SMART Remediation

Smart Methods in Advanced Remediation Technologies

Ongoing Challenges and Performance of Pulsing for Benzene Removal in Groundwater

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SMART Remediation
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Ellen Hachborn, P.Eng., P.Geo. - Dillon Consulting Limited

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About Dillon & Ellen

- A proudly Canadian, employee-owned professional consulting firm specializing in planning, engineering, environmental science, and management
- Founded in 1946 in London, ON
- Over 20 offices throughout Canada
- Honoured as one of Canada's Best Managed Companies since 2006.

Ellen Hachborn, P.Eng., P.Geo

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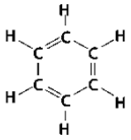
Outline

- Site Overview and Background
- Remedial Action Plan (RAP)
- Pulsing Plan Methodology
- Pulsing Performance
- Challenges
- Questions

Benzene



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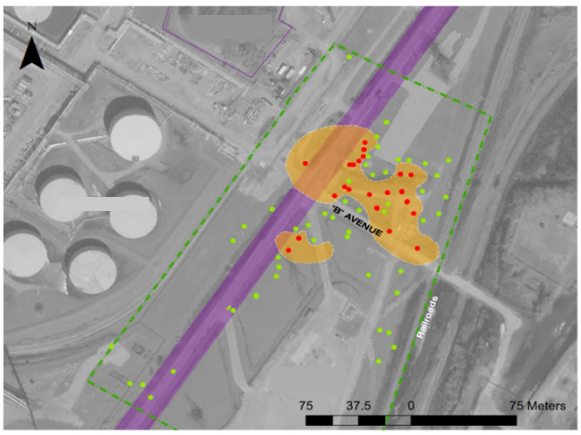
Project Overview

- Benzene contamination assessment and delineation over 2 ha area known as Third Party Pipeline Right-of-Way (ROW)
- First Nation's engagement support
- Remediation design
- Contracting and tendering
- Overseeing engineered remediation
- Devise long-term system/contaminant management
- Ongoing monitoring



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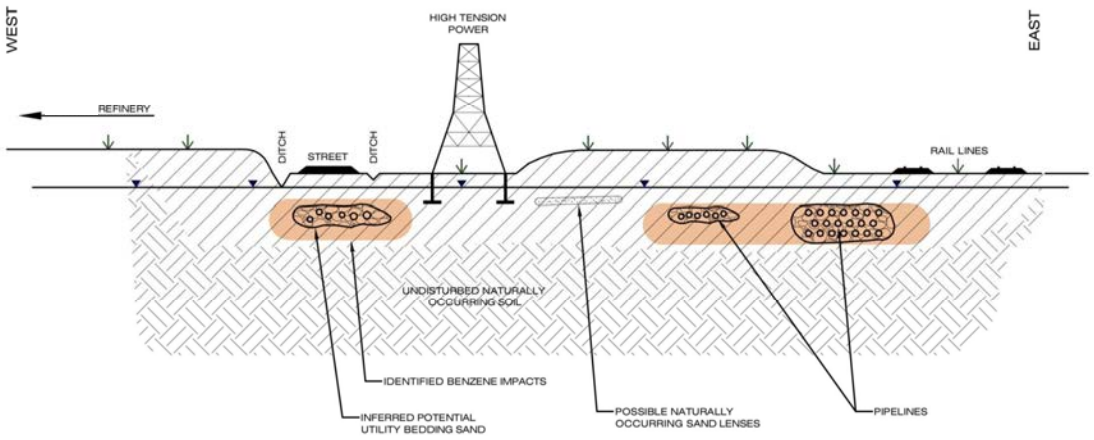
Conceptual Site Model (CSM)



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Timeline

2013:
Project Initiation

2014:
Remediation Action Plan (RAP), engagement with First Nation and MECP

2015:
Air Quality Management Plan

2015 – 2017:
Construction /Remediation

2018 – Present:
Ongoing Monitoring

2021:
Initiation of the Pulsing Plan

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Remedial Action Plan (RAP)

Installation of Groundwater Extraction and Treatment System (GETS)

