PIONEER TECHNICAL SERVICES

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February 28, 2025

Mr. Jay Shearer
Environmental Science Specialist
Petroleum Tank Cleanup Section
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

RE: **Cleanup Work Plan for Petroleum Release at the Forsyth Watering Hole**
1017 Front Street, Forsyth, Rosebud County, Montana 59327
Facility ID #44-01244 (TREADS ID #27590), Release #5387, Work Plan ID #34929

Responsible Party:	RRR Properties, LLC. DeAnne Jonas/Jeremy Smith PO Box 1110 Forsyth, MT 59327 forsythwh@yahoo.com	Consultant/ Work Plan Preparer:	Pioneer Technical Services, Inc. Charles Peterson, P.G. 2310 Broadwater Ave, Suite 1 Billings, MT 59102 cpeterson@pioneer-technical.com

Dear Mr. Shearer:

On behalf of RRR Properties, LLC., Pioneer Technical Services, Inc. prepared the following Cleanup Work Plan and cost estimate for performing corrective action work at the Watering Hole facility in Forsyth, Montana. As requested in correspondence dated October 2, 2024, from Montana Department of Environmental Quality, our scope of work and associated proposed costs are outlined below.

If you have any questions concerning this project or the proposed scope of work, please contact me at (406) 702-2430 or cpeterson@pioneer-technical.com.

Sincerely,

Charles Peterson, P.G.
Program Manager
Pioneer Technical Services, Inc.

Attachment 1: Figures
Attachment 2: Cost Estimates
Attachment 3: REGENESIS PetroFix Design

cc: DeAnne Jonas/Jeremy Smith, RRR Properties, LLC., PO Box 1110, Forsyth, MT 59327

EXECUTIVE SUMMARY

The purpose of this document is to provide a Cleanup Work Plan (work plan) for the Watering Hole facility (Site), located at 1017 Front Street, Forsyth, Rosebud County, Montana, Facility ID #44-01244, as requested in electronic correspondence from Montana Department of Environmental Quality (DEQ) dated October 2, 2024. The purpose of the proposed work activities is to clean up petroleum-impacted soil and groundwater associated with Release #5387 by applying remediation fluid and proposing additional work to resolve Release #5387.

The DEQ outlined these recommendations in the work plan request letter dated October 2, 2024. These recommended actions are included in this work plan, which involves remediation fluid applications, screening data for potential petroleum vapor intrusion (PVI), and preparing a Cleanup Report appended with a Release Closure Plan (RCP) upon completion of all activities. These activities are detailed in the following work plan.

These proposed actions are based on the findings and results of the previous remedial investigation (RI) conducted at the Watering Hole facility in Forsyth, Montana, for the Montana DEQ Petroleum Tank Cleanup Section. The Site is located at 1017 Front Street, Forsyth, Montana, in Rosebud County; the DEQ facility identification number is #44-01244, and the release number is 5387.

Discussions between DEQ, RRR Properties, LLC (responsible party), and Pioneer Technical Services, Inc. (Pioneer) defined the scope of this work plan, which includes the application of remediation fluid, soil vapor intrusion (VI) sampling, evaluation of the VI risk, and project reporting.

1 FACILITY SUMMARY AND CURRENT CONDITIONS

The Site is situated in a mixed commercial and residential area within the boundaries of the town of Forsyth, Montana. The Site is located at the northeast intersection of Front Street and 10th Avenue, near the urban core of the town. The Site is currently occupied by a single-story, brick and block, slab-on-grade convenience store building and a set of retail gasoline fuel pump islands located under a canopy at the front (south) of the store. According to Montana Cadastral, the existing convenience store building was constructed in 1982 (Montana State Library, 2024). The Site currently has a gasoline underground storage tank (UST) basin that consists of one 10,000-gallon and two 4,000-gallon gasoline USTs and associated dispenser islands and underground supply piping. This UST basin is located to the east of the building. The surface surrounding the building is paved with asphalt.

The property is bordered to the north by a paved parking lot and a vacant commercial building, to the east by private single-family homes, to the south by Front Street, across from which is a motel, and to the west by 10th Avenue South, across from which is a former gasoline station and former bulk fuel storage yard currently occupied by a restaurant. This area of Forsyth is served by public utility city services (e.g., potable water and sanitary and storm sewer systems). The location of the Site is shown on the Location and Vicinity Map (Figure 1) and Site Map (Figure 2) provided in Attachment 1.

In February 1992, the former owners (Home Oil) of the subject facility removed three USTs from the ground due to a failed tank tightness test. These tanks were formerly located west of the existing on-Site building. During removal, the USTs were observed to be heavily pitted. Three new USTs were installed in a tank basin location to the east of the existing building. Montana DEQ assigned Release #1035 to the previously mentioned release.

As part of a RI for Release #1035, soil samples showed moderate levels of hydrocarbons in the vadose zone. Water samples collected from monitoring wells at the time of drilling indicated total dissolved benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations of up to 18,000 micrograms per liter (µg/L) (AJM, 2012a). In 1995, a soil vapor extraction (SVE) system was installed at the Site. Monitoring of the SVE system indicated that a significant portion of contaminants had been removed from the groundwater, and the system was shut down in November 2001 at the request of Montana DEQ. Periodic groundwater monitoring events were conducted from 2007 until 2012 (AJM, 2012a). In August 2010, AJM, Inc. removed the existing Knaack boxes, remedial equipment, abandoned air-sparge and SVE wells, and polyvinyl chloride (PVC) vent lines; Montana-Dakota Utilities removed associated electrical components (AJM, 2012a).

Results from the June 2012 groundwater monitoring report indicated monitoring wells MW-1, MW-2, MW-4, MW-6, MW-8, and MW-9 were below DEQ risk-based screening levels (RBSLs), while monitoring well MW-3 was still above the respective groundwater DEQ RBSLs (AJM, 2012b). No other work related to Release #1035 was completed at the Site until Release #5387 was discovered in 2018.

On December 6, 2018, the facility failed a tightness test on an unleaded line between the middle and western pump islands. Based on impacted soil gathered from below the piping in the leak area, DEQ assigned Release #5387 to this release.

As requested by DEQ on October 7, 2022, Pioneer submitted RI Work Plans #34621 and #34622 on behalf of RRR Properties, LLC to perform additional RI activities at the Site (Pioneer, 2022). Montana DEQ approved both work plans on January 10, 2023. The work plans included installing additional soil borings and monitoring wells, installing VI sampling ports, completing soil sampling, groundwater monitoring, soil VI sampling, and preparing a RI report and updated RCP.

