Innovative Environmental Technologies, Inc.

"Safer, More Effective ISCO Remedial Actions Using Non-Extreme Persulfate Activation to Yield Sustained Secondary Treatment"

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IET In-Situ Delivery Process

Step #1 – Pathway Development

Compressed Gas Feed

- Confirms “Soil Break” and open delivery process
- Opens Preexisting Soil Fissures

Step #2 – Sequenced Remedial Compound Injections

Liquid #1 Feed

- Prepares Subsurface for Remedial Process
- Oxygen Scavengers under anaerobic processes
- Dilute H_2O_2 under Aerobic processes
- Colloidal ZVI under Fenton’s Process
- pH adjusts – Calcite, Manganese Oxide, H_2SO_4

Step #3 – Remedial Compound(s) Injections

Liquid #2 Feed

- Viscous Liquids (lactates, butyrates, HRC)
- Hydrogen Peroxide
- Magnesium Peroxide; Calcium Peroxide
- Colloidal Suspensions – $KMnO_4$, $Na MnO_4$

Step #4 – Final Step

Compressed Gas Feed

- Clears Lines
- Drives materials into formation
- Prevents surface escape and spills

Completes Injection Event

Injection Equipment

IET 20' MOBILE INJECTION SYSTEM

Injection Feed Tank – Configuration

Feed Systems, Safety Systems, Compressed Gas Systems
All piping Welded Stainless Steel
Floors Coated in Chemical Resistant RinoLining

Injection Equipment

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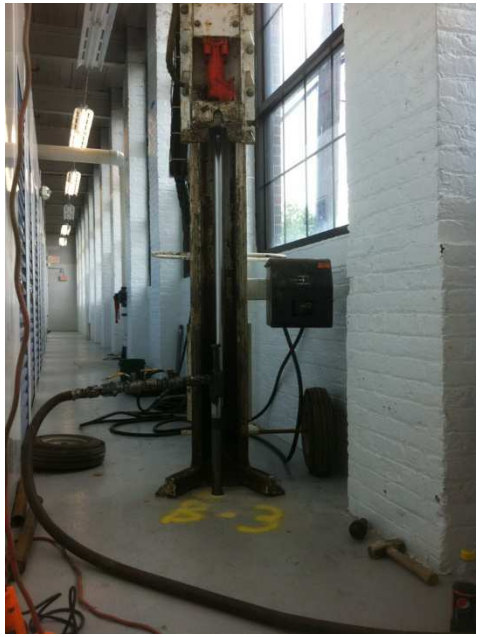
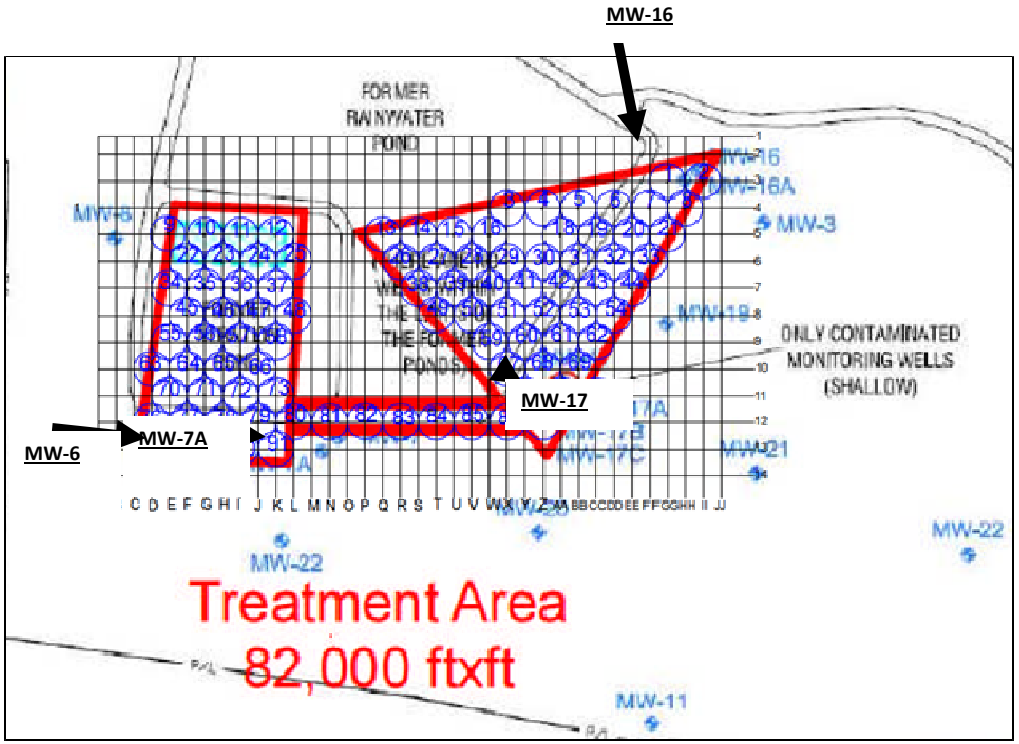