Installation of Geosynthetic Clay Liner (GCL) over top

RAP Objectives

1. Protect ditch water
2. Protect downgradient soil and groundwater
3. Mitigate exposure to human and ecological surface receptors
4. Reduce benzene concentrations in soil and groundwater

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RAP Components

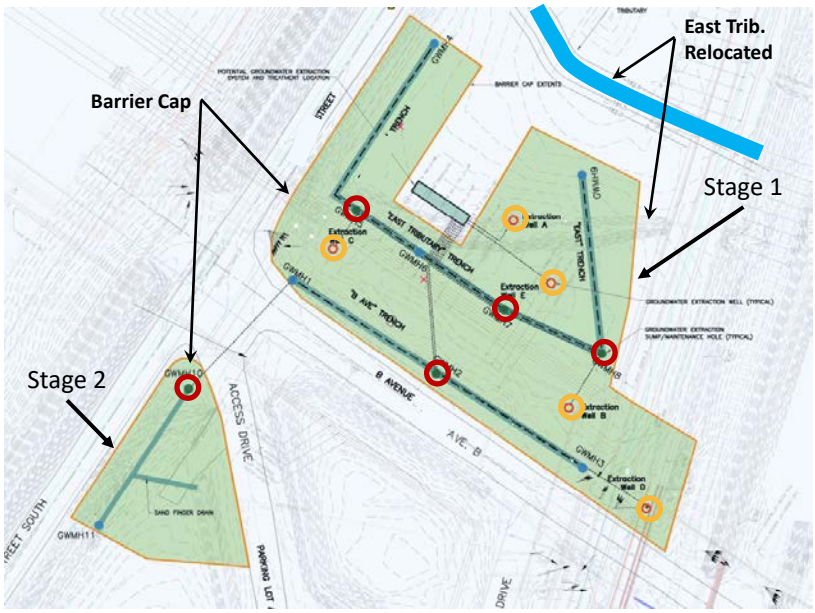
Relocation of the East Tributary

Installation of:

- 5 sand filled groundwater depression trenches connected to 11 maintenance holes (**5 finished as extraction sumps**).
- **5 extraction wells.**

Placement of:

- 0.6 m thick surface barrier cap overlaying a geosynthetic clay liner (GCL).



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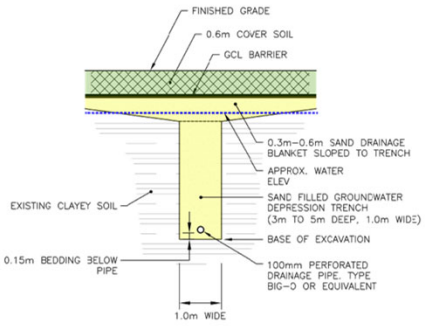
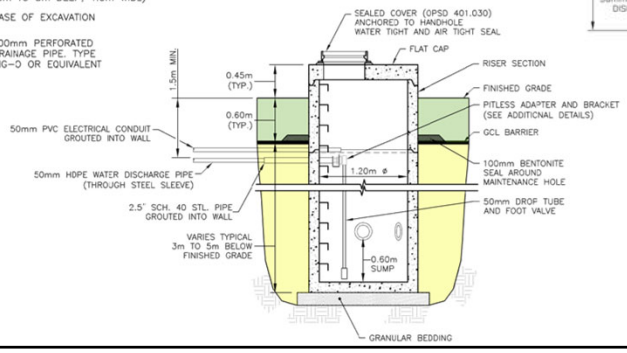
RAP Components

