POSTER GROUP 2

FOCUSING REMEDY TRANSITION AT A FORMER FUEL TERMINAL IN ALASKA ON USING GREEN AND SUSTAINABLE STRATEGIES

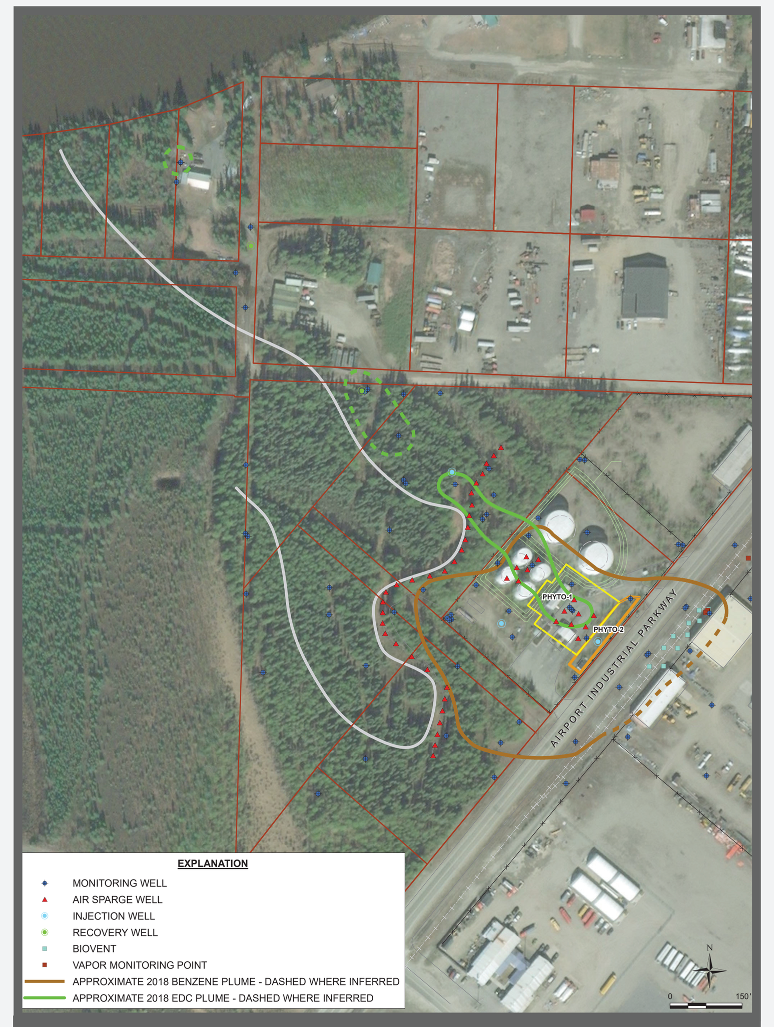
Kyle Waldron (Marathon, Auburn, WA, USA) - kawaldron@marathonpetroleum.com
Chris Schultz (Trihydro Corporation, Eagle River, AK, USA) - cschultz@trihydro.com
Chris Cohu (Phytoremediation and Phytomining Consultants United, Grand Junction, CO, USA)
John Freeman (Intrinsyx Environmental, Moffett Field, CA, USA)
Karin Holland (Haley & Aldrich, Baltimore, MD, USA)
Joe Ricker (EarthCon Consultants, Memphis, TN, USA)

PREVIOUS REMEDY

This project site is a former fuel terminal in interior Fairbanks Alaska. Remediation efforts had primarily been reactionary based on impacts observed at the site. Petroleum (TPH-d and benzene) and fuel additive (1,2-dichloroethane [EDC]) contaminants have been detected in soil and groundwater.

Groundwater flow resulted in plume migration toward sensitive receptors. Suspected sources include the rail loading rack (RLR), truck loading rack (TLR), and tank farm area.

Initial remediation efforts consisted of a boundary air sparge system to control benzene and EDC migration; and later a groundwater extraction, treatment, and reinjection system to provide hydraulic control and treatment of EDC impacts.