Provect-Ox™ Case Study 1

- Single injection event at a wood treating facility in Midwestern United States in July 2013 to remediate soils and groundwater impacted by the historical release of heavy ended petroleum compounds.
- Total treatment area of approximately 82,000 square feet, treating between 13 and 22 feet below ground surface.

- 91 injection points
- Spaced 34 ft apart
- 22,022 lbs of Provect-OX



Case Study 1 - Groundwater SVOC Analytical Data

Table 1. VOC Data for MW-6 (µg/L).

MW-6				
Sampling Date	**07/2013**	**10/2013**	**01/2014**	**04/2014**
Benzo(a)pyrene	17,000	ND	ND	ND

ND: Not Detected

Table 2. VOC Data for MW-7A (µg/L).

MW-7A				
Sampling Date	**07/2013**	**10/2013**	**01/2014**	**04/2014**
Benzo(a)pyrene	18,000	ND	ND	ND

ND: Not Detected

Table 3. VOC Data for MW-16 (µg/L).

MW-16				
Sampling Date	**07/2013**	**10/2013**	**01/2014**	**04/2014**
Benzo(a)pyrene	20,000	ND	ND	ND

ND: Not Detected

Table 4. VOC Data for MW-17 (µg/L).

MW-17				
Sampling Date	**07/2013**	**10/2013**	**01/2014**	**04/2014**
Benzo(a)pyrene	19,000	ND	ND	ND

ND: Not Detected

Provect-OX™ Case Study 2

- Single injection event implemented at a former gas station in Northern New Jersey in August 2013 to remediate soils and groundwater impacted by the historical release of BTEX compounds.
- Total treatment area of approximately 3,100 square feet, treating between 4 and 14 feet below ground surface.

- 26 injection points
- Spaced 8-10 ft apart
- 4,392 lbs of Provect OX

Case Study 2 – Field Parameters & VOC Analytical Data

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	MW-2				
Sampling Date	06/20/2013	10/02/2013	11/26/2013	02/28/2014	05/28/2014
pH	7.27	6.88	6.89	6.86	7.43
ORP (mV)	-14	+220	+86	+55	-40
D.O. (mg/L)	2.17	0.76	0.90	0.85	0.83
Conductivity (mS/cm)	0.97	3.44	1.52	2.38	1.55
Temperature (°C)	17.7	20.4	17.0	12.2	14.3
Groundwater Elevation (ft)	94.05	90.43	88.86	92.93	93.70
Sulfate (mg/L)	56.6	1,510	266	980	332
Total Iron (mg/L)	0.377	2.01	0.149	0.089	0.160
Dissolved Iron (mg/L)	0.249	1.83	0.0097	ND	ND
Total Xylenes (ppb)	ND	21.04	3.16	ND	ND

Case Study 2 – Field Parameters & VOC Analytical Data

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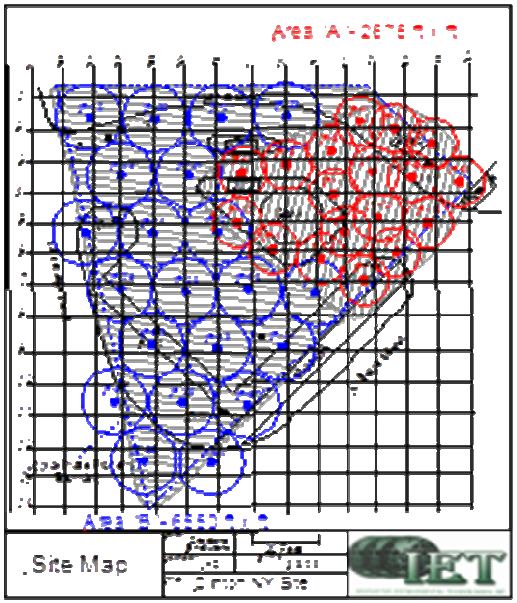
	MW-5						
Sampling Date	06/2013	10/2013	11/2013	02/2014	05/2014	09/2014	12/2014
pH	6.78	6.71	6.68	6.71	6.49	6.95	6.68
ORP (mV)	-23	+230	+180	+95	-68	-78	+118
D.O. (mg/L)	0.32	1.08	0.56	4.32	0.99	0.96	3.13
Conductivity (mS/cm)	1.05	1.24	2.00	4.61	2.57	1.89	2.01

