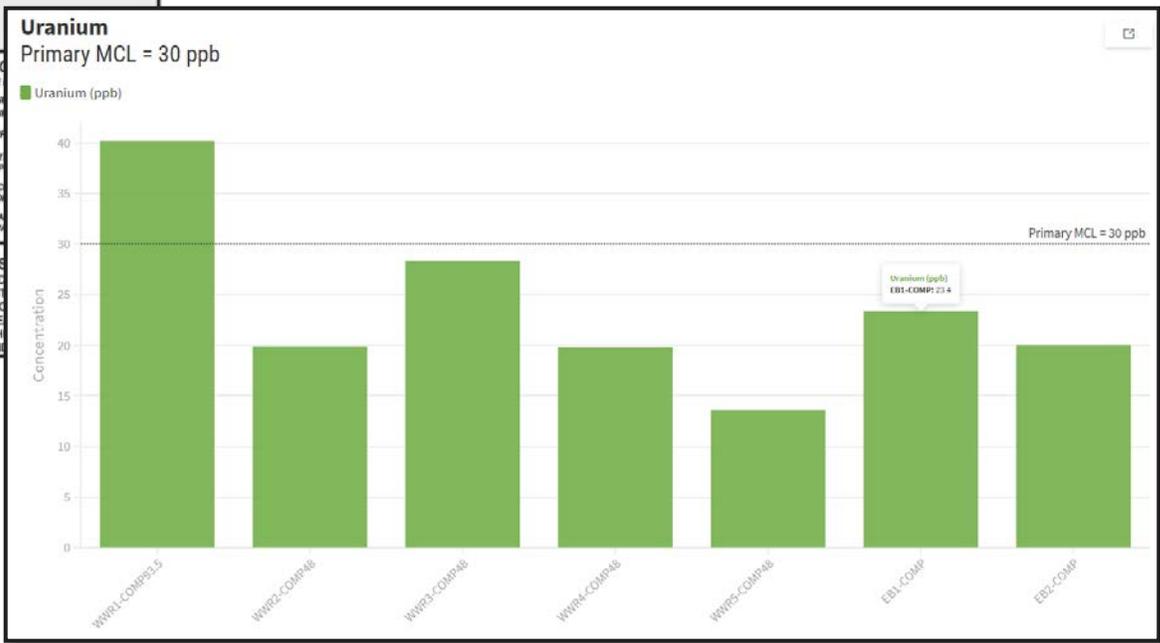
GAUTHIERE ENGINEERING, INC.
 2157 Buena Vista Drive
 Greeley, Colorado 80634
 Phone: (970) 330-0855
 E-mail: john@gauthiere-engineering.com

TERRY RANCH LOCATION

DATE: 2/17/2021

SCALE IN MILES

ATLAS D MISSILE SITE
 TRICHLOROETHYLENE PLUME (TCE) IS THE LARGEST PLUME HAS TRAVELED 12 MILES S...
 TERRY RANCH IN THE PAST 80 YE...
 6 MILES OF TERRY RANCH'S HIGH...
 WELL. TCE IS A CARCINOGEN AN...



Observed Uranium Levels in Terry Ranch

Figure 3. Naturally Occurring Uranium at Terry Ranch.

