Bailing out the Technicians: Assessing Purge Volume Protocols

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Abstract

Sampling procedure for contaminated groundwater is one of the most critical guidelines for environmental technicians working to delineate groundwater impacts and characterize the spread of contamination. Using approved techniques and stringent cross-contamination safeguards, sampling was conducted at three sites with known contamination and historic procedural compliance to determine how samples are affected by obtaining samples with different purge volumes.

To determine the effects, three sites were chosen. The first has wells located within the overburden with well-developed wells producing clear water. The second has wells sunk into shale bedrock with high levels of turbidity even after extensive well development. Finally, the last site has wells of known contamination placed into a siltstone bedrock aquifer.

Samples were analyzed by PADEP 8260B for unleaded gasoline to determine changes seen with differing purge volumes. Purge volume samples were taken at 0 (initial static water level), 1.5, 3, and 5 times the case volume of the wells sampled.

Results provide insights to the necessary downdraw to adequately reduce and stabilize the presence of suspended solids in the form of turbid samples. If turbidity were to increase, it is anticipated that contaminant concentrations should mirror this change due to the removal and replenishment of turbid groundwater into the system carrying contaminants adsorbed to the colloidal fraction of the incoming sediment.

Introduction

The practice of purging wells is well established as a means to generate samples representative of the conditions found in the groundwater system. The practice is used in order to remove the water that has been sequestered into the well and bring fresh water from the aquifer containing contaminants of concern at concentrations that are expected to be seen in the in-situ environment. The practice further aids in generating water of significantly less turbidity.

Methods & Materials

- Samples were collected at four separate times during the purging process. The first sample was obtained from each sampled well before any purge volume was taken, the second at 1.5 times the calculated case volume, the third from the prescribed 3 times the calculated case volume, and a final sample was obtained from a 5 times the calculated case volume.
- Samples were containerized in laboratory supplied vessels and were stored on ice until collected.
- Samples were analyzed by USEPA 8260B analysis for unleaded gasoline constituents.
- Results were plotted for changes seen throughout the purge process.

