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April 21, 2021

REGENESIS Proposal No. DaP67573

Jonathan Dziekan
Tetra Tech
One Oxford Valley Suite 200A
Langhorne, PA 19047
Jonathan.Dziekan@tetrattech.com

SUBJECT: Application Summary Report for Remedial Services at the Ridge Run PFAS Site

Dear Jonathan,

REGENESIS Remediation Services (RRS) has recently completed an *in situ* injection application of PlumeStop® (PlumeStop) at the Ridge Run PFAS Site located at 1419 PA-309, Sellersville, PA 18960. The goal of the remedial application was to address Per- and polyfluoroalkyl substances (PFAS) in the subsurface. RRS employed Sorption technologies to meet remediation goals.

RRS mobilized product, support pickup truck, injection trailer, and personnel to the site to begin work over five (5) days on April 6, 2021. RRS staffed this project with an experienced Project Supervisor, who ensured a safe, successful injection application. After the remedial agent was applied, RRS injected Calcium Chloride (CaCl₂) mixed with water to flush wells and act as a parking agent.

Please review the attached application summary page, injection log, map, and photo log for more detail on the application.

RRS appreciates the opportunity to work at this site with Tetra Tech. RRS will be available to interpret the field data as it is collected, or answer any questions. If you need additional information regarding the application process or attached field notes, please contact Will Clogan at 724.766.1811 or Josh Grasser at 267.472.0360.

Sincerely,
REGENESIS

Will Clogan
East Region Project Manager
REGENESIS Remediation Services

Josh Grasser
Senior Project Supervisor
REGENESIS Remediation Services

cc: Glenn Nicholas Iosue, P.E., BCEE (giosue@regenesisis.com)
Dave Peterson (dpeterson@regenesisis.com)

Summary Page



OVERVIEW

Client: Tetra Tech
Client PM: Jonathan Dziekan
RRS Project Manager: Will Clogan
RRS Project Supervisor: Joshua Grasser

Site Address: 1419 PA-309, Sellersville, PA 18960
Project Name: Ridge Run Pilot Study
Project Dates: 4/6/21 – 4/12/21

REGENESIS Remediation Services appreciates the opportunity to provide remedial services to Tetra Tech at the Ridge Run PFAS Site in Sellersville, Bucks County, Pennsylvania (Site). RRS installed a Permeable Reactive Barrier (PRB) using PlumeStop® Liquid Activated Carbon into four (4) injection wells installed prior to RRS arrival to the Site.

On-Site Work Summary

RRS arrived to the Site on Tuesday, April, 6, 2021, and began collecting pre-injection baseline water samples from OW-1A, OW-1B and MW-6S. These pre-injection samples were kept on reserve to visually compare to samples collected post-injection to help determine the presence of PlumeStop in said monitoring wells. After collecting water samples RRS placed a straddle packer apparatus into IW-4 and started PlumeStop injections. PlumeStop was injected into isolated zones in each injection well by using a straddle packer apparatus with the ability to isolate 10 foot injection zones. RRS primarily pumped on a single 10 foot zone at a time, but on occasion simultaneously injected through the entire injection well column on adjacent injection wells.

Remediation chemistries were mixed in the RRS injection trailer utilizing two 350-gallon tanks equipped with vortex mixers and pumped using a positive pressure electrically powered pump. Downhole pressures and flowrates were closely monitored to enhance PlumeStop distribution and minimize daylighting. Water samples were periodically collected from OW-1, MW-6, and MW-3 and tested for influence of carbon using a REGENESIS colorimetric field test kit.

During injections daylighting occurred through adjacent injection wells. All surfaced material was vacuumed and stored in drums until PlumeStop injections were completed. Upon completion of PlumeStop injections, all surfaced material was gravity fed back into the injection well that it came out of.

During injections, PlumeStop was observed in OW-1 and MW-6. OW-1A displayed carbon concentrations up to 900 ppm, and OW-1B tested up to 100 ppm carbon influence. Upgradient monitoring well MW-6S had carbon influence as high as 300 ppm, but averaged 100 ppm.

Following gravity feeding of surfaced material, calcium chloride was mixed with water and applied into the injection wells. When mixed with water the cations in calcium chloride destabilize the dispersion polymer coating the individual particles of PlumeStop and act to “park” the carbon in the subsurface. The goal of parking the PlumeStop is to keep carbon concentrations high around the PRB. In order to push the calcium chloride further into the formation, clean water was used to flush each well at the conclusion of calcium chloride injections.

Pilot Treatment Area

Average Flowrate (GPM)	Standard Deviation of Flowrate (GPM)	Median Flowrate (GPM)	Average Pressure (PSI)	Standard Deviation of Pressure (PSI)	Median Pressure (PSI)
4.0	1.65	4.0	69	58.86	60

Table 4: Average and median flowrates and average pressures. Two injection wells experienced higher than average pressures creating a large deviation in the injection pressure.

A total of **5,600 lbs. of PlumeStop** was mixed and applied first as a 22,000 ppm (mg/L) activated carbon solution, and later as a 44,000 ppm (mg/L) activated carbon solution. A total volume of **5,012 gallons** was applied in the area.

Application Method: 4.5-inch injection wells utilizing straddle packers

Injection Depth: 87-15 feet bgs

Number of Injection wells: 4

Deviations from Proposal:

1. Injection concentration was increased to 44,000 ppm activated carbon from 22,000 ppm activated carbon to reduce daylighting.