A total of 11 soil borings were advanced on July 11 and 12, 2023. Out of these soil borings, 7 of the 11 were completed as groundwater monitoring wells, and 1 of the 11 was completed as a near-soil vapor port. From October 25 to 26, 2023, Pioneer completed a groundwater monitoring and sampling event and a soil vapor sampling event (Pioneer, 2023). The results from the RI and monitoring event are summarized below:

- Soil encountered during boring advancement was consistent with characteristics of an alluvial depositional environment. Soil types at the Site included silty clay, sandy clay, sand, and variations of sand and gravel. Encountered soil lithology was generally consistent in all borings. The water table was encountered at approximately 6.00 to 6.75 feet below ground surface (bgs).
- During monitoring well development and evaluation, it was determined that monitoring wells MW-4 and MW-9 we were no longer serviceable, and they were abandoned.
- A total of 27 soil samples, including two duplicate samples, were submitted for laboratory analysis. No lead scavengers were present above their respective DEQ RBSLs or laboratory reporting limits in any of the soil samples analyzed.
- Volatile petroleum hydrocarbon (VPH) constituents were present above the most conservative DEQ RBSLs in soil borings MW23-10, MW23-12, and MW23-15 (located near and downgradient of the 2018 line release) from 2 to 10 feet bgs and/or 6 to 10 feet bgs.
- The extractable petroleum hydrocarbon (EPH) screening level (200 milligrams per kilogram [mg/kg]) was exceeded in MW23-12 from 6 to 10 feet bgs (329 mg/kg) and MW23-15 from 2 to 10 feet bgs (963 mg/kg). The EPH fractionation analysis for both samples indicated no constituents above the DEQ RBSLs Direct Contact (Commercial).
- A total of 13 groundwater samples, including one duplicate sample, were submitted for laboratory analyses. No lead scavengers were present above laboratory reporting limits in any of the groundwater samples analyzed.
- Monitoring wells MW23-10, MW23-13, and MW23-14 (located near and downgradient of the 2018 line release) had groundwater VPH constituents in concentrations above the Montana DEQ Tier 1 Groundwater RBSLs (DEQ, 2024).
- Monitoring wells exceeding the groundwater EPH screening (1,000 µg/L) level include MW-3 (1,020 µg/L), MW23-14 (6,180 µg/L), and MW23-15 (2,860 µg/L). An EPH fractionation analysis indicated all monitoring wells had groundwater EPH fractionation constituents below respective DEQ RBSLs. Post fractionation, MW23-14 and MW23-15 had total extractable hydrocarbon values of 3,390 µg/L and 1,240 µg/L, respectively.

- Vapor Probe VI21-01 had a soil vapor C_5 to C_8 aliphatic concentration (15,000 micrograms per cubic meter [µg/m^3]) above Environmental Protection Agency (EPA) Sub-Slab and Near-Source Soil Gas Commercial Regional Screening Level (RSL) (EPA, 2022).
- All remaining soil vapor constituent concentrations were below their respective Commercial RSL.

The results of the 2023 investigation indicate soil sample RBSL exceedances occurred within the area of the dispensers (MW23-10 and MW23-12) and downgradient of the dispensers (MW23-10). Similarly, groundwater VPH constituents exceeded RBSLs in the area of the dispensers (MW23-10) and downgradient of the dispensers (MW23-13, MW23-14, and MW23-15). Air samples taken downgradient of Release #5387 also indicate C_5 to C_8 aliphatic RSL exceedances adjacent to the facility building.

Soil samples taken within the former areas of impact related to Release #1035 (soil borings SB23-01, SB23-03, and MW23-16) indicate no lead scavenger, VPH, or EPH constituents above respective RBSLs. Monitoring well MW-3 (downgradient of the existing UST) required EPH fractionation analysis, but indicated no EPH fractionation constituents present post-fractionation. Monitoring well MW-8 (downgradient of the existing UST) had an increase in VPH constituents detected above laboratory reporting limits relative to historical results, but all constituents remain below their respective RBSLs. The remaining downgradient monitoring wells and monitoring wells within the 1991 excavation area indicate no VPH or EPH constituents above RBSLs in the groundwater.

As requested by DEQ on October 2, 2024, Pioneer is submitting this Cleanup Work Plan #34929 on behalf of RRR Properties, LLC to perform additional cleanup activities at the facility. The locations of the existing wells, former and existing UST basins, and line leak site are shown on the Site Map on Figure 2 in Attachment 1.

2 OBJECTIVES OF CLEANUP WORK PLAN

The primary objective of this work plan is to safely and cost effectively address the remaining residual petroleum impacts located near the source area of Release #5387 through the subsurface application of the remediation fluid PetroFix.

3 CLEANUP METHOD CHOSEN

Pioneer suggests the application of a subsurface remediation fluid be used to remediate the source area. Because the release was sourced from a line leak at the fueling dispenser island and soil excavation would be disruptive of business sales, the excavation of the impacted soils is not the preferred cleanup option for the owners. Moreover, the excavation and landfarm disposal of the soils has been determined to be an excessively expensive alternative. In addition, the lateral extent of any excavation would be constrained by existing structures (i.e., dispenser canopy and dispensers and associated supply lines). To address the limitations of an excavation, the subsurface application of the remediation fluid PetroFix is recommended. Relative to removing existing structures and disrupting ongoing business operations, applying PetroFix is less intrusive and disruptive to the current ongoing business operations and is safer and more cost-effective. The PetroFix remediation

fluid can be applied directly to the subsurface via injection points and via select wells in the source area. The cleanup program will be followed by groundwater monitoring to monitor the attenuation of the dissolved-phase plume.

4 CLEANUP WORK PLAN TASKS

In summary, the scope for this work plan includes applying remediation fluid, performing a PVI evaluation, and preparing a cleanup report, appended with a RCP, upon completion of the remediation fluid injection. Specifically, this work plan proposes the following actions to achieve these goals:

- Applying the remediation fluid PetroFix to the subsurface via injection points, as designed by the manufacturer, REGENESIS.
- Validating all laboratory analytical data using DEQ's Data Validation Summary Form.
- Discussing work plan tasks and results with DEQ's project manager; any modifications required to complete the work plan objectives will be submitted and agreed upon.
- Updating the RCP and discussing the results with DEQ's project manager.
- Performing a PVI evaluation.
- Submitting a cleanup report that details the results of the remedial injection and PVI study.
- Work plan and reports will be submitted electronically following the Petroleum Tank Cleanup Section submittal requirements.

These cleanup activities will be provided to remediate and resolve Release #5387. As requested by DEQ, Pioneer proposes the following scope of work:

- Task 1 Project Management, Permitting, and Planning.
- Task 2 Remediation Fluid Application.
- Task 3 PVI Evaluation.
- Task 4 Reporting.

The following sections describe each task for the proposed work and Pioneer's cost estimate and proposed schedule.

4.1 Task 1 – Project Management and Planning

Task 1 Project Management and Planning work will include:

- Preparing a work plan and cost estimate.
- Developing bid requests for subcontractor solicitation.
- Subcontractor selection and oversight.
- Coordinating utility locates.
- Project scheduling.
- Preparing a Health and Safety Plan.
- Coordinating with subcontractors, owners, and regulators.

- Site work preparation.

Pioneer will notify 811 for utility locates prior to drilling activities. A private utility locate company will locate the private utilities owned and maintained by the facility. Pioneer field personnel will document the locations of marked underground and aboveground utilities on the figures provided with the final report.

4.2 Task 2 – Remediation Fluid Application

Pioneer is proposing to apply PetroFix, a remediation treatment fluid, into the Site's subsurface by injecting PetroFix into two separate treatment zones. Area 1 is identified as the upgradient source area and Area 2 is identified as the downgradient barrier treatment area. PetroFix is an environmentally compatible formulation of micron-scale activated carbon combined with both slow and quick release inorganic electron receptors. PetroFix is designed to remediate petroleum hydrocarbons without requiring time consuming and expensive *ex situ* soil or groundwater treatment and disposal of the soil or groundwater from the excavation. We are proposing to apply 800 pounds of PetroFix within Area 1 Site using an 8-point grid pattern. near the release site. We propose applying 3,200 pounds of PetroFix to Area 2 within an 18-point grid pattern. The specifics of the design are further described in the REGENESIS, Inc. design document presented in Attachment 3.