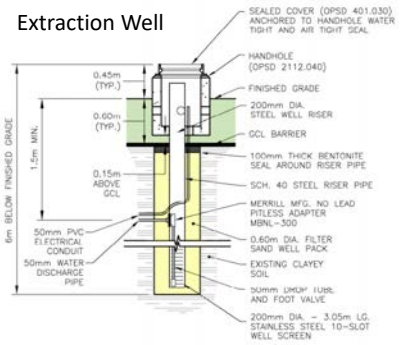
Depression Trench



Maintenance Hole



Extraction Well



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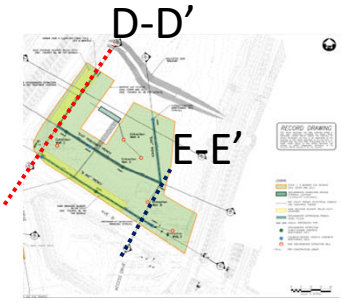
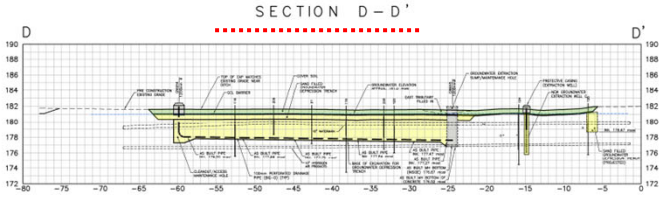
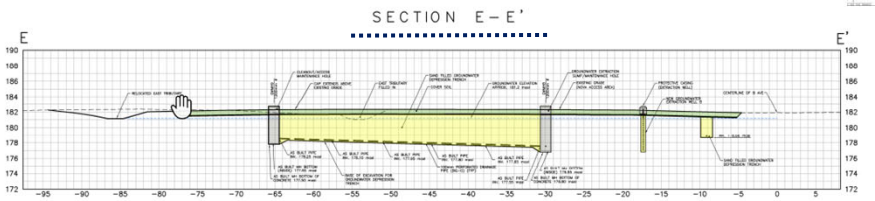
Design Details – Stage 1

- N-S Cross-Sections







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Annual Monitoring Activities

Monthly
- Groundwater elevation monitoring required by Permit To Take Water (PTTW)

Winter & Summer
- 2 partial groundwater sampling rounds at 9 select monitoring wells

Spring & Fall
- 2 full RAP groundwater sampling rounds at 60 monitoring wells

Annually
- Other monitoring (air, surface, soil)

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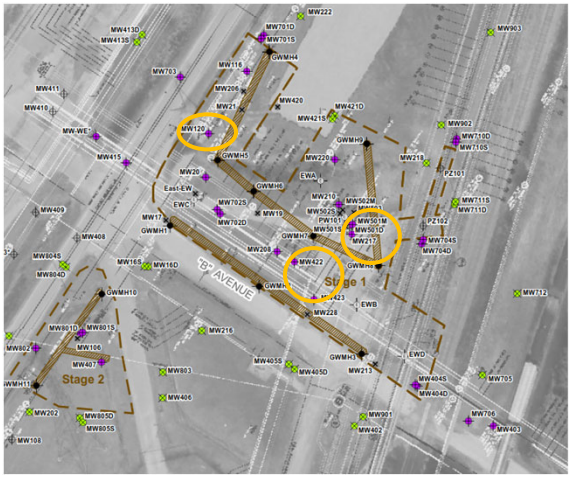
RAP Implementation Performance & Challenges

Stage 1 Concentration Variability

- Benzene concentration above O.Reg. 153/04 Table 3 ICC at most recent event:
  - MW120 & MW217
  - MW422 and MW510M (dry but historically above)



Long Term Performance Expectations

- Overall decline in benzene concentrations followed by an asymptotic trend

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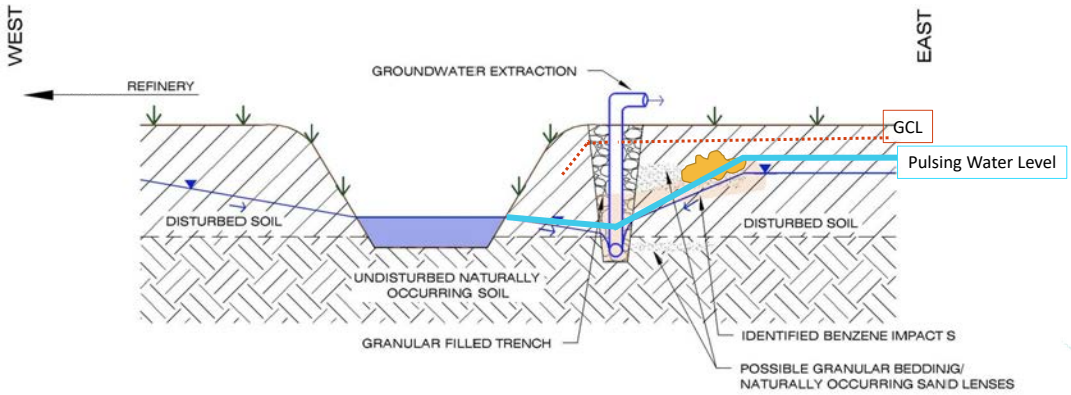
Pulsing Plan