Site Maps

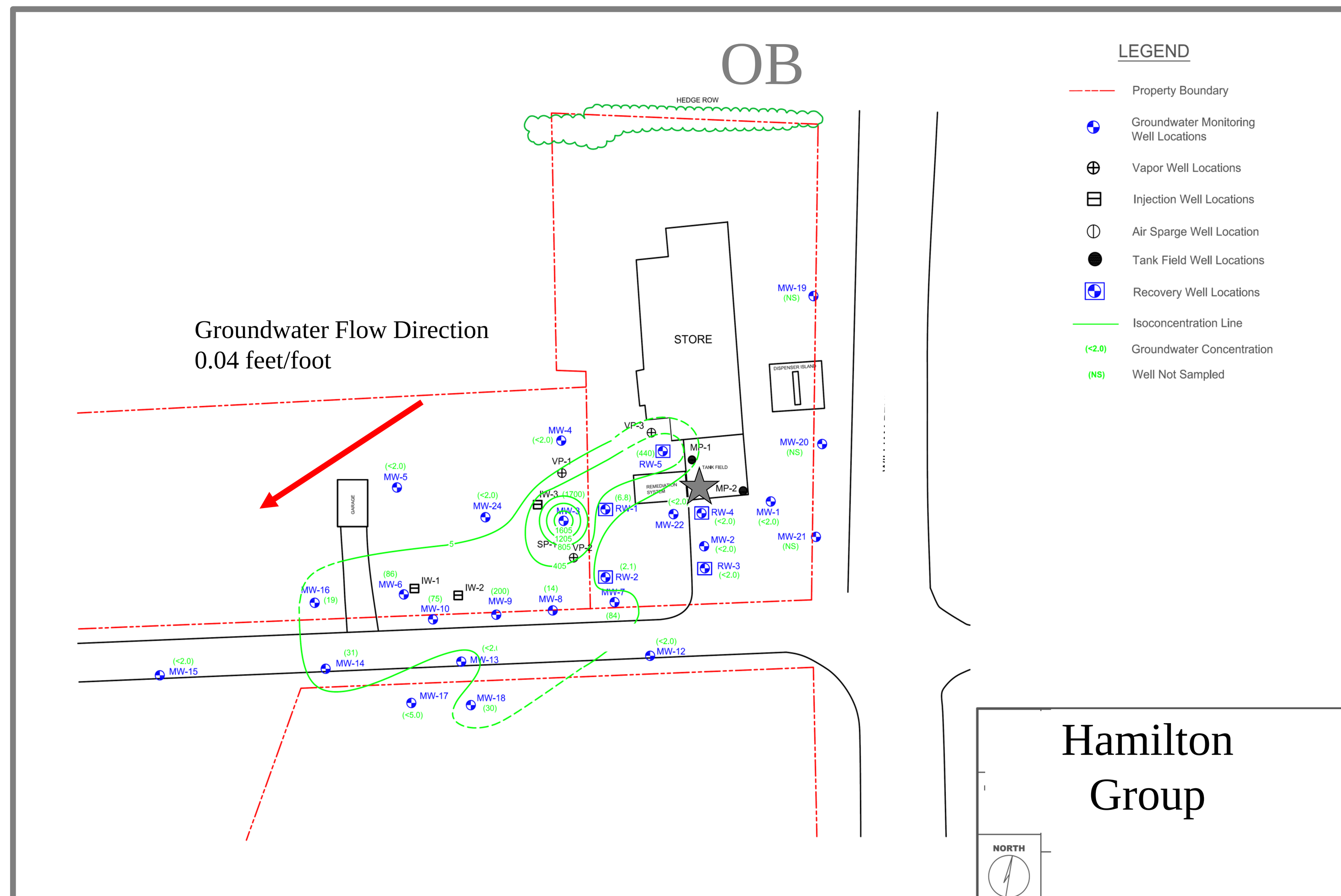

Figure 1: Site map of site OB indicating groundwater flow direction and plume extent. Starred location is the assumed source area. Note the maximum contamination is located at MW-3 suggesting movement of plume down gradient.

OB: Reported a petroleum release in the early 2000s and has gone through several consulting firms in attempting to remediate the groundwater and soil impacts at the site. Wells at this location are located in shale bedrock.

Well distance from source: **Approximately 100'**
Highest Concentration Date: **September 15, 2004**
Highest Concentration: **10,000 ppm Benzene**

