Petroleum Plume Mitigated to Protect Flathead Lake

PetroFix Barrier Stops Benzene and Other Hydrocarbons From Entering The Lake

Background

WCEC Uses High-Resolution Site Characterization to Delineate Hydrocarbon Plume

Polson, Montana is a small town located south of Glacier National Park and situated on the southern shore of Flathead Lake, the largest natural freshwater lake west of the Mississippi River. Popular with outdoorsmen for fishing, boating, swimming, and other recreational activities, the area has become a prime destination for many wanting to enjoy the surrounding natural environment's majesty.

"There were four primary release sources converging at a (street) intersection. Our investigations provided us with a good conceptual site model, showing that within the overall fine-grained lake bed sediment was a gravel layer, 12 to 18 inches thick, where groundwater and contaminant transport was occurring."

Jim Rolle
Director of Environmental Services, WCEC

In the 1990s, environmental investigations of a legacy petroleum hydrocarbon (PHC) release in downtown Polson identified a large undefined light non-aqueous phase liquid (i.e., LNAPL) plume, with benzene and other contaminants migrating toward Flathead Lake. WCEC, a prominent full-service environmental firm with offices in Montana, North Dakota, and Minnesota, was hired to develop and implement a remediation plan to protect the lake.

Before the remediation plan could be developed, further plume characterization was necessary to develop a conceptual site model (CSM) detailing the contamination's extent and migration pathways in the subsurface. As part of the CSM development, WCEC performed high-resolution site characterization (HRSC), including deploying the Ultra Violet Optical Screening Tool (UVOST) technology to delineate the three-dimensional extent of the LNAPL plume. Additionally, WCEC further delineated the contaminant flux zone within the dissolved phase plume threatening Flathead Lake to accurately target the remedy.

Figure 1 — Benzene Plume Extents

Benzene plume prior to PetroFix PRB installation.

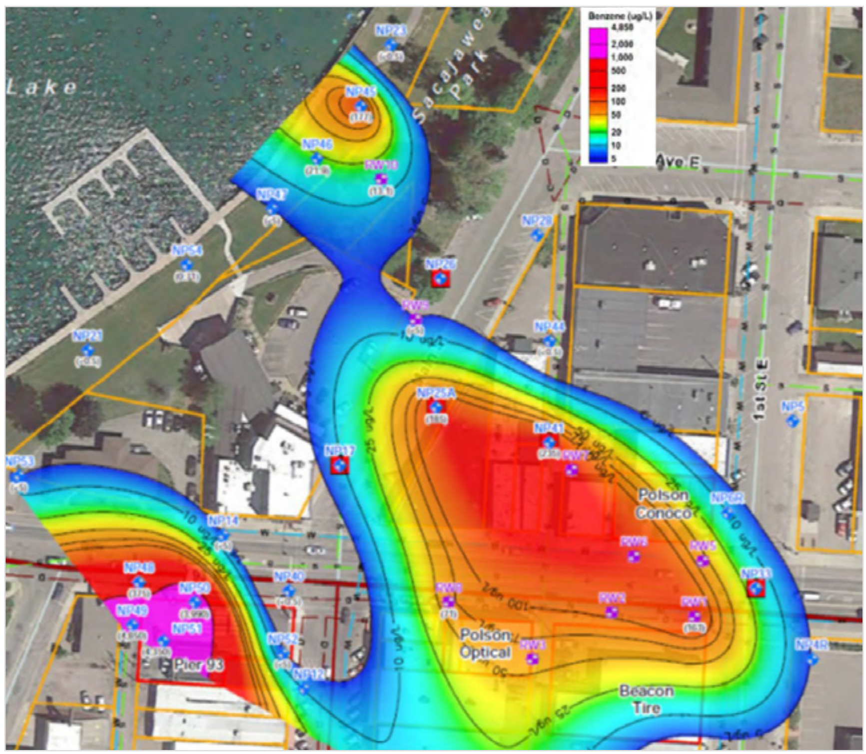
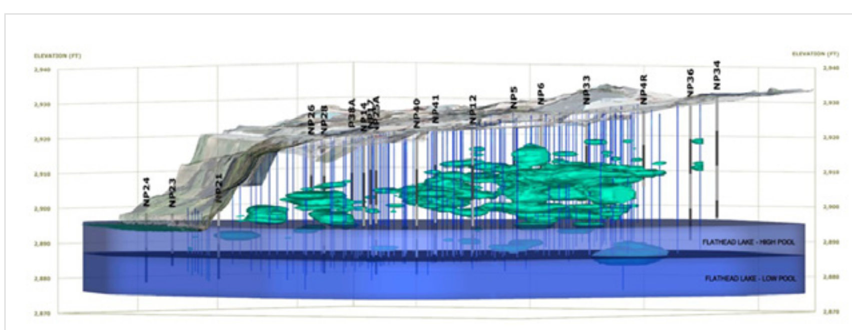


Figure 2 — 3-D Plume Extents

UVOST data visualization depicting the LNAPL plume's three-dimensional extent relative to Flathead Lake.



