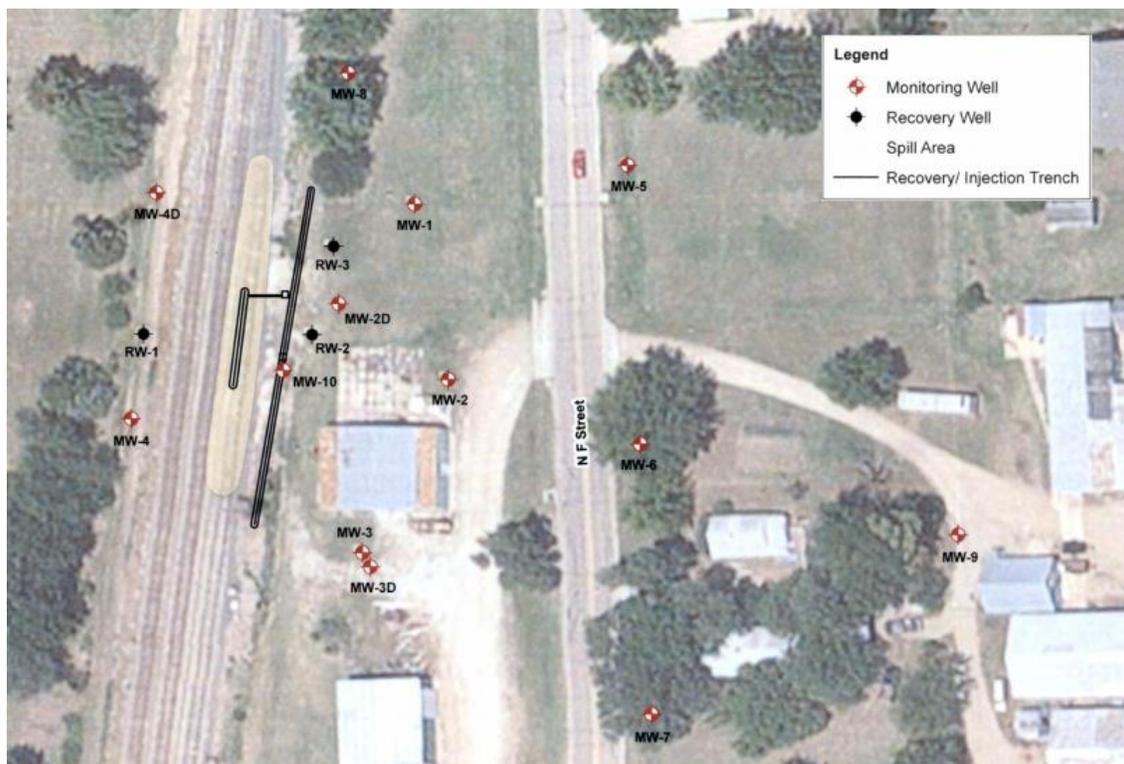


NITRATE REDUCTION USING NURTIENT-AMENDED SUBSTRATE INJECTIONS

Type of Project:	Full Scale Mobile Injections
Contaminants Treated:	Nitrate-nitrogen
Concentration:	762 mg/L nitrate-nitrogen
Technology Applied:	Mobile injection of CarBstrate™: a water-soluble, nutrient-amended substrate
Geology:	Silt and sandy silt
Treatment Interval:	GW zone at 15-18 feet bgs
Nitrate-nitrogen Goal:	10 mg/L
Timeframe:	48 months to complete cleanup over 3 injection events

SITE DISCUSSION/INFRASTRUCTURE: ETEC, LLC supplied CarBstrate™ for intermittent injection events at a railroad fertilizer release in Kansas. In 2003, approximately 15,000 gallons of ammonium-nitrate and urea fertilizer was released at the surface. ETEC performed a pilot study injection in 2012 using CarBstrate™, a water-soluble nutrient-amended substrate, which acted as an electron donor to reduce elevated nitrate-nitrogen concentrations.

In March 2014, a full-scale injection program was completed. Two injection trenches were installed to facilitate the injection activities. One trench was installed along the western property boundary measuring 50 feet in length intended to address nitrate-nitrogen impacts underneath the railroad track. A second 175-foot injection trench was installed further east to apply CarBstrate™ to the rest of the release site. A total of 15,000 gallons of CarBstrate™ amended water was injected into the trenches and select wells distributing substrate to reduce nitrate-nitrogen concentrations. A supplemental injection event was completed in June 2016 consisting of 4,000 gallons of CarBstrate™ amended water injected into select monitoring wells to address residual nitrate concentrations.



GOALS: The substrate injection goals include meeting the Kansas Department of Health & Environment Risk Based Standards (RSKs). The RSK levels are 10 mg/L for nitrate-nitrogen.

RESULTS: The initial injection event in March 2014 resulted in dramatic nitrate-nitrogen concentration decreases, as shown in figures of MW-1 and MW-3D. The initial injection activities decreased nitrate-nitrogen concentrations in MW-1 from 762 mg/L (April 2013) to 172 mg/L (March 2016). In the follow-up CarBstrate™ injection event in 2016, nitrate-nitrogen concentrations decreased to non-detect values. In MW-3D, the initial substrate injection resulted in the decrease of nitrate-nitrogen to below the 10 mg/L performance standard.

Overall, the CarBstrate™ injection events decreased elevated nitrate-nitrogen concentrations from a major release to near 10 mg/L using one full-scale and one follow-up injection event. As of April 2017, only one monitoring exceeded the RSK criteria of 10 mg/L, measuring nitrate-nitrogen at 15.3 mg/L. The injection events showed that CarBstrate™ is an effective substrate at reducing nitrate-nitrogen plumes to regulatory goals with minimal remediation effort.