Contours show benzene and EDC above cleanup levels
Groundwater flows to the northwest from the source areas

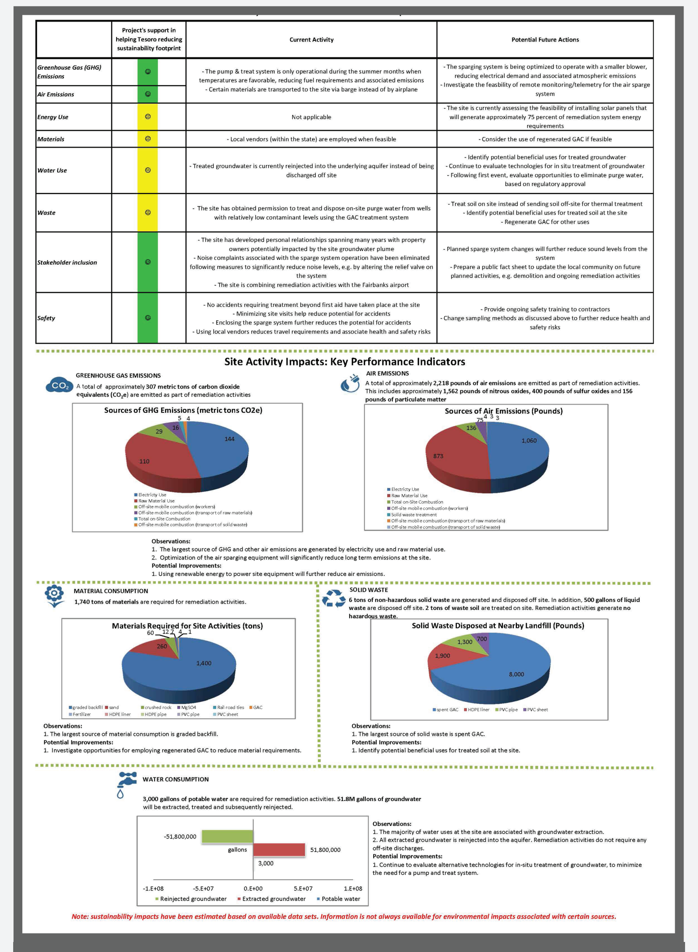
TLR AND PUMP HOUSE BEFORE AND AFTER PHOTOS

Transition from dilapidated aboveground infrastructure to a clean tree covered site.

SUSTAINABILITY ASSESSMENT

Site remediation activities were assessed for sustainability using a newly developed standardized process for Marathon in order to evaluate environmental, social, and economic factors. The assessment identified opportunities for incorporating sustainable practices into the remediation program. The following are examples of best management practices implemented to increase sustainability performance.

- Setup routine meetings with agency to openly communicate long term strategy of transition to sustainable remediation practices
- P&T system considered for groundwater recirculation for addition of electron acceptors
  - Weigh benefits of running P&T system to operate enhanced bioremediation
  - Evaluate P&T OM&M energy and material use
  - System had high environmental footprint and would require significant rework to deliver amendment to plume hot spots.
- Update CSM to assess plume analytics to determine if system is warranted to control plume migration.
- Optimize air sparge blower and sparge system operation to reduce energy consumption.