Remediation

PetroFix Permeable Reactive Barrier Chosen as Most Viable Solution to Protect Lake

Upon completing the conceptual model, WCEC began developing a remedial plan to protect the lake from the migrating PHC contaminants. Numerous regulatory agencies were involved in the plan's development and review, including the Montana Department of Environmental Quality (MTDEQ), the City of Polson, Lake County, the Confederated Salish and Kootenai Tribes, and the US EPA.

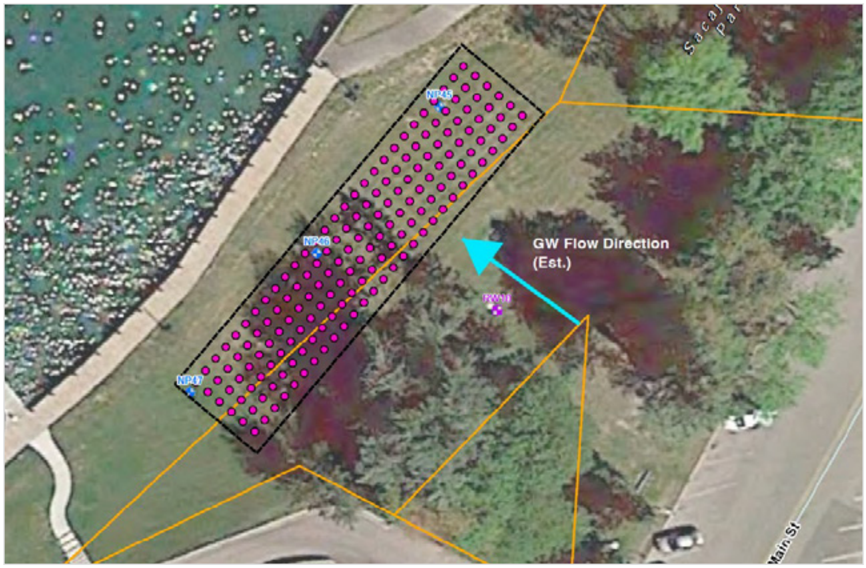
Following a comprehensive review of remedial alternatives, WCEC determined that installing a permeable reactive barrier (PRB) using PetroFix® Remediation Fluid would be the most viable and cost-effective strategy to quickly halt the dissolved phase plume's movement toward the lake. The PRB functions as an underground filtration treatment that removes PHC contamination from impacted groundwater, often below the laboratory detection levels.

The PetroFix PRB design consisted of several rows of closely spaced injection borings placed perpendicular to groundwater flow, upgradient of the lakeshore. The injection depths were matched to the contaminant flux zones identified during the HRSC activities.

Figure 3

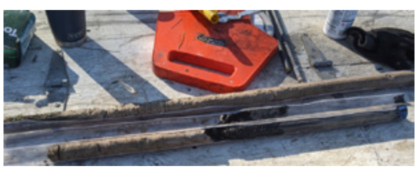
PetroFix PRB Layout

Photograph depicting PetroFix permeable reactive barrier injection point layout and surrounding area.



Injection Details

PetroFix PRB Length:	160 ft
Injection Depth:	6 - 12 ft bgs
Injection Points:	168
Spacing:	5 ft
PetroFix Applied:	5,600 lbs



PetroFix is observed in a soil core spanning the contaminant flux zone.

With the aid of the PetroFix Design Assistant and REGENESIS' technical support, WCEC completed the PetroFix injection in April 2020, ensuring the proper equipment was on hand, including the multi-port injection tooling, flow meters, and pressure gauges needed to effectively apply PetroFix.

During the injection, WCEC collected soil core samples to confirm that PetroFix was adequately distributed throughout the target injection zone. Based on visual observation of these samples, the field crew adjusted the injection tooling, volumes, and flow rates in real-time to ensure the PetroFix distribution goals were met.

Results

Benzene Concentrations Remain Non-Detect for 3.5 Years, Thus Far

"The barrier has remained effective for three-and-a-half years. We sample the groundwater along the lake shore on both sides of the barrier. So, we know what concentrations are getting to the barrier, and we know there are no concentrations on the down gradient side of the barrier."