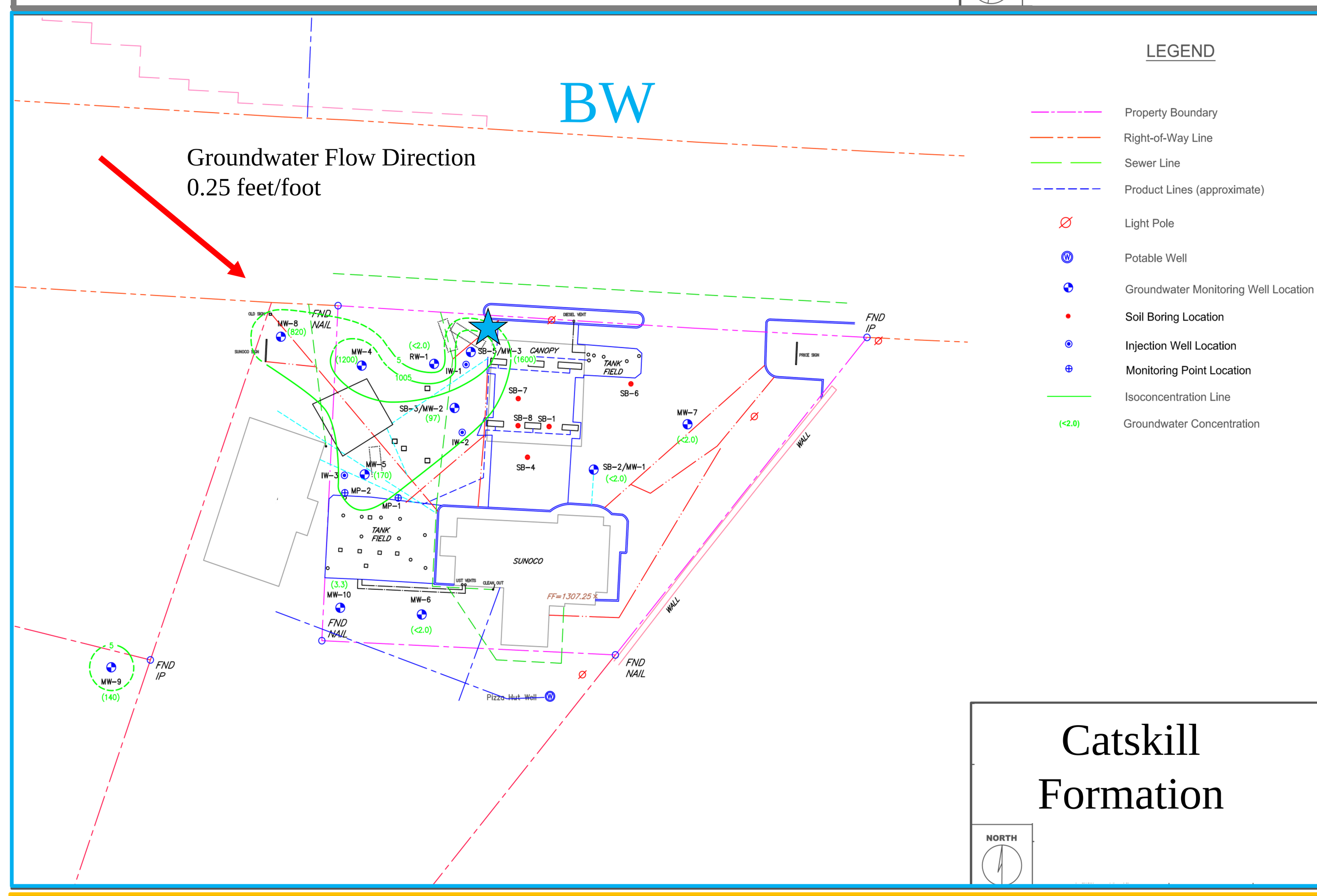

Figure 2: Site map of site BW indicating groundwater flow direction and plume extent. Starred location is the assumed source area. Note the maximum contamination is located upgradient of the source due to presumed subsurface anomaly.

BW: Reported a petroleum release in early 2016 the site is located in an area of prevalent retail fuel stations. Wells at this site are located in well consolidated Catskill formation siltstone.

Well distance from source: **Approximately 50'**
Highest Concentration Date: **February 15, 2018**
Highest Concentration: **2,200 ppm Benzene**