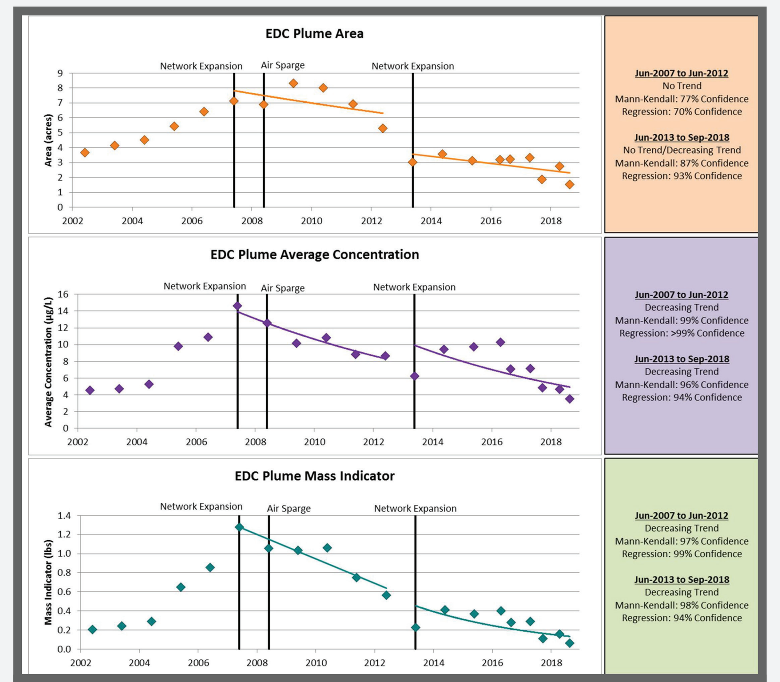


SUSTAINABILITY DASHBOARD

Sustainability dashboard completed by Haley & Aldrich with site specific and system details input by site specific consultant.

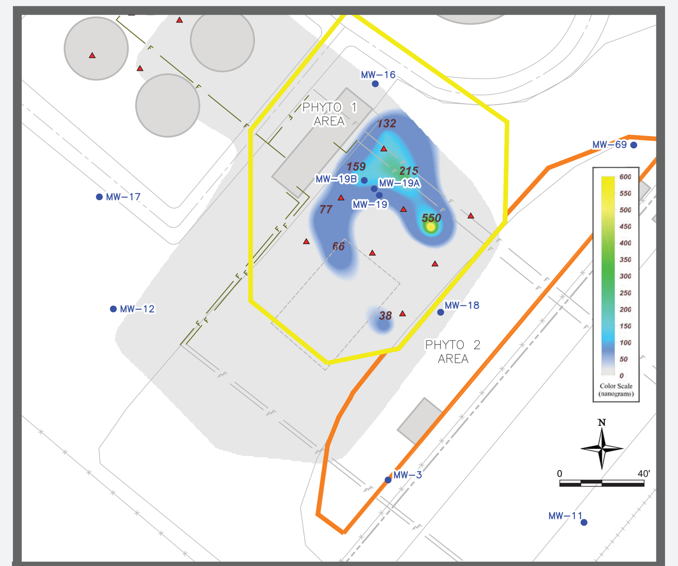
CONCEPTUAL SITE MODEL UPDATE

Following the sustainability assessment, the conceptual site model was updated utilizing Ricker Method® Plume Stability AnalysisRicker, a supplemental investigation, and creation of a 3-D model.



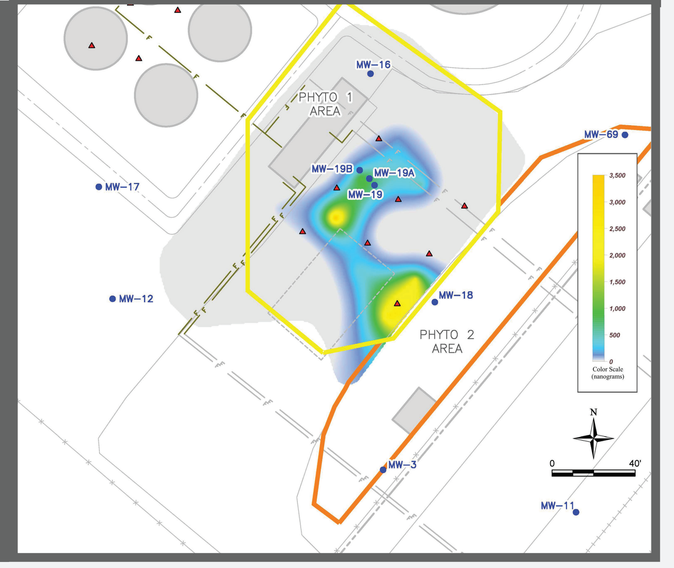
RICKER METHOD® PLUME STABILITY ANALYSIS

Ricker Method® Plume Stability Analysis was used to better assess the effectiveness of the onsite remediation systems with a focus on the groundwater extraction system.