Jim Rolle
Director of Environmental Services, WCEC

Following the installation of the PetroFix PRB, the threat of dissolved phase contaminant migration into the lake was immediately mitigated, with these results sustained for over 3.5 years thus far, as performance monitoring continues. The remedy remains in place to protect against further contaminant migration due to the residual PHC plume remaining upgradient. LNAPL recovery activities are still being implemented in the plume body to remove the source mass contributing to the PHC plume.

Besides protecting Flathead Lake, WCEC has successfully applied PetroFix on several other sites in the region to quickly reduce levels cost-effectively and accelerate their clients' site closures.

Figure 4

Pre-Application Plume Extents

Northern extent of benzene plume in March 2018 before installing the PetroFix barrier.

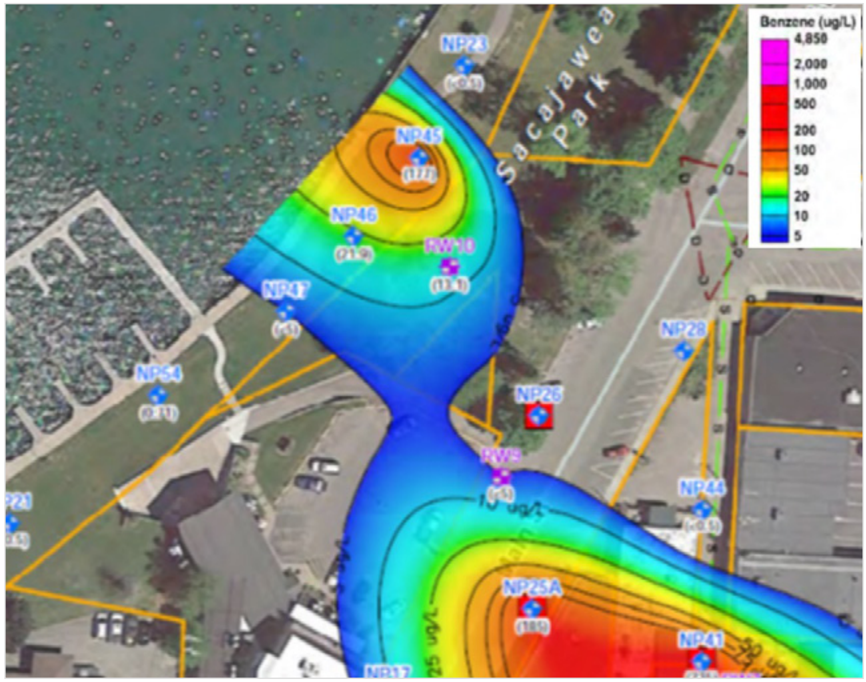
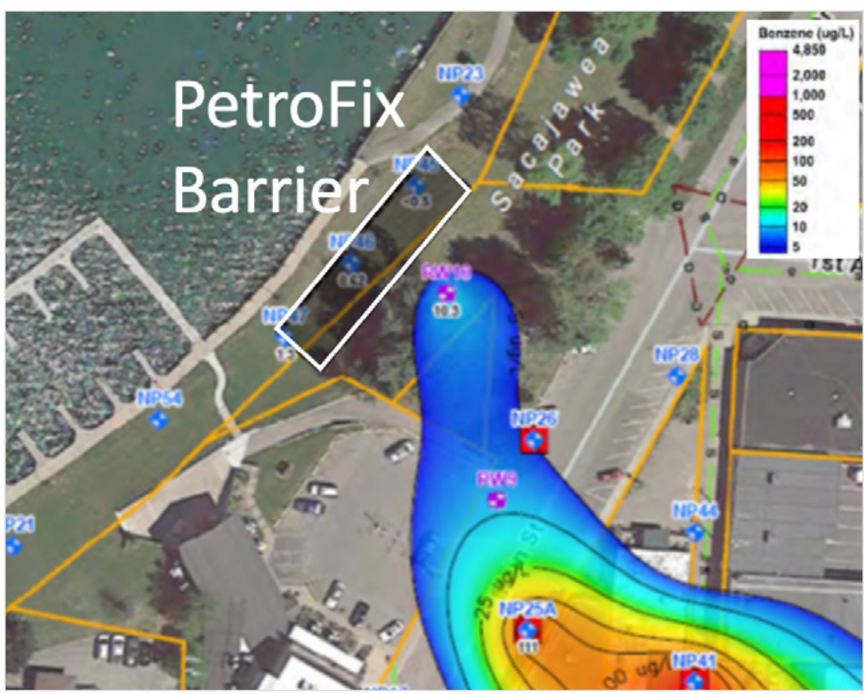


Figure 5

Post-Application Plume Extents

Northern extent of benzene plume in December 2020, eight months after installing the PetroFix barrier. Benzene concentrations continue to remain non-detect in the barrier treatment zone through 3.5 years of monitoring completed.



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