- Injection free pulsing (i.e. precipitation only) to allow groundwater elevations to rise within Stage 1 and remobilize benzene trapped above the water table



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Pulsing Plan

- New levels implemented
  - Increase of 0.5 m on August 4, 2021
  - Second increase of 0.5 m on June 13, 2022

Location	MH Bottom Elevation	Approx. GCL Elevation	Pre-Pulse Operational Levels		2022 Pulsing Operating Levels	
	(masl)	(masl)	Low Level (masl)	High Level (masl)	Low Level (masl)	High Level (masl)
GWMH2	177.41	181.0	178.01	178.36	179.01	179.36
GWMH5	176.67	181.2	177.27	177.62	178.27	178.62
GWMH8	176.90	181.7	177.55	177.90	178.55	178.90

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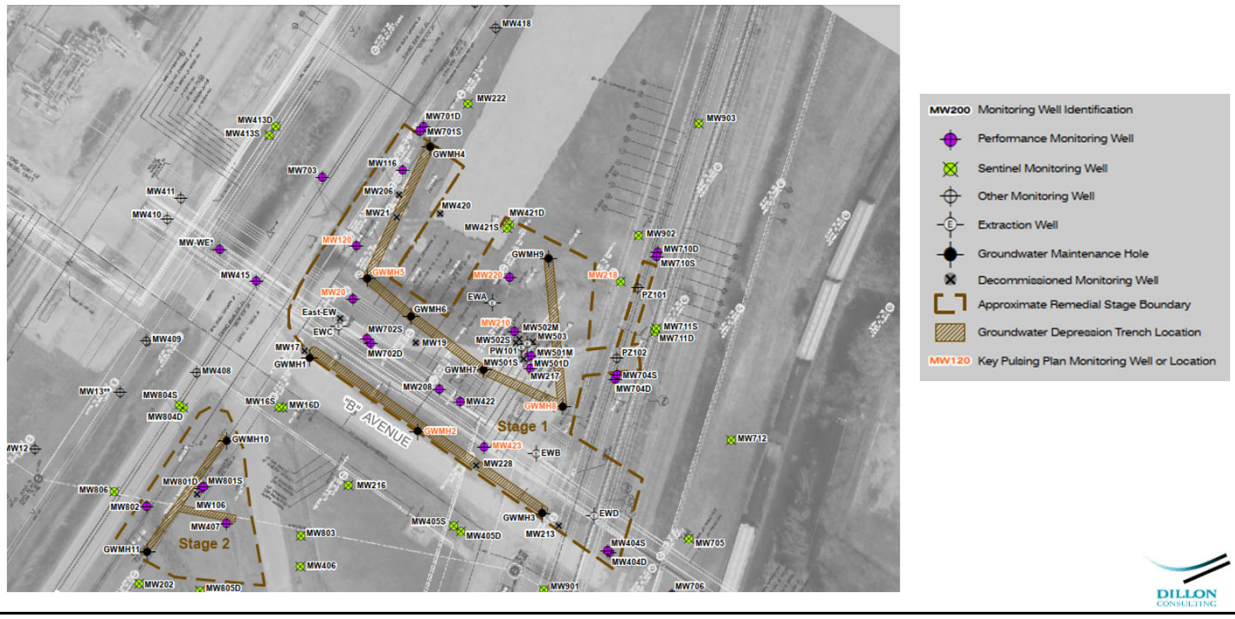
Pulsing Plan Locations