General Observations

1. Injection pressures were generally higher in the bottom intervals
2. Transmissivity between injection wells

Please see attached Table 1 for details on injection flow rates and pressures observed.

Tetra Tech- Ridge Run PFAS
Calcium Chloride flush
Pilot Test Injection Area



Table 2

Well ID	Date	Time	Pressure (psi)	Volume (gallons)	Flush gallons	Total volume (gallons)	lbs CaCl2
OW-1S	4/8/2021	16:19	25	40	0	40	20
OW-1S	4/9/2021	13:05	20	80	20	100	40
IW-2	4/12/2021	10:30	20	120	30	150	60
IW-3	4/12/2021	12:30	55	120	30	150	60
IW-4	4/12/2021	13:19	30	120	30	150	60
IW-1	4/12/2021	14:45	20	120	50	170	60



Tetra Tech-Ridge Run PFAS
 PlumeStop Injection Summary Log
 Pilot Test Injection Area



Table 1

Injection Point	Date	Time	Injection Depth (feet)	Injection Pressure (psi)	Flow Rate (gpm)	Volume of PlumeStop Injected			Total Gallons Per Location	Pounds of PlumeStop Injected Per Location	PlumeStop Concentration (mg/L)	Comments
						Beginning Flow Meter (gal)	Ending Flow Meter (gal)	Gallons Injected Per Interval				
1	4/7/2021	16:12	81-71	160	2.24	0.00	30.34	30.34	1386	1569	22,000	
	4/8/2021	9:04	81-71	160	3.53	0.00	223.28	223.28				
	4/8/2021	10:11	72-62	60	4.93	0.00	254.29	254.29				
	4/8/2021	11:39	40-30	60	4.27	0.00	254.30	254.30				
	4/8/2021	12:49	81-0	50	7.24	0.00	300.13	300.13				
	4/8/2021	13:17	81-0	50	7.32	300.13	452.02	151.89				
	4/8/2021	14:35	81-0	30	3.19	452.02	623.42	171.40				
											44,000	Double concentration for remaining volume
2	4/7/2021	10:36	87-77	150	4.19	0.00	254.83	254.83	1205	1504	22,000	Water test pressures up to 130 psi. Used 6 gallons water. Set packers, tested with water and water went up casing with 160 psi. Moved to next interval
	4/7/2021	11:13	65-55	160	1.28	0.00	8.00	8.00				
	4/7/2021	8:49	40-30	130	1.19	0.00	20.28	20.28				
	4/7/2021	12:56	40-30	60	4.25	0.00	300.50	300.50				
	4/7/2021	14:49	87-30	80	4.31	300.50	470.50	170.00				
	4/9/2021	13:56	87-0	0	1.20	0.00	98.84	98.84				
	4/9/2021	15:18	87-25	60	6.00	98.84	216.52	117.68				
4/12/2021	9:46	87-15	40	4.25	0.00	235.29	235.29					
											44,000	Start at 12:20 Place packer in well at 25 feet at 14:54
3	4/8/2021	16:19	85-75	170	3.49	0.00	85.43	85.43	1128	1354	22,000	
	4/9/2021	8:09	85-75	165	4.01	85.43	190.38	104.95				
	4/9/2021	10:15	70-60	170	3.88	190.38	381.15	190.77				
	4/9/2021	10:31	53-43	140	3.95	381.15	571.39	190.24				
	4/9/2021	10:59	40-30	70	5.30	571.39	763.87	192.48				
	4/9/2021	12:48	85-45	75	4.14	0.00	132.98	132.98				
	4/9/2021	13:57	85-45	25	1.31	132.98	201.24	68.26				
4/12/2021	11:40	85-25	75	4.18	0.00	163.00	163.00					
											44,000	Started at 170 psi, and 2 gpm. At 9:46 pressure dropped to 130, so upped flowrate to 4 gpm and 150 psi. Surfacing through IW-4, Slowed to 1 gpm
4	4/6/2021	12:34	84-74	80	4.22	0.00	254.28	254.28	1292	1173	22,000	Used 19 gallons water to build pressure to 70 psi, back pressure up to 25 psi
	4/6/2021	14:06	73-63	55	4.20	0.00	254.13	254.13				
	4/7/2021	11:18	0	0	0.00	0.00	0.00	0.00				
	4/7/2021	11:18	84-0	5	2.70	0.00	277.38	277.38				
	4/7/2021	12:56	84-0	5	2.87	277.38	344.22	66.84				
	4/7/2021	14:00	84-0	10	2.59	344.22	467.82	123.60				
	4/7/2021	14:46	84-0	0	2.14	467.82	478.38	10.56				
	4/8/2021	9:58	84-0	0	2.21	0.00	264.82	264.82				
4/8/2021	10:38	84-0	0	2.22	264.82	305.55	40.73					
												Fitting came loose, and well had significant back pressure. Over 15 gallons of fluid cleaned up before it settled back down. IW-3 at 10,000 ppm Daylighting through IW-3. direct pathway suspected
									Total Gallons:	Total Lbs. PlumeStop		
									5012	5600		

Ridge Run PFAS

In-situ Area Injection, Observation, and Monitoring Wells Locations

Legend

- IW
- MW
- OW
- Three mile Run



Photo Log



Photo 1: Injection area with RRS injection trailer. Looking South

Photo Log



Photo 2: Injection area with RRS injection trailer Looking N

Photo Log



Photo 3: Injection area. Looking North