TRUCK LOADING RACK PASSIVE SOIL GAS

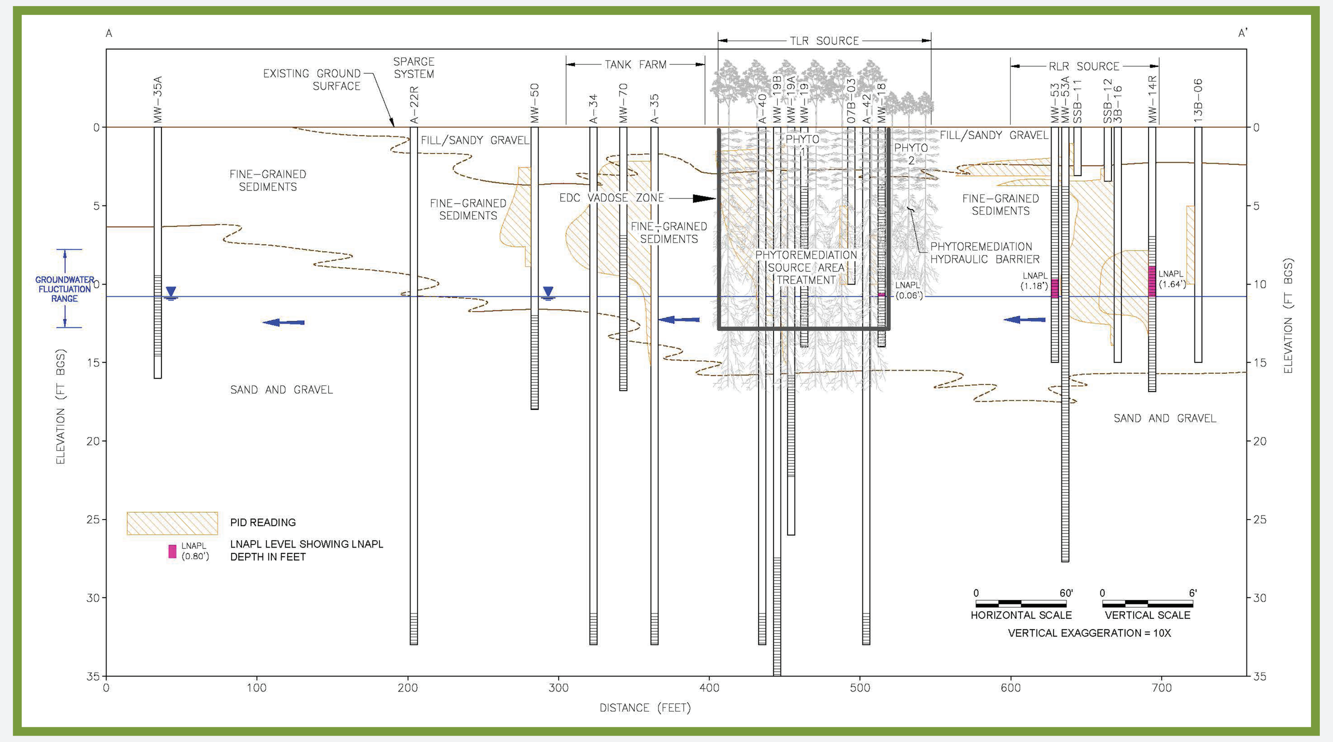
A supplemental investigation was performed to identify the extent of the EDC in soil. A passive soil gas survey was conducted to focus drilling and analytical soil sampling and identify EDC and benzene hot spots within the TLR.