The application areas are limited to the areas defined on Figure 3 in Attachment 1.

4.3 Task 4 – Perform Petroleum Vapor Intrusion Study

Pioneer personnel will complete a desktop evaluation of the potential for PVI in the vicinity of the on-Site building and adjacent utility corridors using the previous soil data, historical data (cumulative soil analytical data), current and past groundwater monitoring analytical data, and sample location and depth data according to Section 2.4 of DEQ's VI Guidance (DEQ, 2021a).

4.4 Task 5 – Reporting

Pioneer will prepare one cleanup report for this work plan. The cleanup report will include the results of soil excavation, remedial fluid injections, soil sampling efforts, PVI evaluation, and an updated RCP.

4.4.1 Cleanup Report

Following the fluid application, Pioneer will report the results of the remedial injection, and PVI in a cleanup report according to the *Montana Groundwater Monitoring Work Plan and Report Guidance for Petroleum Releases* (DEQ, 2021b). The report will include the following:

- Updated facility maps illustrating locations of remedial injection, current and former fuel systems, Site buildings, locations of petroleum source material areas, receptors including underground utilities, and locations of groundwater monitoring wells.
- Tables summarizing locations/depths of field data.
- PVI evaluation.
- Field notes, field data sheets, and related field data.
- Data validation.
- Data interpretation and recommendations relevant for further remediation and/or closure plan for the release.
- An appended RCP.

The report will be submitted within 45 days after completion of the proposed remedial fluid injection.

5 COST ESTIMATE

A detailed cost estimate to perform this scope of work is presented on the worksheet in Attachment 2.

6 SCHEDULES

Pioneer proposes to perform and complete the remedial injection (Task 2) during the spring or summer of 2025. The cleanup report will be completed and submitted within 45 days of completing the injections. The full duration of the project is approximately 8 months, and the final report will be issued sometime in the fall or winter of 2025.

7 REFERENCES

AJM, 2012a. Corrective Action Report KUM & GO Convenience Store. AJM Incorporated. January 24, 2012.

AJM, 2012b. Groundwater Sampling Report 7-11 (KUM & GO) Convenience Store. AJM Incorporated. October 23, 2012.

EPA, 2022. Vapor Intrusion Screening Level Calculator. Accessed March 2023.

DEQ, 2018. Groundwater Sampling Guidance. Montana Department of Environmental Quality Contaminated Site Cleanup Bureau. DEQ-WMRD-GWM-1. March 6, 2018. Helena, Montana 59601.

DEQ, 2021a. Montana Vapor Intrusion Guide. Montana Department of Environmental Quality Waste Management and Remediation Division. DEQ-WMRD-Vapor-1. September 2021. Helena, Montana 59601.

DEQ, 2021b. Montana Groundwater Monitoring Work Plan and Report Guidance for Petroleum Releases. Montana Department of Environmental Quality, Waste Management and Remediation Division Petroleum Tank Cleanup Section. March 2021.

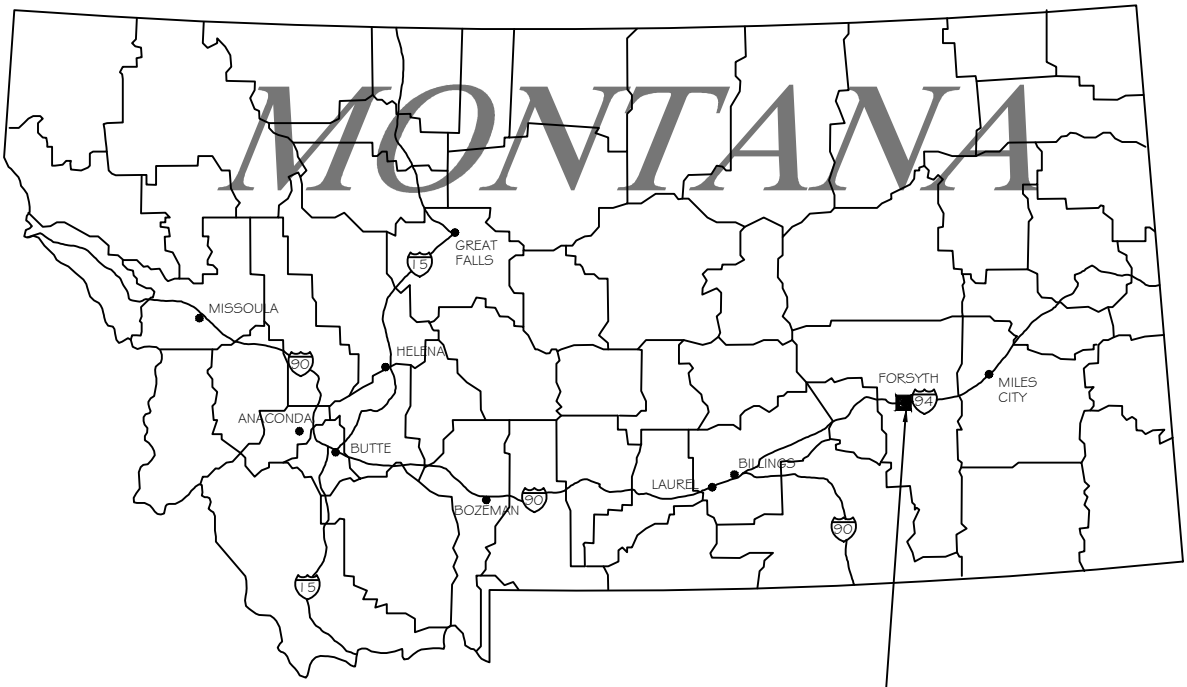
DEQ, 2024. Montana Risk-Based Corrective Action Guidance for Petroleum Releases. Montana Department of Environmental Quality. February 2024.

Montana State Library, 2024. Montana Cadastral. Available at Montana Cadastral.

Pioneer, 2022. Remedial Investigation Work Plan for Petroleum Releases at Forsyth Watering Hole, 1017 Front Street, Forsyth, Rosebud County, Montana 59327, Facility ID #44-10244 (TREADS ID #27590), Releases #5387 and #1035, Work Plan IDs #34621 and 34622, Respectively. Pioneer Technical Services, Inc. November 18, 2022.

Pioneer, 2023. Remedial Investigation Report – Soil Boring, Groundwater Monitoring, and Vapor Intrusion Sampling, Forsyth Watering Hole, 1017 Front Street, Forsyth, Rosebud County, Montana 59327, Facility ID #44-01244, Release #5387 and #1035, Work Plans #34621 and #34622. Pioneer Technical Services, Inc. December 19, 2023.