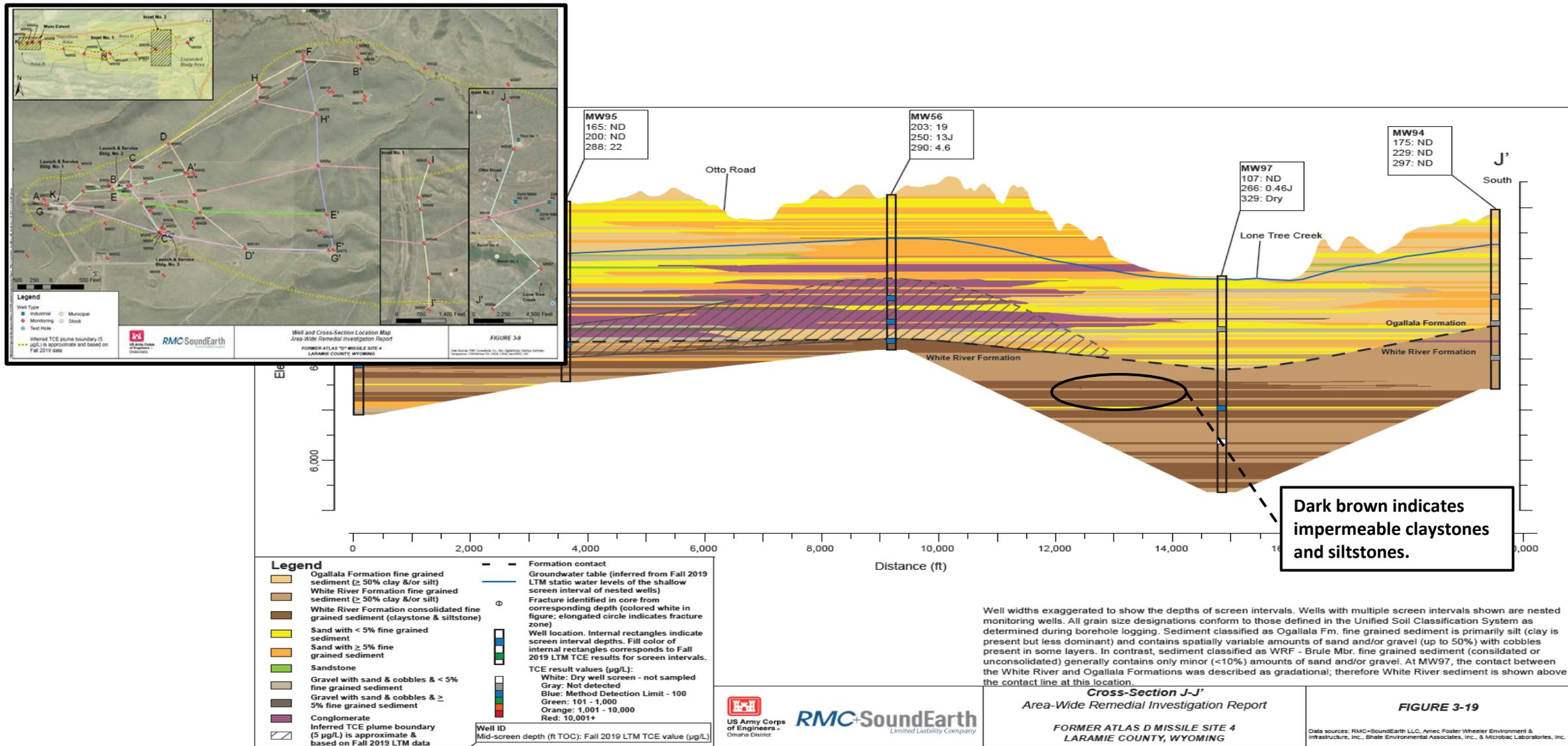


Figure 4. Impermeable claystones and siltstones of the White River Formation.

Adapted from "Final Area-Wide Remedial Investigation Report. Former Atlas D Missile Site 4. Laramie County, Wyoming. Contract No. W9128F-13-D-0004, 0001," prepared for the U.S. Army Corp of Engineers, Omaha District. 2020. p. 414. Copyright 2020 by USACE [1].