REMEDY TRANSITION

Following remediation systems evaluation, the air sparge system was expanded into the Tank Farm and TLR source areas to provide focused EDC treatment and a buffer for required system shutdown in winter months. Prior to installation in the TLR Trihydro and PPCU worked on phytoremediation system design. During sparge well installation phytoremediation design specific and contaminant baseline monitoring soil samples were collected. This remedy transition provided additional benefits including reduced noise from a smaller air sparge blower and a tree covered site instead of a dilapidated fuel terminal.

Endophyte Enhanced Phytoremediation



GEOLOGIC CROSS SECTION

Baseline soil samples from 5-12 ft bgs with impacts above cleanup levels (TPH-G 1,050 mg/kg TPH-D 34,100 mg/kg benzene 46,600 µg/kg and EDC 245 µg/kg).

Phytoremediation specific soil samples were collected and analyzed for pH, EC, SAR, % OM, CEC, soil texture, nitrate, elemental analysis for B, Ca, Cl, Cu, Fe, Mg, Mn, Na, K, and Zn.

Soil samples were consistent with soil pH between 7.8 and 8 which is at the high end for balsam poplar (6-8). Organic matter at 1.025%, CEC, and nitrates were low and increasing these was done by addition of fertilizer and peat moss which will lower soil pH.

PHYTOREMEDIATION INSTALLATION

325 balsam poplar poles (12 ft) installed in 6-foot deep pre cleared 10 inch diameter holes.

300 balsam poplar stakes (4 ft) installed in 2 foot deep trenches.

Trees inoculated with PPCU-Intrinsyx Environmental Tree *Endophytes Pseudomonas putida* PD1 and *Enterobacter sp.* PDN3 to increase contaminant degradation rates.

12 trees were left uninoculated for control and research opportunities.

PHYTOREMEDIATION SITE BASELINE

Existing remediation systems operated seasonally from May through October.

Phytoremediation provides for transition to passive remediation and hydraulic control at the source area.

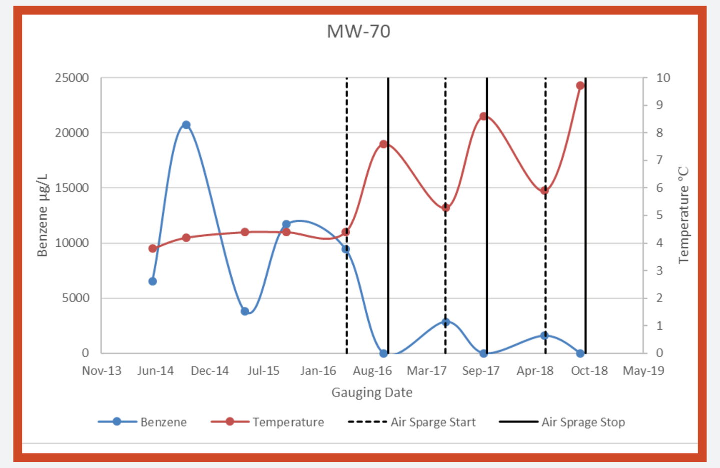
Numerous local state regulators were invited for a site walk during planting to discuss the benefits and potential effectiveness of phyto technology in Alaska.