Attachment 1
Figures



PROJECT LOCATION

SITE VICINITY MAP

DEQ FACILITY ID: #44-01244
RELEASE NUMBER: #5387
WORK PLAN NUMBER: #34929

FORSYTH WATERING HOLE
1017 FRONT STREET
FORSYTH, MONTANA 59327

DISPLAYED AS:
COORD SYS/ZONE: NAD83, NAVD88
DATUM: MSP
UNITS: INT. FEET
SOURCE: ----

SCALE IN FEET
0 500 1000

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FIGURE 1

FORSYTH WATERING HOLE
LOCATION AND VICINITY MAP

DATE: OCTOBER 2024

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DEQ FACILITY ID: #44-0144
RELEASE NUMBER: #5387
WORK PLAN NUMBER: #34929

DISPLAYED AS:
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DATUM: MSP
UNITS: INT. FEET
SOURCE: BING

SCALE IN FEET
0 25 50

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FIGURE 2
FORSYTH WATERING HOLE SITE MAP

DATE: OCTOBER 2024

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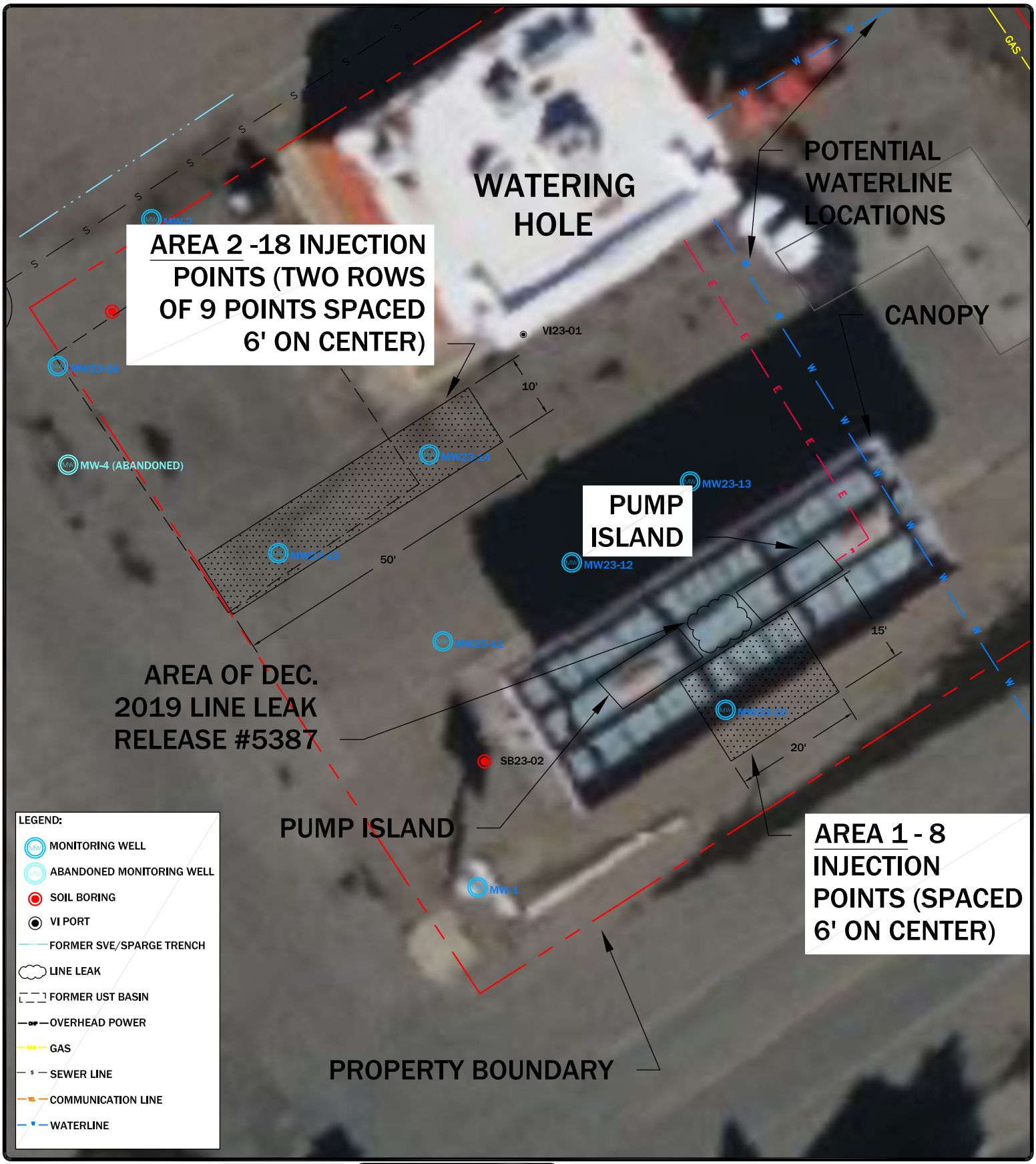

DEQ FACILITY ID: #44-0144
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WORK PLAN NUMBER: #34929

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UNITS: INT. FEET
SOURCE: BING

SCALE IN FEET
0 10 20

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FIGURE 3
FORSYTH WATERING HOLE
TREATMENT AREA

DATE: OCTOBER 2024

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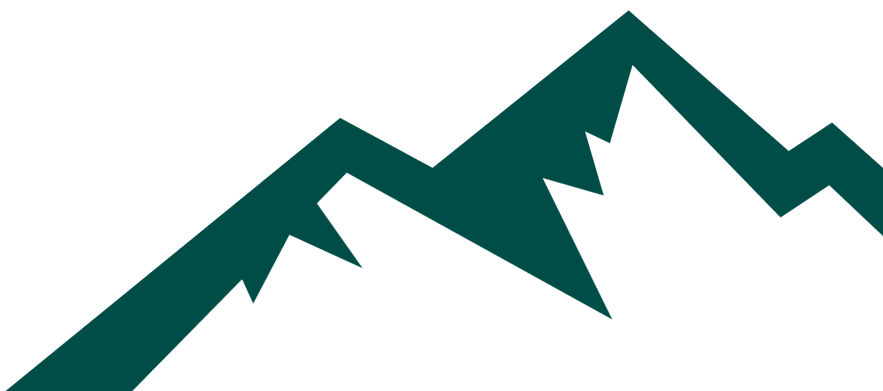
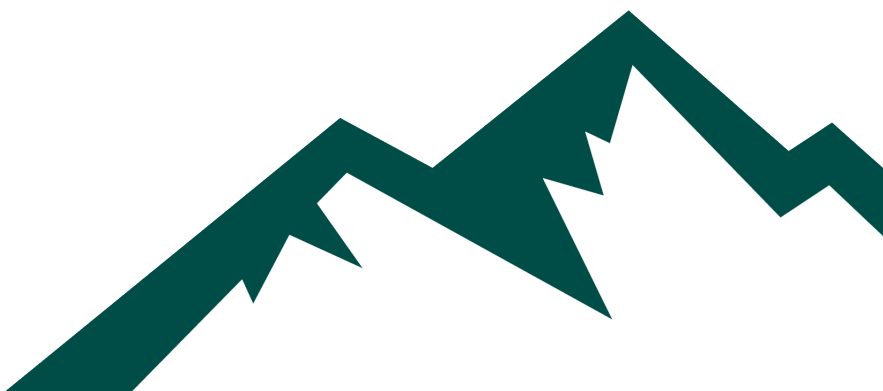
Attachment 2
Cost Estimate



Attachment 3
REGENESIS PetroFix Design



REGENESIS

Technology-Based Solutions for the Environment

PROJECT NAME

Forysth Watering Hole

PREPARED FOR

Pioneer Technical Services
Taylor Bienvenue
tbienvenue@pioneer-technical.com

PREPARED BY

REGENESIS
Brittain Griffiths
bgriffiths@regenesis.com

February 27, 2025

Project Summary

REGENESIS appreciates the opportunity to provide Pioneer Technical Services our remedial design and cost estimate for the Forysth Watering Hole project. This proposal includes an overview of our proposed solution, the project goals, technologies proposed, application design summary table and a treatment area map.