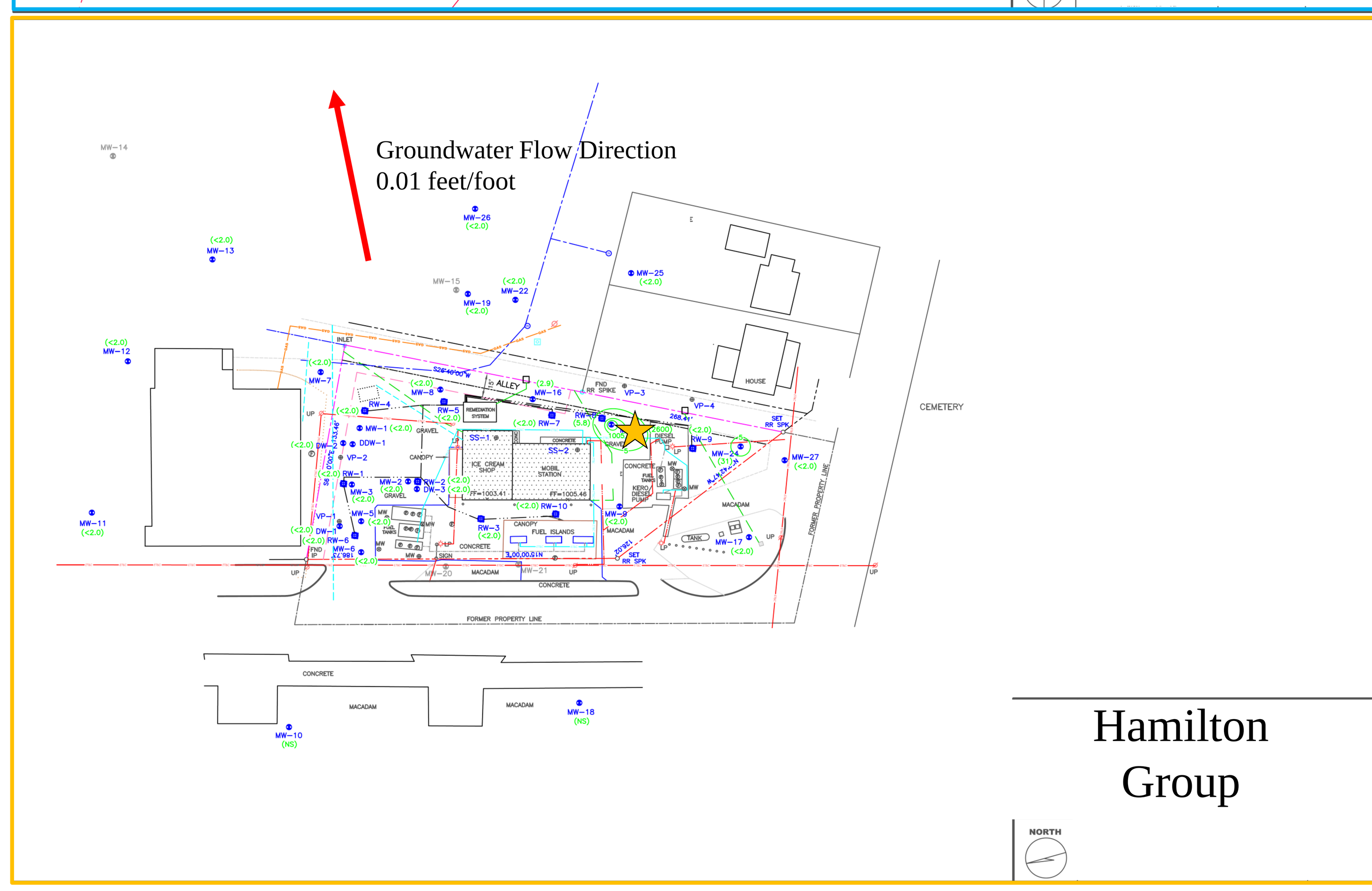

Figure 3: Site map of site WS indicating groundwater flow direction and plume extent. Starred location is the assumed source area. Note the maximum contamination at MW-27 is located near to the presumed source area.

WS: Reported a petroleum release which is believed to have followed preferential flow paths created by the piping system of the tanks and pumps. Wells in this location are located in silty clay overburden.

Well distance from source: **Approximately 75'**
Highest Concentration Date: **July 18, 2016**
Highest Concentration: **226 ppm Benzene**

Results

OB MW-3				
Number of Case Volumes	Purge Volume (Gallons)	Well diameter (Inches)	Total Depth (Feet)	SWL (Feet)
0.0	0.00	2"	29.75'	7.40'
1.5	21.89	2"	29.75'	10.55'
3.0	43.78	2"	29.75'	15.98'
5.0	72.97	2"	29.75'	26.87'
BW MW-4				
Number of Case Volumes	Purge Volume (Gallons)	Well Diameter (Inches)	Total Depth (Feet)	SWL (Feet)
0.0	0.00	2"	40.35'	12.00'
1.5	6.93	2"	40.35'	12.05'
3.0	13.86	2"	40.35'	12.02'
5.0	23.11	2"	40.35'	12.04'
WS MW-24				
Number of Case Volumes	Purge Volume (Gallons)	Well Diameter (Inches)	Total Depth (Feet)	SWL (Feet)
0.0	0.00	2"	18.78'	10.64'
1.5	1.99	2"	18.78'	11.10'
3.0	3.98	2"	18.78'	11.05'
5.0	6.65	2"	18.78'	11.15'

Figure 4: Well data from testing procedure. Note that the well that responded most effectively to purging was able to be drawn down significantly. This is possibly due to drawing the water down below the level that contaminants are found, thus allowing the water to stabilize in contaminant concentrations.

