

High Frequency Groundwater Sampling – Insights Into Detailed Plume Characterization and Risk Management

Remtech, October 2020

Blake Hamer

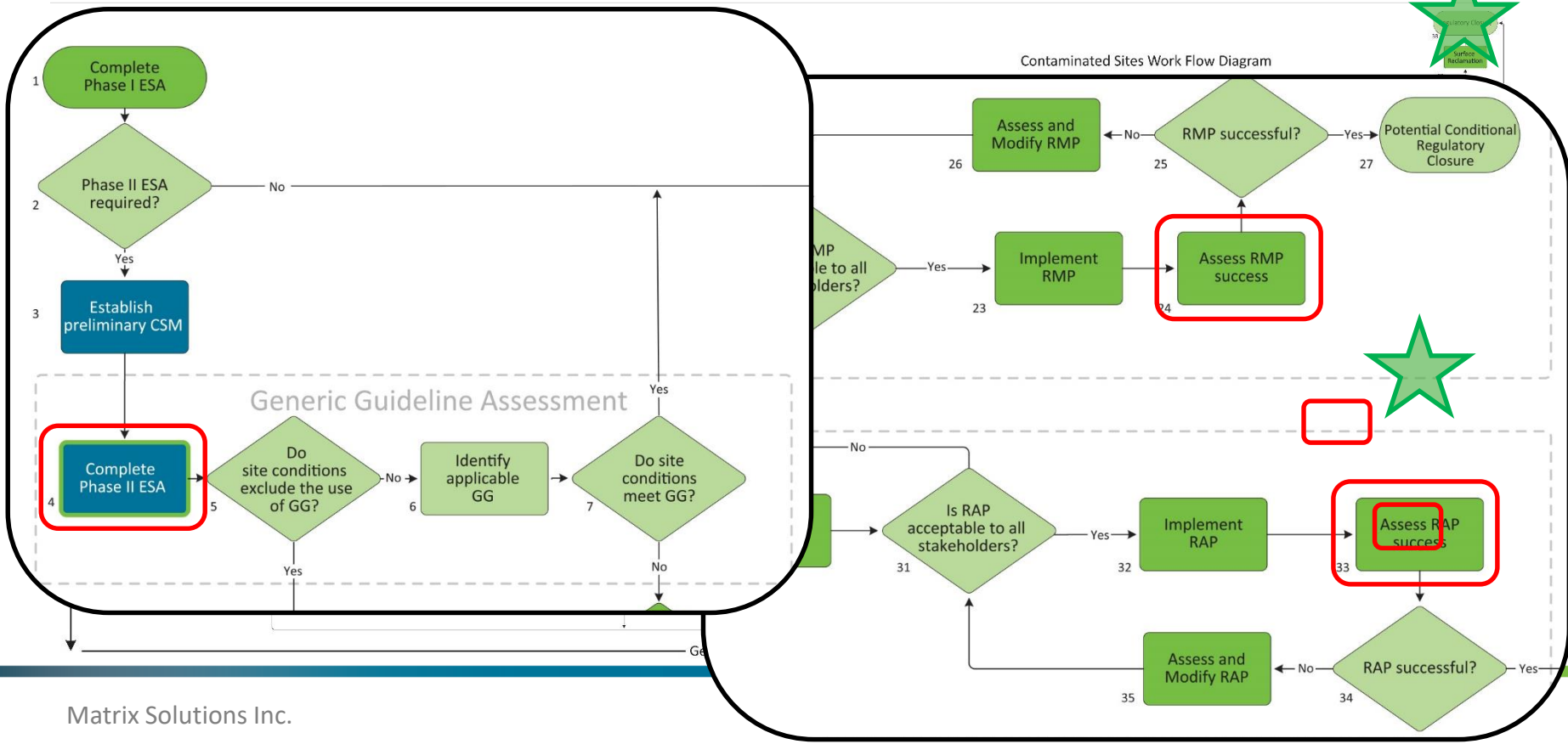
Alex Haluszka

Outline

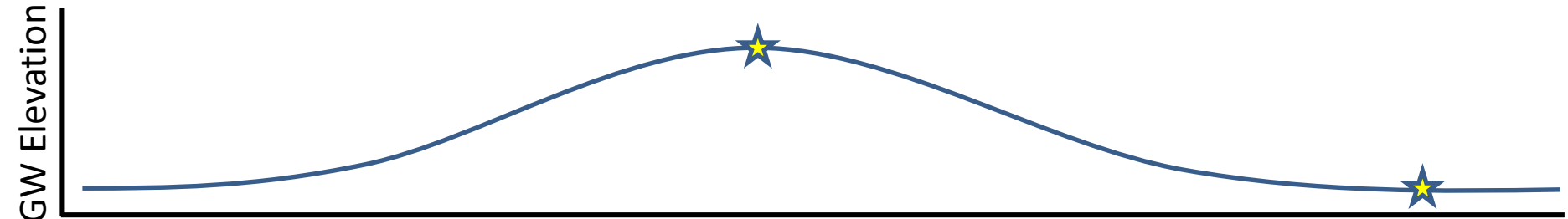
- What is the purpose of groundwater monitoring?
- Challenges with selecting appropriate sampling schedule/frequency