Proposed Solution

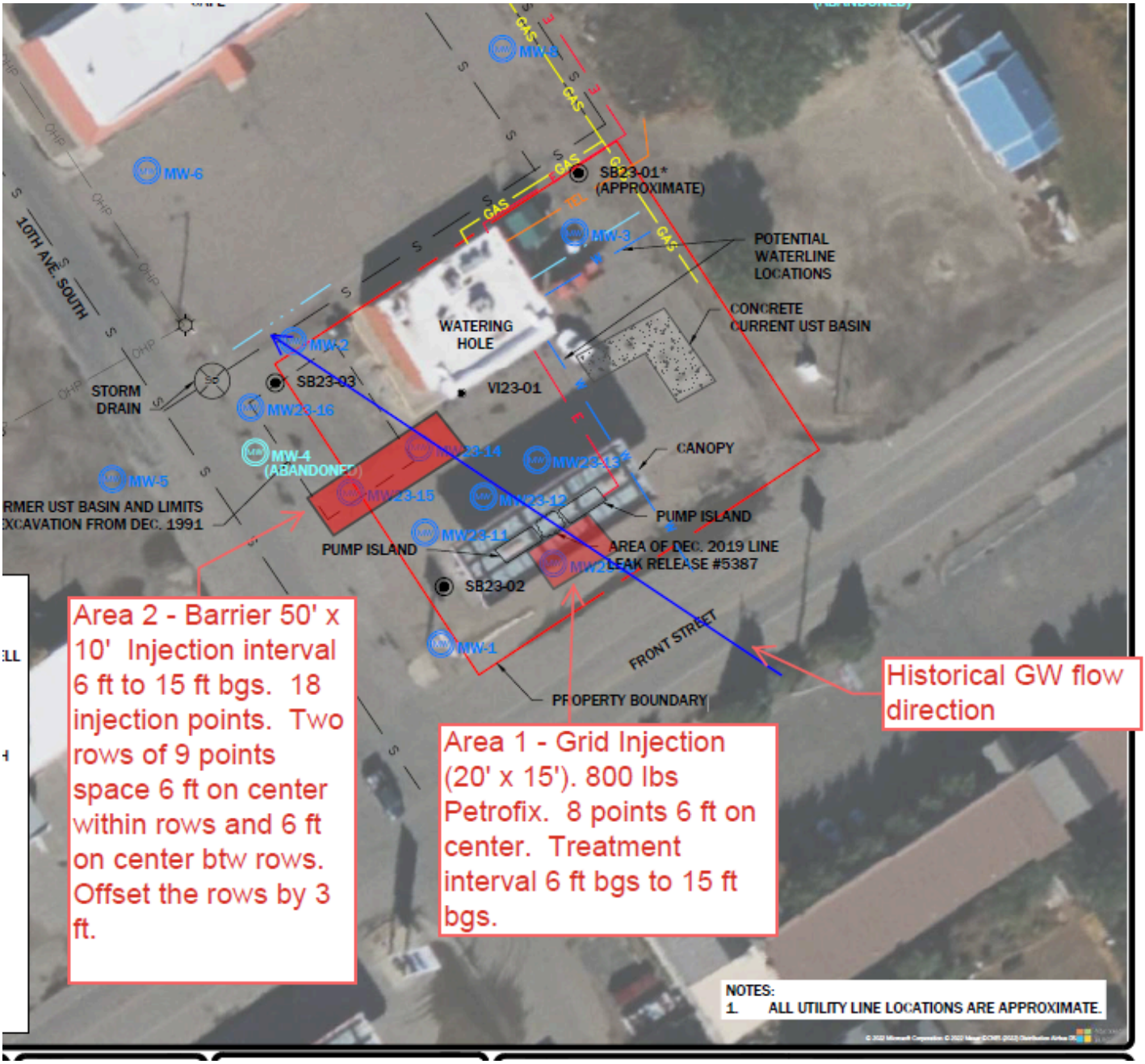
We propose the implementation of PetroFix Remedial Fluid to absorb and remediate dissolved phase hydrocarbons at your project site. Per my conversation with Charlie Peterson a 300 square foot area upgradient of the pump islands will be treated and a 50 foot wide Petrofix barrier will be created. In the area of the barrier there are some hits of soil contamination in addition to the groundwater contamination. This barrier has been designed to stop the plume from continuing to migrate. The Petrofix will not remediate the contaminated soil. I have assumed a certain amount of soil contamination will be released into the groundwater during the injection process. If more contamination is released than I have assumed, then an additional application may be necessary. Based on my conversation with Charlie I feel an additional application is unlikely to be needed.

The goal of the barrier is to stop the migration of the plume. The goal of Area 1 is to reduce the contaminant concentrations to the following:

Petroleum Hydrocarbons	(µg/L)
Benzene	<5
Toluene	<1000
Ethylbenzene	<700
Xylenes	<10000
MTBE	<30
Naphthalenes	<100
Trimethylbenzenes	None Est.
TPH-g	None Est.
TPH-d	None Est.

Area 1 - In the 300 square foot treatment outlined on the attached site map we recommend 800 lbs of Petrofix be mixed with 2,948 gallons of water and injected into 8 points spaced 6 feet on center. The Petrofix solution should be evenly injected from 6 ft bgs to 15 ft bgs.

Area 2 ***Barrier*** - A fifty foot Petrofix barrier should be created to control the migration of the plume. To create the barrier we recommend 3,200 lbs of Petrofix be mixed with 4,849 gallons of water and injected into 18 injection points. The barrier will consist of two rows of 9 injection points spaced 6 ft on center within rows and 6 ft on center btw rows. Offset the two rows of injection points by 3 feet. The Petrofix solution should be evenly injected from 6 ft bgs to 15 ft bgs.



