LESSONS LEARNED ABOUT ACTIVATED CARBON INJECTIONS ON A SITE IN WYOMING





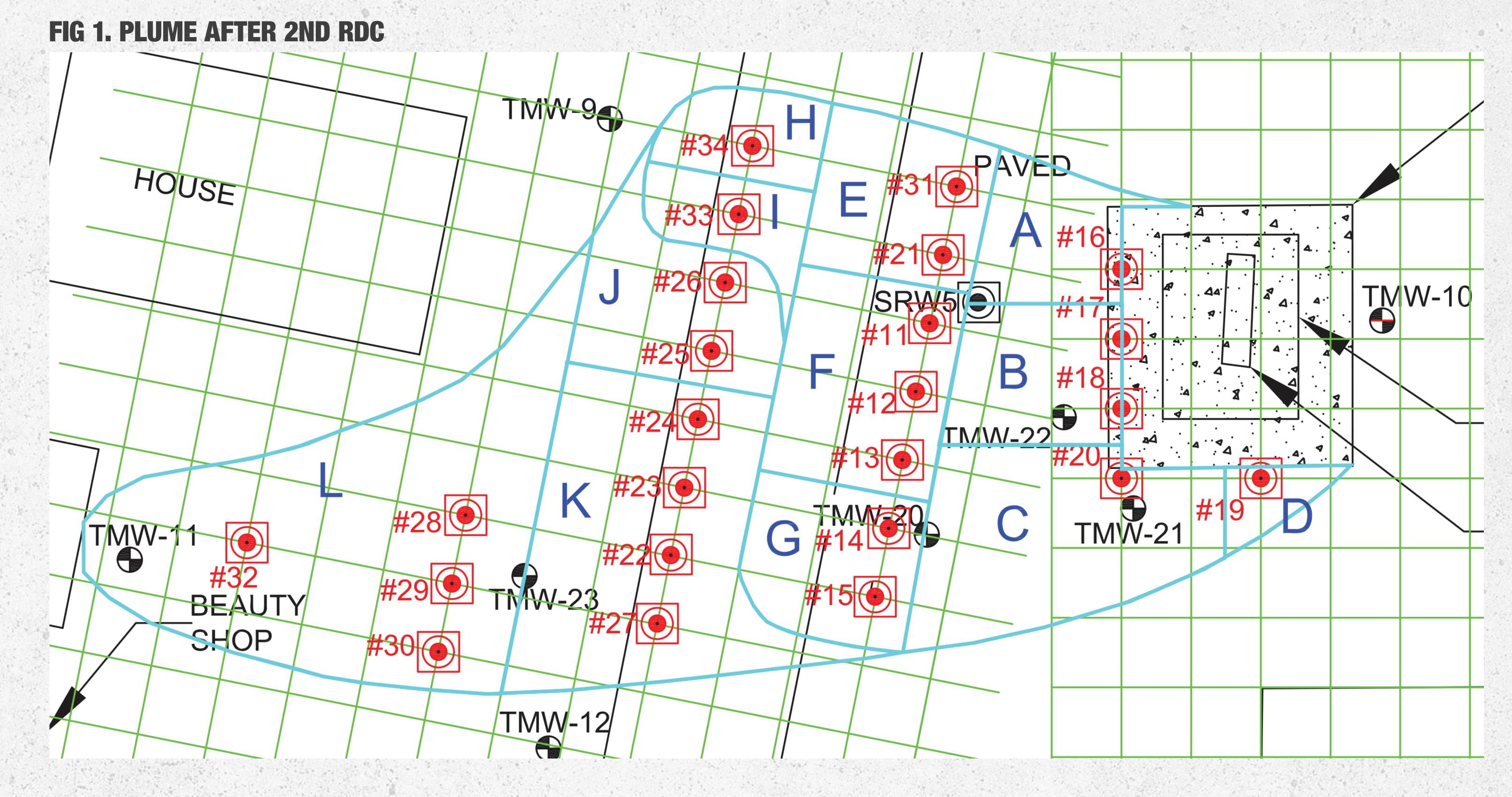
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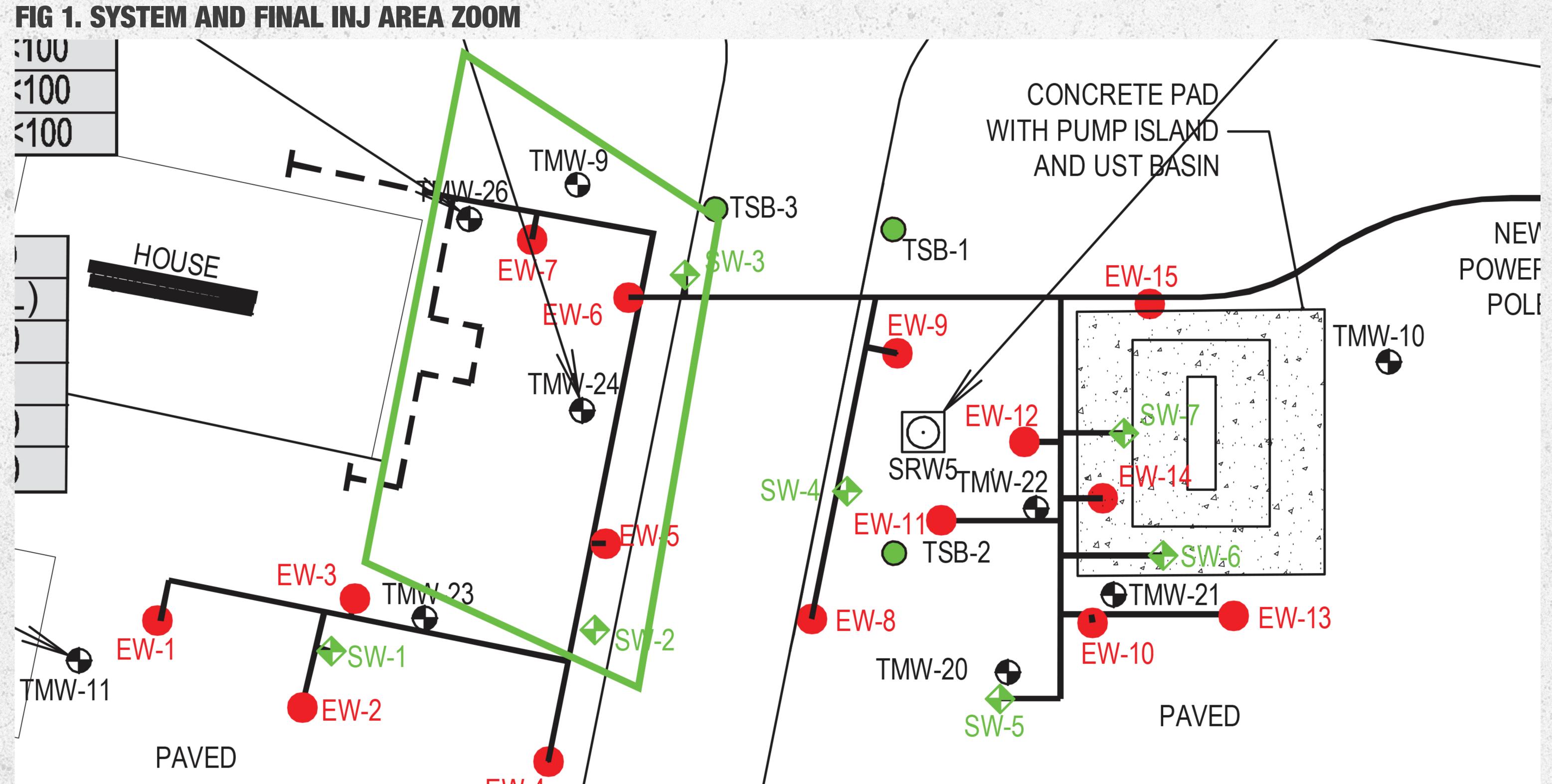
BACKGROUND

- A site in Wyoming was discovered to have petroleum hydrocarbon contamination migrating from below an underground storage tank (UST).
- The original leaking UST had been replaced but not all of the contaminated soil was removed at that time
- Impacts were originally present in both the soil and the groundwater.
- · Lithology at the site consists of sands and gravel above siltstone.