- Cool case study
- Learnings for optimizing monitoring programs and risk management



What is the purpose of GWM?



Monitoring frequency



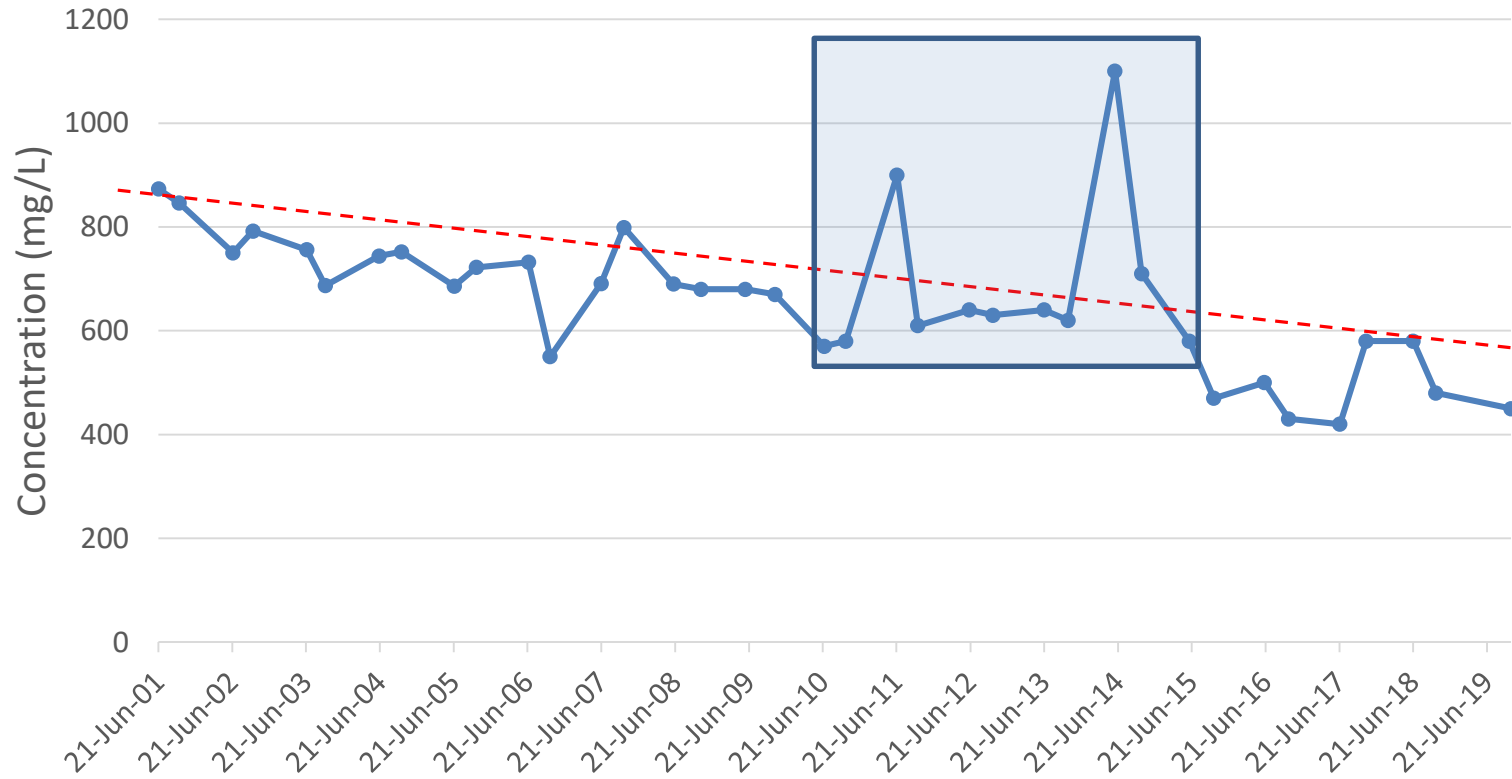
Low frequency monitoring



- Low risk sites
 - Homogeneous, low permeability stratigraphy
 - Stable plumes
 - No nearby receptors
 - No active source