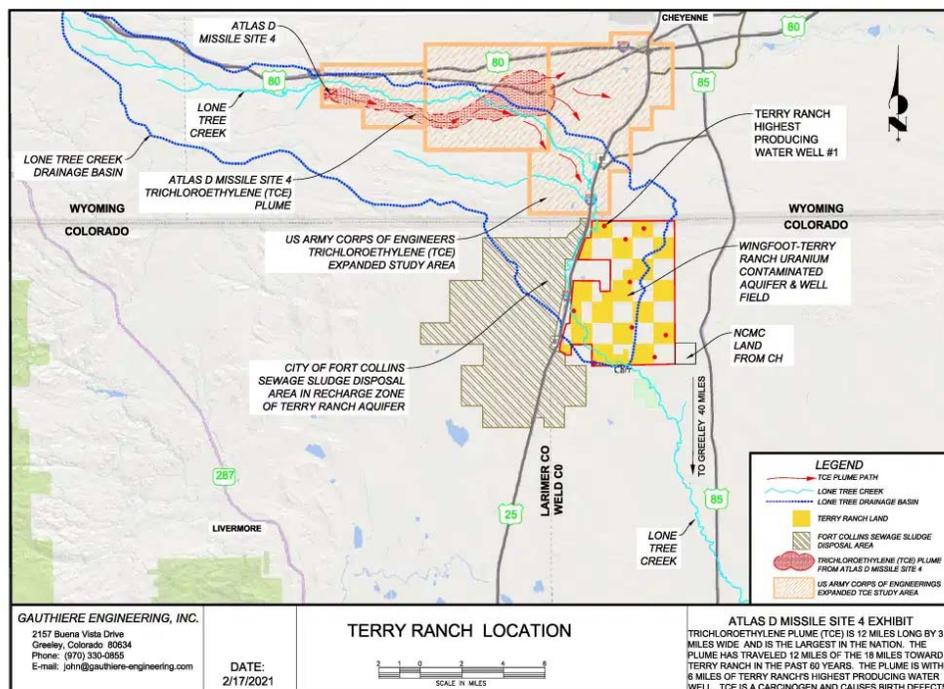


Appendix A

Save Greeley's Water

United Against Uranium in Our Drinking Water

Terry Ranch in the Path of Nation's Largest Trichloroethylene Plume



The Atlas D Missile Site 4 trichloroethylene (TCE) plume is the largest TCE plume in the nation. Trichloroethylene is a known carcinogen and is a cause of birth defects.

This dialogue is intended to explain the above map of the trichloroethylene (TCE) plume, which originated at **the Atlas D Missile Site 4**, eighteen miles west of Cheyenne, Wyoming. It is important to understand the location of the Atlas D Missile Site 4 Trichloroethylene ground water contamination plume in relation to Terry Ranch.

The Atlas D Missile Site 4 is just South of I-80. *The (TCE) plume emanating from it is now 12 miles long and 3 miles wide, according to the Wyoming Department of Environmental Quality. Atlas Site 4's TCE concentrations in the groundwater exceeds 240,000 parts per billion, well above Safe Drinking Act limit of 5 parts*

per billion.^[1] As a matter of fact, the TCE at the site is 48,000 times the safe drinking water limit.

It is quite possible that the TCE plume will turn South and follow the Lone Tree Creek geology to Terry Ranch and its Upper Laramie aquifer recharge area. The TCE plume has advanced 12 miles in 60 years towards the Ranch. The TCE plume is within 6 miles of the Northern border of Terry Ranch and the highest capacity water producing well on the Ranch. Judging from the historic rate of travel, it could take 30 years, plus or minus, to get to Terry Ranch.

As a practical matter, the geology in the area is complex, and the presence, location, nature, and extent of lenses of highly permeable material, fractures and solution holes are never completely understood. However, *buried paleo-drainages that generally mimic the surface topography exist, such as the drainage pattern of Lone Tree Creek. These paleo-drainages represent preferential groundwater flow pathways.*^[2]

If this is true, then the TCE plume would likely follow the Lone Tree Creek pathway and travel to the Terry Ranch. While the City of Greeley's staff considers the Brule Member of the White River geologic formation a confining impermeable geologic formation that might impede downward seepage of the TCE plume into the Upper Laramie (Terry Ranch) formation, it would be a mistake to do so. *It would likely be incorrect, however, to simply consider the Brule a confining unit throughout the Site 4 study area.*^[3]

The US Corps of Engineers (USACE) has been trying to model the trajectory of the TCE plume but is having difficulty producing a reliable model because of the complexity of the geological formations. Note the USACE Expanded Study area which covers the area between the East end of the plume and the Northern border of Terry Ranch. The expanded study area indicates that USACE believes the plume could possibly head south to Terry Ranch. It is hard to ignore the US Corps of Engineers' good judgement. However, Adam Jokerst, Deputy Director of the Greeley Water Department, seems more than willing to ignore this good judgment.