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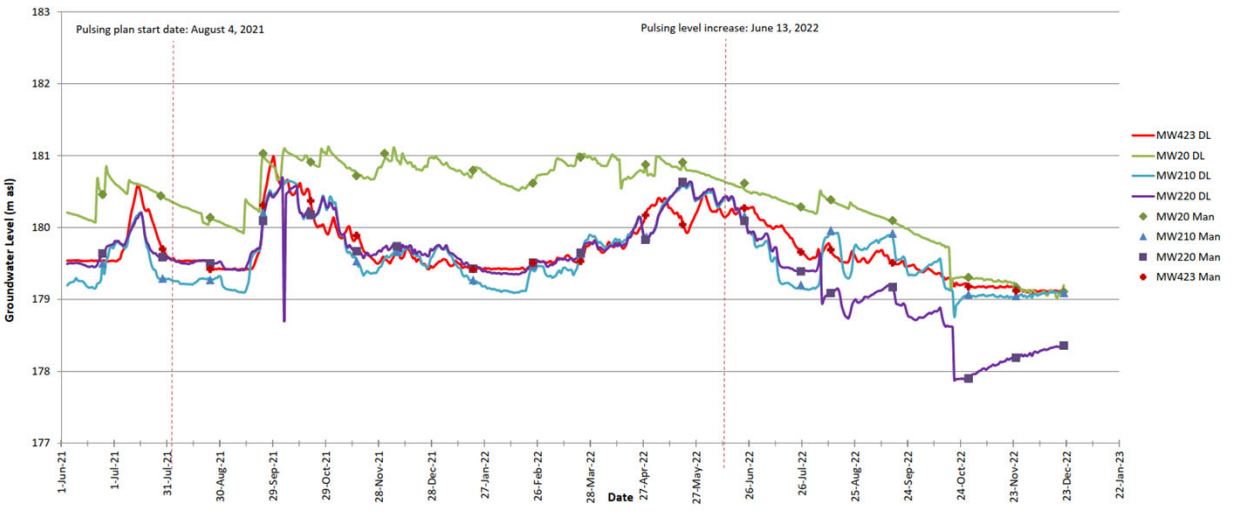
Water Level Response



m asl =metres above sea level
Man = Manual Measurement
DL = Data Logger Measurement

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Stage 1 Benzene Impacts – Shallow Wells

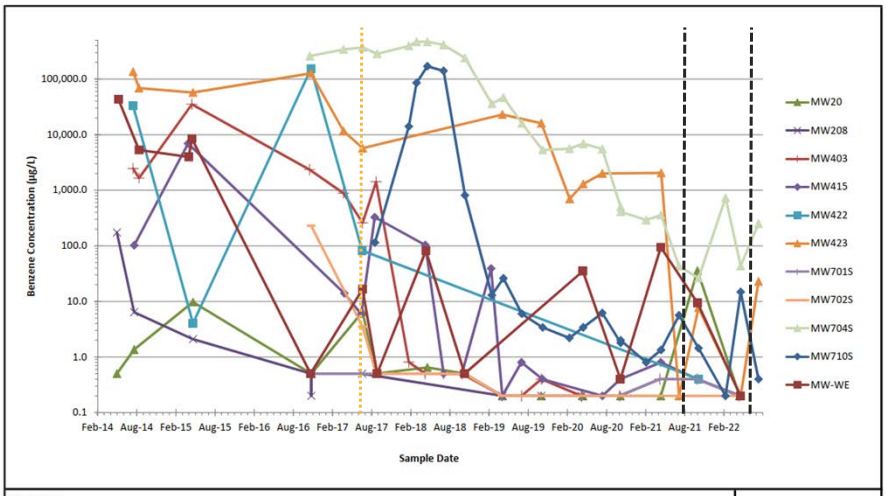

Figure 5a:
Benzene Concentrations in Groundwater - Shallow Stage 1 Performance Monitoring Wells

Notes:
- The applicable O.Reg. Table 3 Standard for benzene is 430 µg/L.
- Non-detect samples are indicated on the graph as a measured value (ie., 0.5 µg/L for <0.5 µg/L). These values were included to differentiate between "non-detect samples" and "wells that were not sampled."