Forysth Watering Hole

Pioneer Technical Services

February 27, 2025

Figure 1-Treatment Area Map

REGENESIS

Technology-Based Solutions for the Environment

Detailed Design Tables

REGENESIS

PetroFix Application Summary
Grid Estimate
Area 1

PetroFIX Remediation Fluid

PetroFix Amount	800 lb
Electron Acceptor Amount	40 lb
Treatment Surface Area	300 ft^2
Injection Points	8
Point Spacing	6.0 ft
Top of Treatment Interval	6.0 ft bgs
Bottom of Treatment Interval	15.0 ft bgs
Treatment Volume	100 yd^3
PetroFix Dose	8.0 lb/yd^3

Total Volume	3,029 gal
Product Volume	82 gal
Water Volume	2,948 gal
Injection Volume Per Point	379 gal
Injection Volume Per Vertical Foot	42 gal
Product/Point	10.2 gal
Water/Point	368.4 gal
Soil Type	Coarse >75% Sand/Gravel
Effective Pore Volume Fill %	60%

Mix Tank Volume*	275 gal
Dilution Factor	37.0 x
PetroFix per Mix Tank	7.4 gal
Water Per Mix Tank	267.6 gal
Electron Acceptor per Mix Tank	3.6 lb
Number of Batches Required	11.0

**Adjust tank volume to that used in field.*

AREA NOTES

Reported Groundwater Concentrations (mg/L)

Benzene	0.187	Isopropylbenzene	0.000
Toluene	0.123	Naphthalenes	0.014
Ethylbenzene	0.103	MTBE	0.000
Xylenes	0.154	TPH-GRO	1.120
Trimethylbenzenes	0.000	TPH-DRO	0.324
Butylbenzene	0.000	TPH-ORO	0.000

PetroFix Application Summary
Barrier Estimate
Area 2

PetroFix Amount	3,200 lb
Electron Acceptor Amount	160 lb
Barrier Length	50 ft
Delivery Points	18
Point Spacing Within Rows	6.0 ft
Point Spacing Between Rows	6.0 ft
Number Of Barrier Rows	2
Top of Treatment Interval	6.0 ft bgs
Bottom of Treatment Interval	15.0 ft bgs
Treatment Area	500 ft^2
PetroFix Dose Within Barrier	19.2 lb/yd^3

Total Volume	5,177 gal
Product Volume	328 gal
Water Volume	4,849 gal
Injection Volume Per Point	288 gal
Injection Volume Per Vertical Foot	32 gal
Product/Point	18.2 gal
Water/Point	269.4 gal
Soil Type	Coarse >75% Sand/Gravel
Effective Pore Volume Fill %	62%

Mix Tank Volume*	275 gal
Dilution Factor	13.5 x
PetroFix per Mix Tank	17.4 gal
Water per Mix Tank	257.6 gal
Electron Acceptor per Mix Tank	8.5 lb
Number of Batches Required	18.8

**Adjust tank volume to that used in field.*

AREA NOTES

Technology Overview

PetroFix is a unique activated carbon remedial fluid (carbon milled to a diameter of 1 to 2 micrometers) paired with soluble, anaerobic electron acceptors designed to remediate dissolved hydrocarbons. This allows the product to be injected as a fluid using low pressure. PetroFix is commonly used for source and plume treatment, excavation polishing, and barrier applications. PetroFix features:

- Provides rapid and sustained results allowing for faster and more certain site closure
- Dual-technology approach relies on both carbon sorption and anaerobic biodegradation
- Low-pressure "flooding" vs high pressure "fracturing" improves distribution and reduces surfacing
- Safe to handle because is non-hazardous and shipped as a liquid (no fugitive carbon dust)
- Mitigates hydrocarbon back diffusion which is a cause of concentration rebound

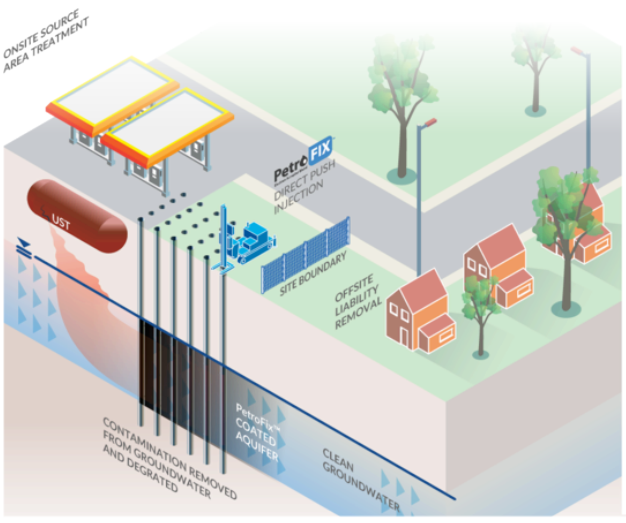
PetroFix is typically self-applied and is supported by a large library of application instruction, technical bulletin, and videos. Based on our experience at hundreds of sites we have developed recommendations listed in a hyperlinked planning document included in the following sections. Below are links for additional technologies information:

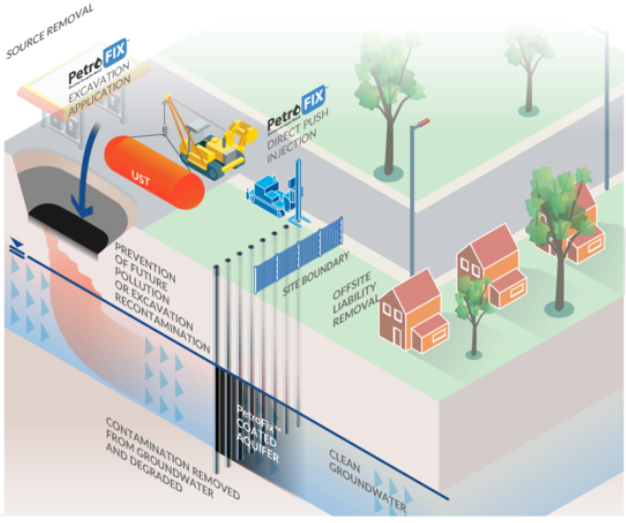
PetroFix - An Animated Overview

PetroFix - All Webinars

Representative Case Studies

- PetroFix Case Study - Engineering Rapid Closures Multi-Site
- PetroFix Case Study - Former Gas Station Closure and +99% Reductions - CO
- PetroFix Case Study - PetroFix Estimated to Save $1 Million Compared to Long-Term Monitoring
- PetroFix Case Study - All





Storage

While PetroFix has a multiple month shelf-life while stored in proper conditions, it is recommended to deliver PetroFix as soon to the planned application as possible.

How to store for immediate use:

- Out of direct or prolonged sunlight
- Prevent freezing conditions
- Do not store in temperatures exceeding 90 degrees for greater than three weeks

Additional information on long term storage can be found in the PetroFix Technical Memo: Freezing and Hot Weather Handling document. Proper prolonged storage conditions include:

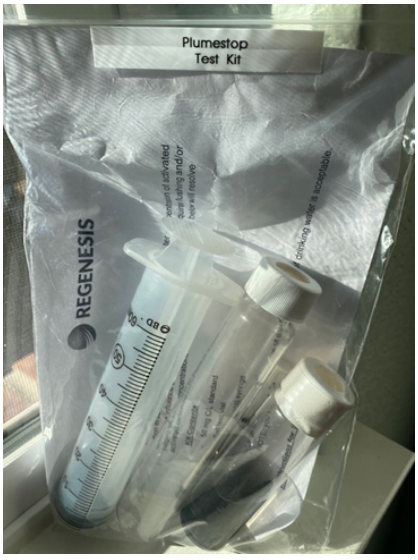
- Shade - no direct sunlight
- In original CLOSED containers
- Between 40 - 90^{o}F
- Well ventilated

PetroFix Test Kit

Each shipment of PetroFix comes with a quantitative test kit. These test kits should arrive taped to the tops or sides of PetroFix or associated electron acceptor containers upon shipment. If a test kit cannot be found, please inform REGENESIS, and a replacement can be shipped to site.

These test kits are reusable if stored similar to the recommended storage conditions for PetroFix.