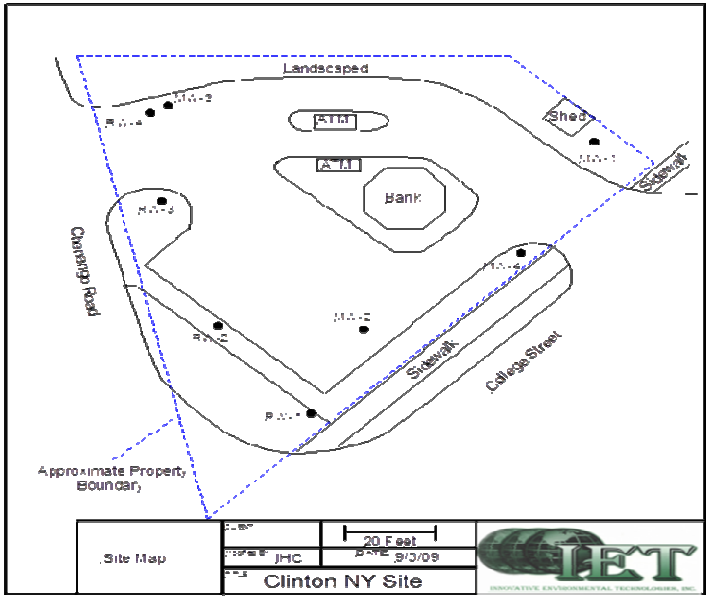
	MW-5						
Sampling Date	06/2013	10/2013	11/2013	02/2014	05/2014	09/2014	12/2014
Benzene (ppb)	3.38	1.91	0.52	ND	1.27	ND	ND
Toluene (ppb)	1.71	0.21 J	0.16	ND	0.57	ND	ND
Ethylbenzene (ppb)	15.6	0.4 J	ND	ND	14.2	ND	ND
Total Xylenes (ppb)	25.94	1.98 J	0.37	ND	7.85	ND	ND

Provect-OX™ Case Study 2

- Single injection event at a former gas station upstate New York to address soil and groundwater contamination due to the historical release of BTEX compounds.
- Total treatment area of 9,225 square foot area, treating between 9 and 15 feet below ground surface.

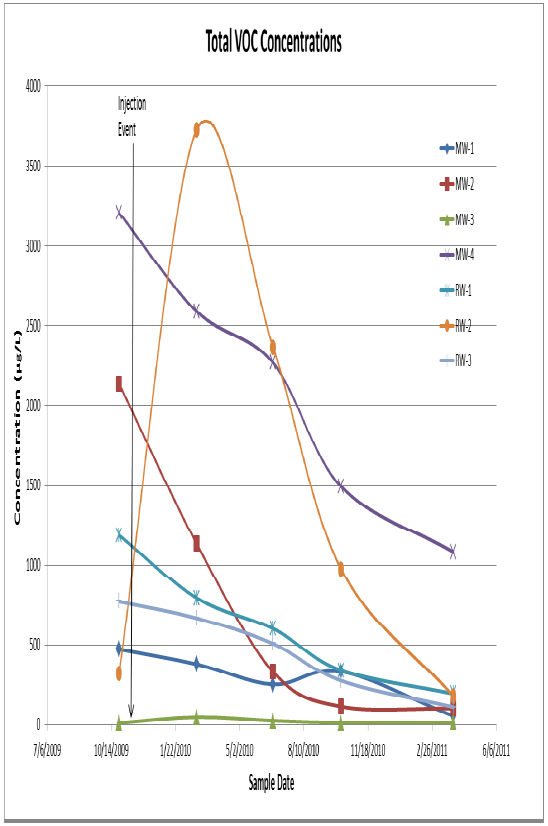
- 39 injection points
- Spaced 12-20 ft apart
- 8,006 lbs of Provect OX