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Stage 1 Benzene Impacts – Deep Wells

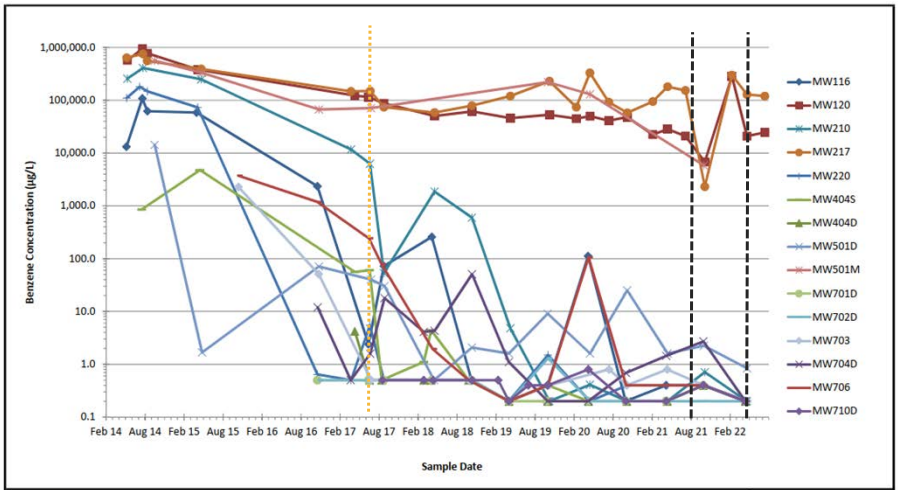

Figure 5b:
Benzene Concentrations in Groundwater - Deep Stage 1 Performance Monitoring Wells

Notes:
- The applicable O.Reg. Table 3 Standard for benzene is 430 µg/L.
- Non-detect samples are indicated on the graph as a measured value (ie., 0.5 µg/L for <0.5 µg/L). These values were included to differentiate between "non-detect samples" and "wells that were not sampled."

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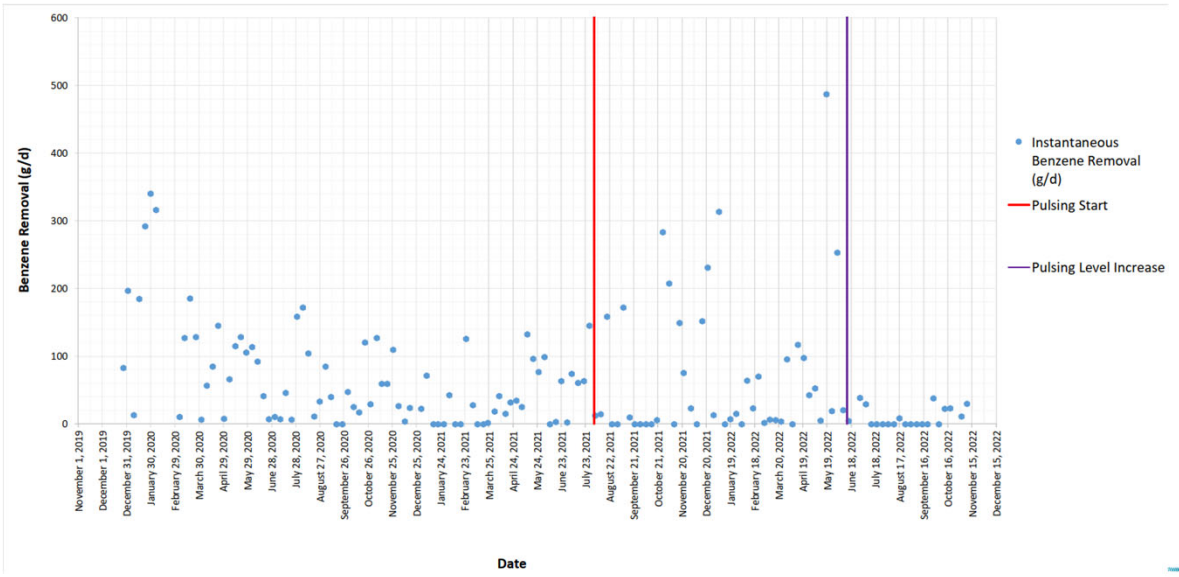
Instantaneous Benzene Removal