SITE ACTIVITIES & DISCUSSION

- A Remedial Design Characterization (RDC) consisting of 33 grab groundwater samples and 6 continuous soil borings was performed at the site in the summer of 2002.
- The original plume footprint was estimated at 18,400 square feet.
- This RDC demonstrated that the source was located below the new UST and that the contamination was present in a narrow 4 to 6 foot vertical zone. This zone has been the target of all but the final injection event.
- The vertical injection zone was increased for the final event to match the total depth of the monitoring wells.
- In situ injections of ~4,700 pounds of an oxygen release material (ORM) were completed in the summer of 2002.
- ORM was installed a second time in the spring of 2003 (~2,400 pounds).
- ORM injections were successful in reducing the footprint of the hydrocarbon plume, but contamination was still coming from the source.
- Injections of ORM up-gradient of the USTs in an attempt to address the source had not been effective.
- In the summer of 2004, 8,250 pounds of Remediation Products Incorporated (RPI) BOS 200® was injected at the site along with 8,250 pounds of supplemental sulfate.
- This installation was intended to act as a barrier treatment for the estimated 2,200 pounds of hydrocarbons under the UST.
- By December of 2006, it was obvious that the barrier was not working as intended, and a second RDC of 34 continuous soils and grab groundwater samples was performed to investigate why.
- It was unknown if the poor performance was related to a higher hydrocarbon load than planned or poor distribution of the BOS 200® within the treatment zone.
- Severe surfacing occurred during the installation, and there were also concerns that the sands and gravels had hindered the distribution of the slurry.
- Results from the RDC indicated that it was likely a combination.
- Concerns over being able to install enough BOS 200® in a treatment barrier to account for the entire hydrocarbon load led to the installation of an air sparge and soil vapor extraction remediation system in 2009.
- The system ran for 8 years.
- Injections of 5,000 pounds of BOS 200® was completed at the site in the summer of 2018.
- Site closure was requested in March of 2020 based on 3 consecutive quarters of groundwater concentrations below the designated cleanup levels.





DISCUSSION OF CHANGES MADE

- Some of the successful results of the second BOS 200® installation can likely be attributed to the reduction in the hydrocarbon load from the AS/SVE system, but the BOS 200® injection process was updated and refined in a multitude of ways between 2004 and 2018.
 - Injection boreholes were located on 10-ft centers as standard procedure in 2004. By 2018, that had been revised to 7.5-foot centers.
 - Tighter grids require less volume per injection, which increases the distribution and decreases the likelihood of surfacing.
 - Injection tools are now custom designed for different types of injectate and lithology. Injection ports are drilled in the sides of the final rod as opposed to the initial BOS 200® injections that were performed using drop-off points at the bottom of the rod string.
 - Moving the injection ports to the side and decreasing the port radius increases the exit velocity of the injectate. This is especially beneficial in sands and gravels. Injections from the bottom of the rods would not have had as large of a radius of influence as those from the newer injection tools.
 - A higher exit velocity would also keep the carbon from being filtered out by the sands and gravels.
 - Larger pumps have allowed for an increase in flow rates used in sands and gravels from 25 gpm to 70 gpm.
 - In addition, the purpose of the injection event changed between the injection events.
 - Although barrier type injections are more commonplace today, the treatment needed for the final event was more of a polishing event for areas of persistent contamination instead of treatment of the source area.

RESULTS/LESSONS LEARNED

- After the first unsuccessful injection, the injection process was changed in a variety of ways leading to a final successful event.
- The site was closed in March 2020.