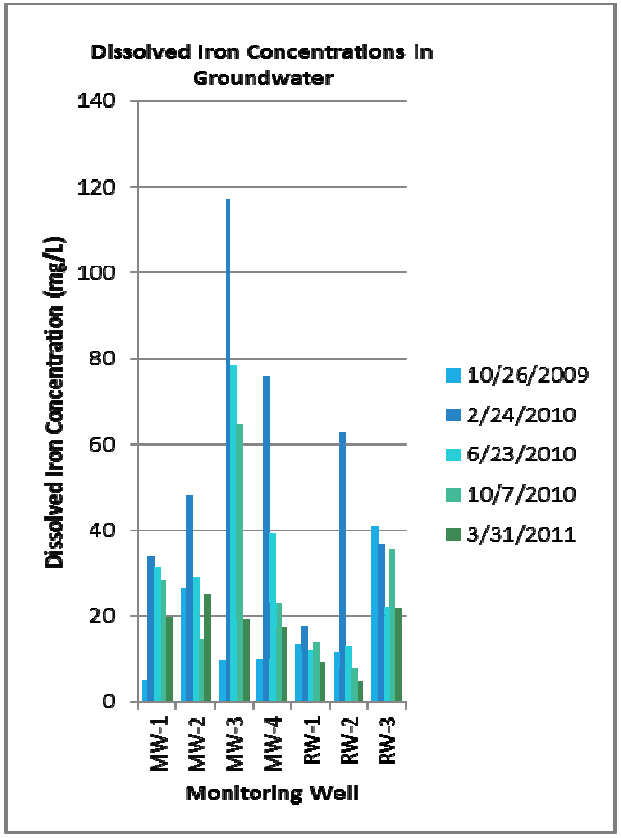


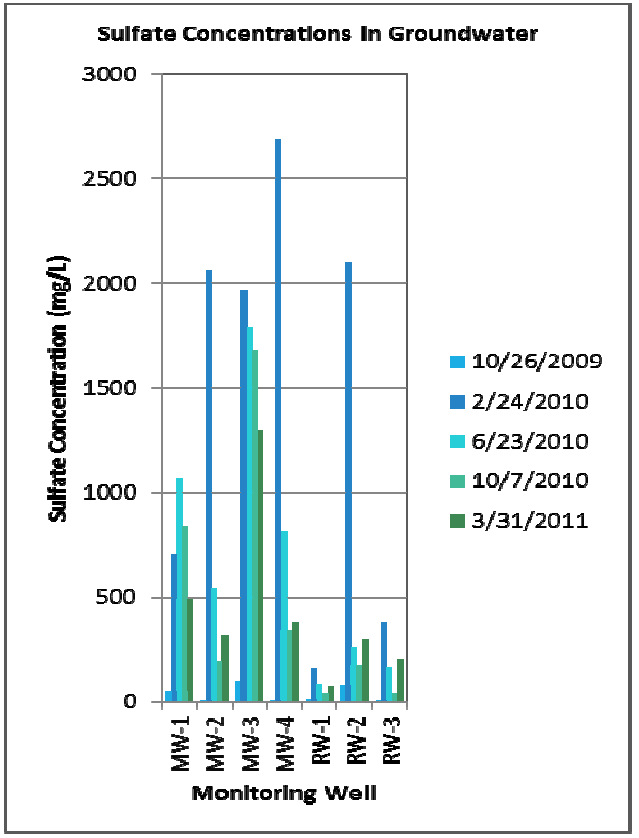


Case Study 3 – Geochemical and VOC Data

Sulfate and Iron Utilized as Terminal Electron Acceptors to Sustain Bioremediation and Minimize Rebound







CONCLUSIONS

- **Provect-OX™ combines multiple ISCO and enhanced biological processes**

- **Safely catalyzed process without the Hazards of Extreme Activation**
- **No Heat Generated – minimizes gassing and surfacing issues**

- **Uses Fe^{3+} as activator (no persulfate "Mandated Supplier")**

- **Long-lived reactions – sustained treatment manages rebound**

- **Demonstrated effectiveness under field conditions**

- **Cost-effective – reduces need for multiple injection events**

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Questions