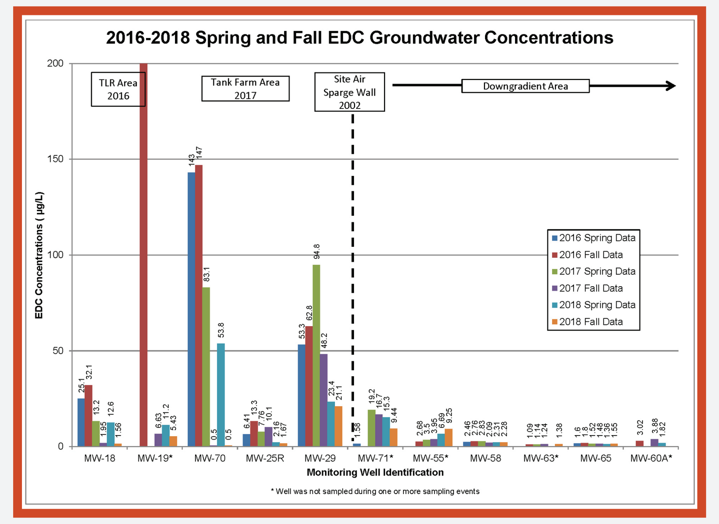
PHYTOREMEDIATION SEASON 1 GROWTH

Tree growth following first growing season.

Tree health and moisture content were monitored weekly. Stakes in the trenched area were watered using drip irrigation, watering not required for poles installed near the water table.

Passive soil gas and leaf tissue sampling will be utilized in addition to the groundwater monitoring program to assess and monitor remediation progress.

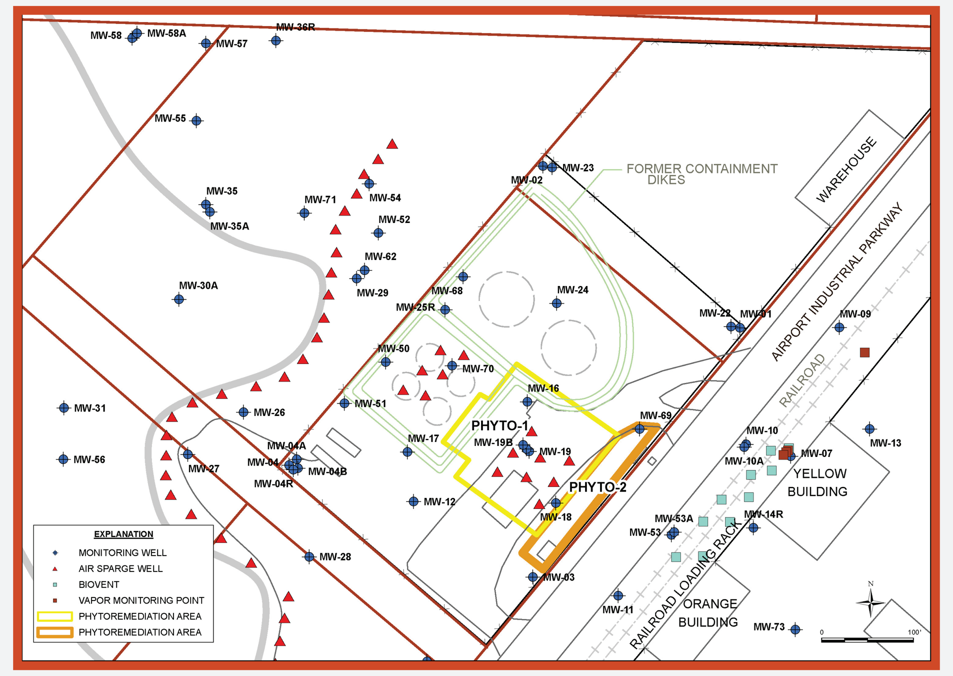




Air Sparge Expansion and Upgrades

Sparging was expanded without increased OM&M costs or energy consumption.

Sparge operation in the tank farm resulted in increased natural attenuation via oxygen addition.



SUMMARY AND LESSONS LEARNED

- Assessing the sustainability at the remediation phase led to developing a remedy transition with a focus on passive and green remediation.
- Working closely with the regulatory agency provided engagement opportunities with brown bag presentations and onsite meetings with Trihydro, PPCU, and EarthCon.
- The process identified that remedy effectiveness could be improved, and the remediation lifecycle could be reduced.
- The iterative approach identified footprint reductions and reduced energy consumption, and focused investigation and remediation.
- To continue to explore passive and sustainable options, a passive biovent well pilot study was also installed to deliver additional oxygen to the subsurface using barometric pumping to enhance in-situ bioremediation.