Considering the interesting surprises that lurk in underground geology, the City of Greeley should not invest in, or depend on, the Terry Ranch as its future source of water for Greeley Citizens. Greeley Citizens deserve the right to vote on this most important issue.

By John G. Gauthiere, P.E.

[\[1\]](#) STATEMENT OF THE HONORABLE JOHN BARRASSO, A UNITED STATES SENATOR FROM THE STATE OF WYOMING, Cleaning Up Our Nation's Cold War Legacy Sites, Homeland Security digital Library March 29, 2017, page 4

[\[2\]](#) **US Army Corps of Engineers, Final Area-Wide Remedial Investigation Report Former Atlas D Missile Site 4, P XIV**

[\[3\]](#) US Army Corps of Engineers, Final Area-Wide Remedial Investigation Report Former Atlas D Missile Site 4, P 5

 [waterguru02](#)  [February 21, 2021](#)  [Uncategorized](#)  [1 Comment](#)

Terry Ranch

Part 2 and Part 3 of a three part series on Greeley's decision to approve or disapprove the Terry Ranch Project is on the Greeley Tribune website.

Save Greeley's Water takes issue with most of Adam Jokerst's responses and SGW will provide its rebuttal shortly.

 [waterguru02](#)  [February 21, 2021](#)  [Uncategorized](#)  [2 Comments](#)

An Interesting Analysis of the Terry Ranch Proposal

[Jack Schneider: An analysis of the proposed Terry Ranch aquifer purchase](#)

 [waterguru02](#)  [February 19, 2021](#)  [Uncategorized](#)  [Leave a comment](#)



ENVIRONMENTAL TREATMENT PILOT STUDIES:

In Situ Treatment (Potassium Permanganate/Zero-Valent Iron)

Former Atlas 'D' Missile Site 4, Laramie County, Wyoming

In situ treatment is a widely used cleanup technology applied at hazardous waste sites and is being used at thousands of sites across the country. In situ is a Latin phrase that simply means "in its original place." As such, in situ injection treatment simply involves injecting an amendment into the ground in order to turn contaminants into harmless natural chemicals.

Amendments to be studied at Former Atlas 'D' Missile Site 4 (Site 4) include potassium permanganate (an oxidant) and zero-valent iron (a reactive metal powder).

HOW DOES IT WORK?

Potassium Permanganate

Potassium permanganate, which is pink or purple in color, is dissolved in water and pumped through injection wells at a specified concentration and rate. The chemical is not toxic at the low concentrations used for the treatment process.

Once introduced into groundwater, the potassium permanganate chemically reacts with the trichloroethene (TCE), causing it to oxidize and break down into harmless natural chemicals. Permanganate can remain in the groundwater for nearly a year, continuously breaking down the TCE.

Zero-Valent Iron

Zero-valent iron, dark grey to black in color, is pumped into the formation, typically at a high pressure. The iron does not contain harmful chemicals and is safer to handle when compared to oxidants. Once introduced, the zero-valent iron remains where it is injected and does not flow with the groundwater.

Zero-valent iron is an abiotic reaction (a physical rather than biological reaction), causing the TCE to break down with no intermediary by-products. Zero-valent iron provides a long-term treatment solution (3-15 years longevity), continuously breaking down the TCE.

WHAT ARE THE BENEFITS?