Test kits should be used during the PetroFix application to help determine the radius of influence and during monitoring.

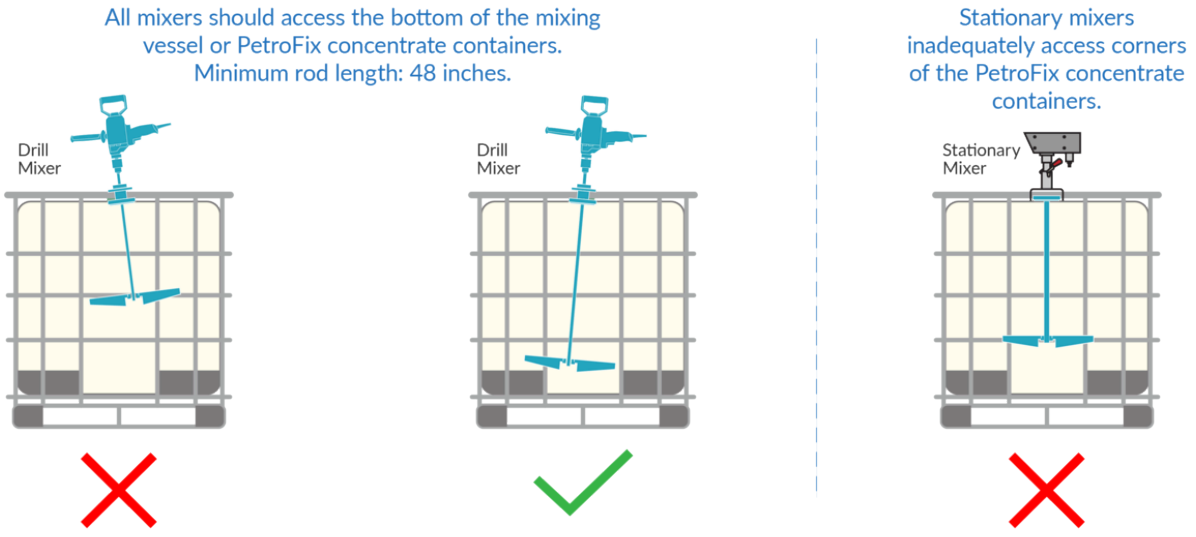


Mixing & Transfering

Below is an abbreviated overview of product mixing recommendations for injection. Please see the application planning checklist for a complete list of all available application guidance.

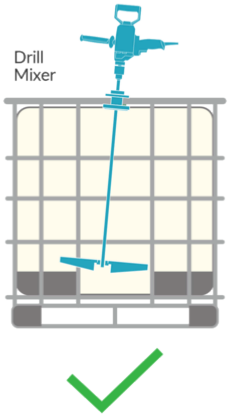
1. Homogenization – All PetroFix is checked for qualty control specifications prior to shipment. The typical material viscosity is similar to motor oil (sometimes thicker) in the shipping containers. The shipped PetroFix should be homogenized prior to dilution to ensure consistency. In some cases, PetroFix may exhibit some settling or some lump formation, both of which can easily be mixed back into the product upon homogenization. REGENESIS recommends a mixer capable of being freely moved to all parts and corners of the tote or drum and capable of reaching within 3 inches of the bottom of the tote or drum to ensure complete homogenization (see illustration on next page). Dedicated tote mixers are not recommended.
2. Transferring PetroFix to mix tank - Prior to transferring PetroFix to the mix tank the specified amount of dilution water should be added to the mix tank. The recommended amount of water can be found on the design summary page. Next, the injection contractor should determine their preferred way of measuring the amount of PetroFix to be transferred to the mix tanks. Examples included physical volume transfers (i.e., graduated buckets), use of volumetric flow meters couple to pumps, internal staging sticks, or external staging marks. Specific pump recommendations that can be used for machine transfer will be discussed later under equipment recommendations.
3. Adding electron acceptor to mix tank - The electron acceptor must be added AFTER the PetroFix remedial fluid is added to the dilution tank with water. We recommend the use of a field scale to measure recommended amounts of electron acceptor needed per batch.
4. Solution Mixing – The diluted PetroFix solution should be allowed to mix for at least five minutes prior to application. Once mixed, the solution should be mixed at least every twenty minutes if continuous mixing is impractical. Recirculation mixing is not recommended. Recirculation tends to inadequately mix the PetroFix solution resulting in the collection in corners of the mixing vessel.

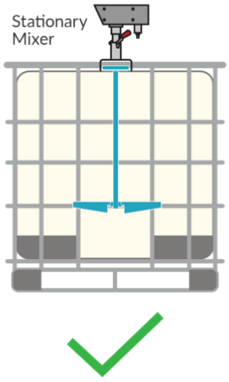
Homogenizing PetroFix In Totes and Drums



Mixing Diluted PetroFix in Mix Tanks

Stationary mixers and handheld paddle mixers are recommended for PetroFix solution mixing





Recirculation inadequately mixes the PetroFix solution

Technical Approach - Monitoring

PetroFIX Remediation Fluid

Monitoring Parameters

Analytical Parameter	Method
Recommended	
Contaminants of Concern (COC's)	Varies by site. Recommend a minimum of BTEX analysis plus Total Petroleum Hydrocarbon (TPH) measurements for gasoline (TPH-G) and/or diesel range contamination (TPH-D) based on contaminant source.
pH	Meter reading taken in flow-through cell (DO can also be measured with a Hach kit)
Dissolved Oxygen (DO)	
Oxidation Reduction Potential (ORP)	
Electral Conductivity (EC)	
Cations - Ca, Mn, Al*	EPA Method 6010
Sulfate	EPA 375.3 or EPA 9056
Nitrate	EPA 353.1 or EPA 9056
Visual Confirmation of PetroFix in Wells**	Place groundwater sample in 40 mL VOA for inspection. PetroFix shipments come with a field concentration test kit taped to the top of a drum or a tote. See the groundwater sampling guidance document via the hyperlink at the bottom of the page for more information.
Optional	
Total Fe	Colorimetric Hach Method or EPA 6000 series with filtered and unfiltered samples
Total Mn	
Dissolved Fe	
Dissolved Mn	
Sulfide	EPA 376.1
Chemical Oxygen Demand (COD)	EPA 410.1-.2
Biological Oxygen Demand (BOD)	EPA 5210B
Methane and CO_2	ASTM D1945
Evaluation of biodegradation response through measurement of functional genes	QuantArray Petroleum

Regenesis recommends that baseline samples of all monitoring parameters be taken before injection. Please check any state-specific underground injection control (UIC) guidelines for parameters that may also need to be collected, but are not included in this table.

*Cations listed are recommended for applications involving dedicated well injection or borehole injection.

As is normal in any injection PetroFix may flow into adjacent wells during application. Observation in wells is helpful in knowing that you are achieving product distribution. As an option, PetroFix can be flushed from wells post injection with a clearwater flush. PetroFix normally takes a few weeks/months to attach to soils and clarify from groundwater and sampling precautions should be taken if sampling is needed during the attachment phase. **Helpful technical bulletins on post-application groundwater sampling, well flushing, and other information are provided online per the resource section link below.