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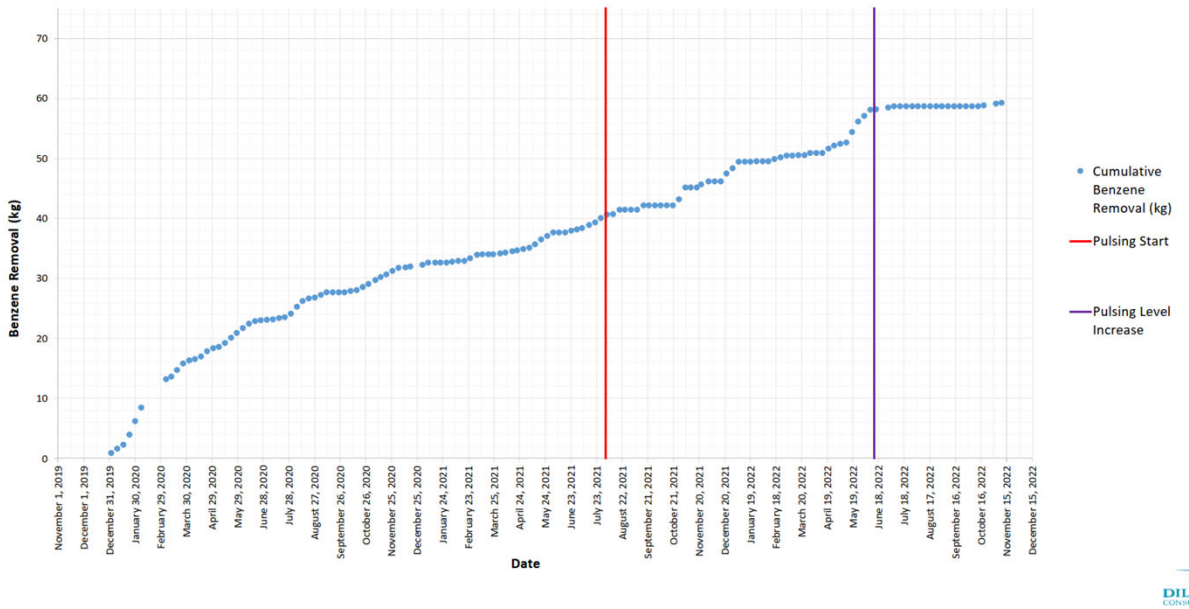
Cumulative Benzene Removal



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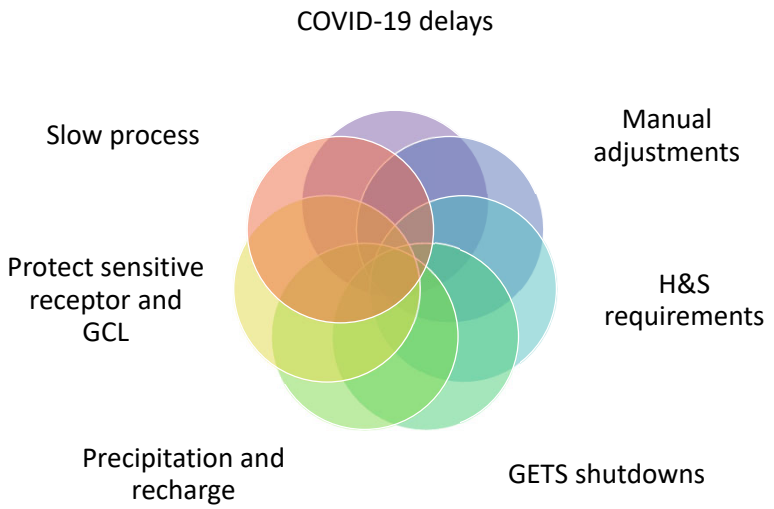
Challenges



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Pulsing Plan Performance

Levels

- Results indicate that the first round of pulsing saw response in water levels but not in benzene concentration

Concentrations

- Will continue to monitor influent concentrations and sample concentrations to evaluate effect of new levels

Protection

- Continued monitoring to protect raising groundwater height above the GCL or ditch inverts using level loggers

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