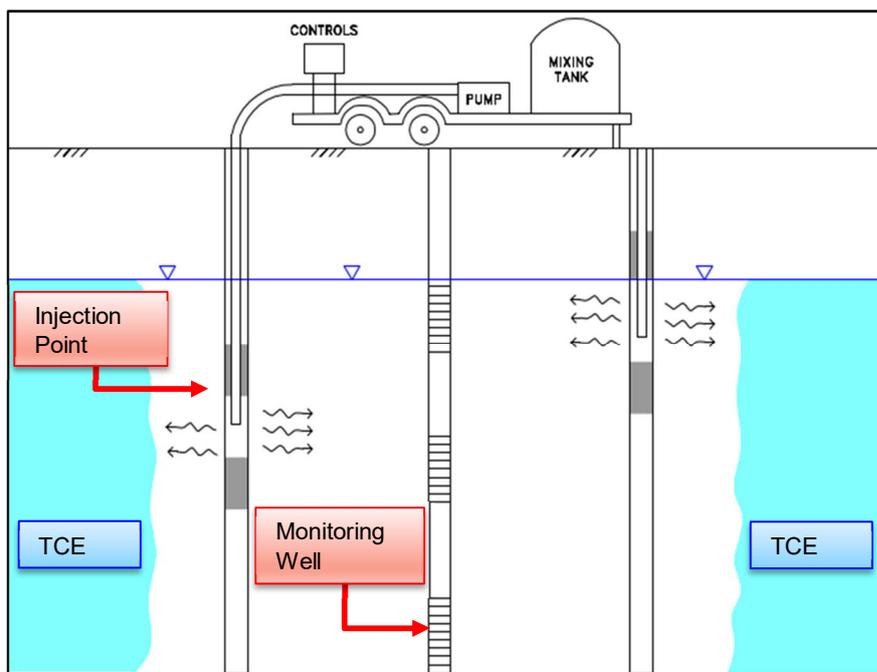
Both potassium permanganate and zero-valent iron are stable and relatively safe for workers to handle. Both can be injected at deep depths. Potassium permanganate is an effective and relatively fast treatment method for cleaning up high concentrations of TCE. Zero-valent iron is an effective and longer-term treatment method for cleaning up medium to low concentrations of TCE. Both treatments can be implemented relatively quickly.

WHERE IS IN SITU TREATMENT TO BE USED AT SITE 4?

The pilot studies for both potassium permanganate and zero-valent iron are planned at the source area. The flame pit at Launch and Service Building No. 1 will be the trial area for determining the distribution and effectiveness of potassium permanganate. The flame pit at Launch and Service Building No. 2 will be the trial area for determining the distribution and effectiveness of zero-valent iron.

WHEN ARE THE IN SITU TREATMENT PILOT STUDIES TO START AT SITE 4?

The pilot studies for both potassium permanganate and zero-valent iron will begin in summer/fall of 2020 with injection of the amendments. Studying the injection process and the distance each treatment reaches from point of injection will occur at the start. The effectiveness and the longevity of the treatments will be studied by sampling monitoring wells nearby to each pilot study starting in fall of 2020 and continue into 2023.





ENVIRONMENTAL TREATMENT PILOT STUDIES:

Pump, Treat & re-Inject System

Former Atlas 'D' Missile Site 4, Laramie County, Wyoming

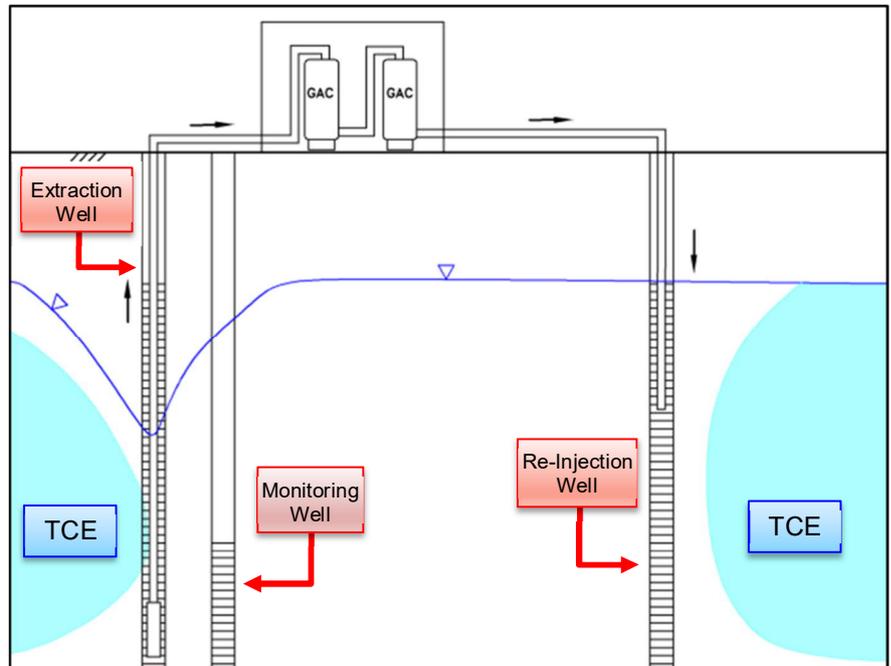
Pump, Treat & re-Inject systems clean groundwater by pumping it from the ground, treating it, and then re-injecting the clean water back into the same aquifer from which it was extracted.

HOW DOES IT WORK?

Made up of three parts, pump-and-treat systems include an extraction system, a treatment system, and re-injection system. The extraction system pulls water from the ground using a well and pump. After extraction, water is sent to the treatment system by piping, where it is cleaned using a variety of methods such as air stripping, carbon filtering and/ or ultraviolet oxidation. After cleaning, the water is piped to a re-injection well where it is allowed to flow back into the aquifer by gravity.

HOW IS IT INSTALLED?

Pump, Treat & re-Inject systems are designed and built specifically for the landscape of the contaminated area and the chemicals present in the groundwater. The geology of the area, including the soils and water sources, can affect the placement of wells and the construction of the water distribution system, treatment plants, and location of re-injection wells. Additionally, the specific minerals in the ground and the concentration of the trichloroethene (TCE) in the groundwater determine the most appropriate treatment system.



For Former Atlas 'D' Missile Site 4 (Site 4), the Pump, Treat & re-Inject system to be built for this pilot test includes carbon filtering so all treated water is returned to the aquifer. Carbon filtering will remove all TCE from the captured groundwater. After treatment, the water is tested to ensure it is clean. The clean water is then re-injected through a well located downgradient of where the groundwater was extracted.

The clean water will be re-injected to meet the substantive requirements of appropriate state and local regulatory agencies, such as the Wyoming Department of Environmental Quality (WDEQ) and the State Engineers Office (SEO).

WHAT ARE THE BENEFITS?

Pump, Treat & re-Inject systems are effective in areas where groundwater cannot be cleaned while it is still underground. They are a safe and well established method of treating groundwater efficiently and effectively and are in use across the country. Pump, Treat & re-Inject systems can also help prevent groundwater contamination from continuing to spread into the downgradient area.

WHERE IS THE PUMP, TREAT & RE-INJECT SYSTEM TO BE PILOT TESTED AT SITE 4?

At Site 4, a pilot study to test the effectiveness of a Pump, Treat & re-Inject system is planned for the Transition Area, located east of the railroad tracks and upgradient of the Borie Well Field. This is an area where the TCE plume narrows and a complete transect of monitoring wells is present across its width.

WHEN IS THE PUMP, TREAT & RE-INJECT SYSTEM PILOT STUDY TO START AT SITE 4?

Installation of the Pump, Treat & re-Inject system pilot study system is to start in summer/fall of 2020 with the drilling of the downgradient re-injection well, installation of piping from the extraction and re-injection wells, and construction of the housing for the carbon filtering. Startup testing will begin in fall of 2020 with operations starting in spring 2021. System operation will occur during the spring, summer, and fall months of 2021 and 2022. Studying the system's effectiveness will occur by 1) monitoring changes in water levels at nearby wells to determine how far from the extraction well water is being captured, and 2) by groundwater sampling to determine if TCE concentrations are at decreasing downgradient monitoring wells.