Direct Push Injection Planning Document

PLEASE REVIEW THE 3 CRITICAL PHASES TO COMPLETING A SUCCESSFUL PETROFIX DIRECT PUSH INJECTION

PHASE 1: PRE-APPLICATION PLANNING AND BID RESOURCES

Please follow the specific handling, injection tips, and field distribution verification steps recommended. Examples include having long, multi-port injection tips and budgeting a few hours for Day 1 field distribution observation and adjustments. Please review:

PetroFix Bid Guidance for Injection Contractors

Pre-Application Presentation (includes field verification testing)

PetroFix Technical Memo: Freezing and Hot Weather Handling

PetroFix SDS File Link

PHASE 2: IMPLEMENTING YOUR PROJECT

In addition to best practices addressed in the "Pre-Application" planning resources, it is recommended you review the available application instructions. Some practitioners opt for a clear water post-injection flush at the end of their injection activities.

Application Document Library

PetroFix Technical Bulletin: Well Flushing

PetroFix® Well Flushing Calculator

PHASE 3: POST APPLICATION GROUNDWATER SAMPLING

Please note, PetroFix takes up to a few months to fully attach to soils. If PetroFix is >100 mg/L in concentration (difficult to see through a 40 ml VOA), it is recommended groundwater not be sampled. Each PetroFix shipment comes with one (1) a colorimetric field test kit taped to the top of a tote or drum to help assess field concentrations. For additional information, please review the "Groundwater Sampling Guidance Document".

PetroFix Monitoring Parameters

PetroFix Technical Bulletin: Groundwater Sampling

Terms & Conditions

1. **PAYMENT TERMS.** Net 30 Days. Accounts outstanding after 30 days will be assessed 1.5% monthly interest. Volume discount pricing will be rescinded on all accounts outstanding over 90 days. An early payment discount of 1.5% Net 10 is available for cash or check payments only. We accept Master Card, Visa and American Express.
2. **RETURN POLICY.** A 15% re-stocking fee will be charged for all returned goods. All requests to return product must be pre-approved by seller. Returned product must be in original condition and no product will be accepted for return after a period of 90 days.
3. **FORCE MAJEURE.** Seller shall not be liable for delays in delivery or services or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of buyer, acts of military or civil authorities, fires, strikes, flood, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through seller's usual and regular sources at usual and regular prices. In any such event Seller may, without notice to buyer, at any time and from time to time, postpone the delivery or service dates under this contract or make partial delivery or performance or cancel all or any portion of this and any other contract with buyer without further liability to buyer. Cancellation of any part of this order shall not affect Seller's right to payment for any product delivered or service performed hereunder.
4. **LIMITED WARRANTY.** Seller warrants the product(s) sold and services provided as specified on face of invoice, solely to buyer. Seller makes no other warranty of any kind respecting the product and services, and expressly DISCLAIMS ALL OTHER WARRANTIES OF WHATEVER KIND RESPECTING THE PRODUCT AND SERVICES, INCLUDING ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE AND NON-INFRINGEMENT.
5. **DISCLAIMER.** Where warranties to a person other than buyer may not be disclaimed under law, seller extends to such a person the same warranty seller makes to buyer as set forth herein, subject to all disclaimers, exclusions and limitations of warranties, all limitations of liability and all other provisions set forth in the Terms and Conditions herein. Buyer agrees to transmit a copy of the Terms and Conditions set forth herein to any and all persons to whom buyer sells, or otherwise furnishes the products and/or services provided buyer by seller and buyer agrees to indemnify seller for any liability, loss, costs and attorneys' fees which seller may incur by reason, in whole or in part, of failure by buyer to transmit the Terms and Conditions as provided herein.
6. **LIMITATION OF SELLER'S LIABILITY AND LIMITATION OF BUYER'S REMEDY.** Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair or use of any goods or performance of any services covered by or furnished hereunder, shall in no case exceed the lesser of (1) the cost of repairing or replacing goods and repeating the services failing to conform to the foregoing warranty or the price of the goods and/or services or part thereof which gives rise to the claim. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, OR FOR DAMAGES IN THE NATURE OF PENALTIES.
7. **INDEMNIFICATION.** Buyer agrees to defend and indemnify seller of and from any and all claims or liabilities asserted against seller in connection with the manufacture, sale, delivery, resale or repair or use of any goods, and performance of any services, covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of buyer, its agents, servants, employees or customers to follow instructions, warnings or recommendations furnished by seller in connection with such goods and services, by reason of the failure of buyer, its agents, servants, employees or customers to comply with all federal, state and local laws applicable to such goods and services, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence or misconduct of buyer, its agents, servants, employees or customers.

8. **EXPENSES OF ENFORCEMENT.** In the event seller undertakes any action to collect amounts due from buyer, or otherwise enforce its rights hereunder, Buyer agrees to pay and reimburse Seller for all such expenses, including, without limitation, all attorneys and collection fees.
9. **TAXES.** Liability for all taxes and import or export duties, imposed by any city, state, federal or other governmental authority, shall be assumed and paid by buyer. Buyer further agrees to defend and indemnify seller against any and all liabilities for such taxes or duties and legal fees or costs incurred by seller in connection therewith.
10. **ASSISTANCE AND ADVICE.** Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods and services. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.
11. **SITE SAFETY.** Buyer shall provide a safe working environment at the site of services and shall comply with all applicable provisions of federal, state, provincial and municipal safety laws, building codes, and safety regulations to prevent accidents or injuries to persons on, about or adjacent to the site.
12. **INDEPENDENT CONTRACTOR.** Seller and Buyer are independent contractors and nothing shall be construed to place them in the relationship of partners, principal and agent, employer/employee or joint ventures. Neither party will have the power or right to bind or obligate the other party except as may be expressly agreed and delegated by other party, nor will it hold itself out as having such authority.
13. **REIMBURSEMENT.** Seller shall provide the products and services in reliance upon the data and professional judgments provided by or on behalf of buyer. The fees and charges associated with the products and services thus may not conform to billing guidelines, constraints or other limits on fees. Seller does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the “Government”). In any circumstance where seller may serve as a supplier or subcontractor to an entity that seeks reimbursement from the Government for all or part of the services performed or products provided by seller, it is the sole responsibility of the buyer or other entity seeking reimbursement to ensure the products and services and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity that seeks reimbursement from the Government, seller does not knowingly present or cause to be presented any claim for payment to the Government.
14. **APPLICABLE LAW/JURISDICTION AND VENUE.** The rights and duties of the parties shall be governed by, construed, and enforced in accordance with the laws of the State of California (excluding its conflict of laws rules which would refer to and apply the substantive laws of another jurisdiction). Any suit or proceeding hereunder shall be brought exclusively in state or federal courts located in Orange County, California. Each party consents to the personal jurisdiction of said state and federal courts and waives any objection that such courts are an inconvenient forum.
15. **ENTIRE AGREEMENT.** This agreement constitutes the entire contract between buyer and seller relating to the goods or services identified herein. No modifications hereof shall be binding upon the seller unless in writing and signed by seller's duly authorized representative, and no modification shall be effected by seller's acknowledgment or acceptance of buyer's purchase order forms containing different provisions. Trade usage shall neither be applicable nor relevant to this agreement, nor be used in any manner whatsoever to explain, qualify or supplement any of the provisions hereof. No waiver by either party of default shall be deemed a waiver of any subsequent default.