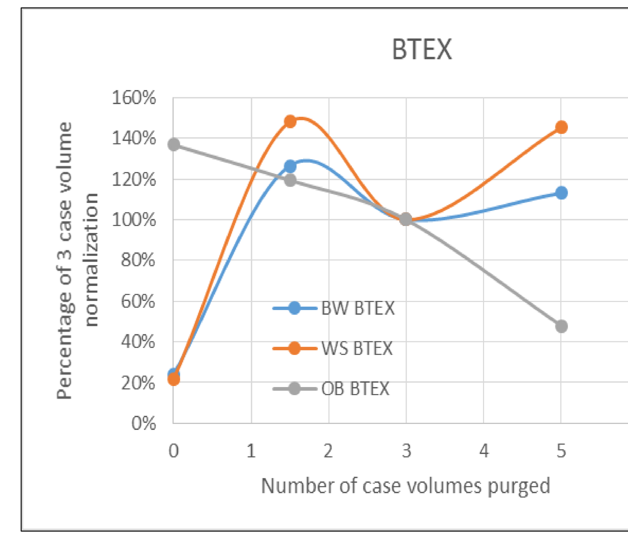

Figure 5: Changes in BTEX contaminant concentrations with varying purge volume. Results were normalized to the prescribed three case volume purge. Results indicate that fluxuations in contaminant concentrations continue beyond the traditionally held stable point of three case volumes. Differences in lithology at the well are made apparent by the differences in contaminant concentration pathways throughout purging.

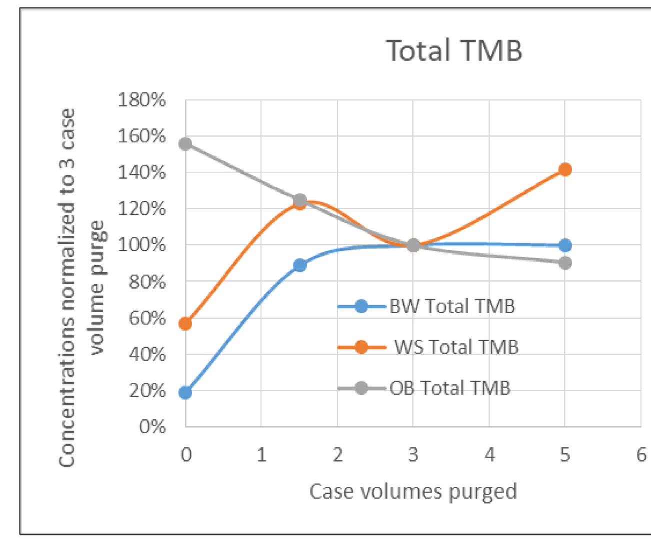

Figure 6: Changes in total TMB concentrations with varying purge volume. Results were normalized to prescribed three case volume purge. Note more stability is imbued from purging in the case of TMB than in BTEX above.

Observations and Implications

- Differences in the effect of purge volume are dependent on the lithology and subsurface nature of the aquifer in question.
  - Additionally, some constituents stabilize more readily from differences in purge volumes.
- Findings suggest that overpurging may not offer any additional benefit and there may be less significant effect if accidental underpurging occurs.
  - The effect seen in the less than 3 times the case volume samples suggest that, though a grab sample may not provide the most effective sample it should be possible in the case of very low production wells.
  - Some amount of purging should be performed if possible, however, in instances of simply looking for possible contamination, 1-3 times the case volume should be applicable.
- Further evaluation will need to be performed in the form of a comparison with low flow protocols, increasing the number of analyzed sites and wells, and collection of samples in wells with poor production.

Acknowledgements

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