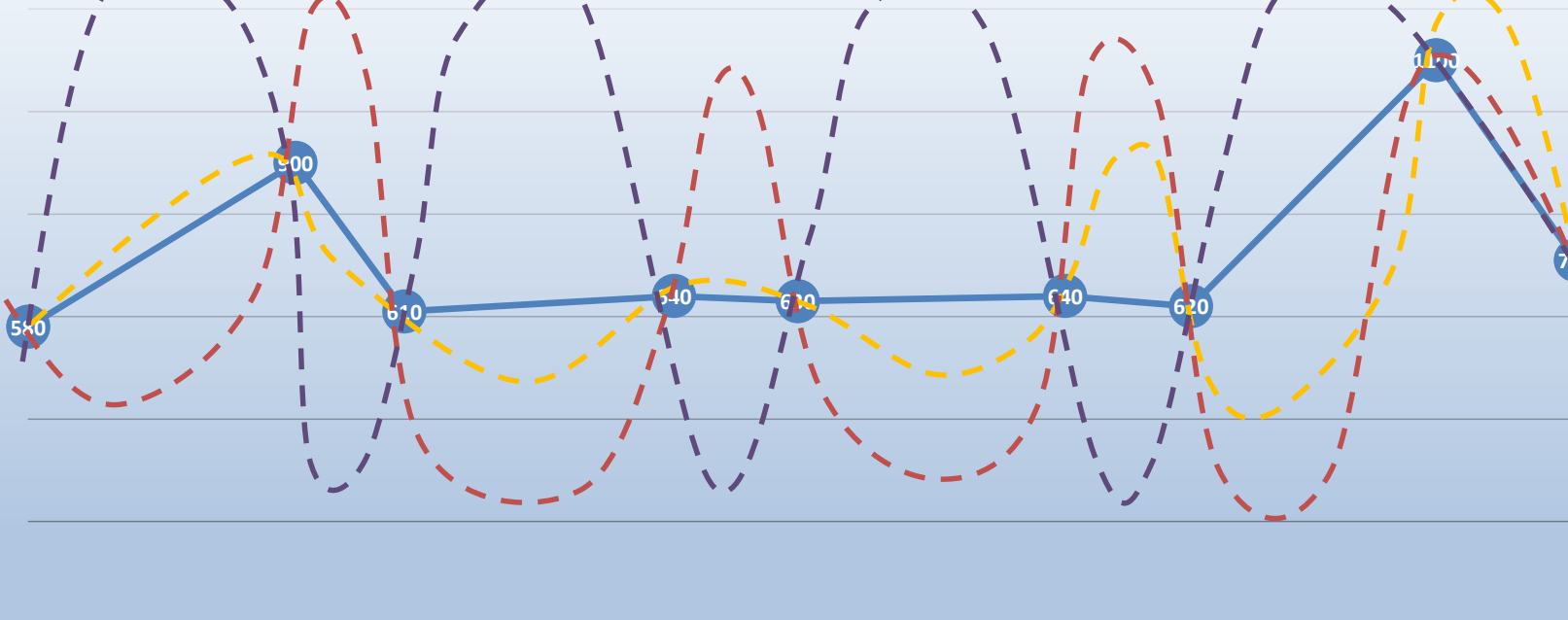
Contaminant Concentrations Over Time



Contaminant Concentrations Over Time

Contaminant Concentration (mg/L)

13-OCT-10 13-DEC-10 13-FEB-11 13-APR-11 13-JUN-11 13-AUG-11 13-OCT-11 13-DEC-11 13-FEB-12 13-APR-12 13-JUN-12 13-AUG-12 13-OCT-12 13-DEC-12 13-FEB-13 13-APR-13 13-JUN-13 13-AUG-13 13-OCT-13 13-DEC-13 13-FEB-14 13-APR-14 13-JUN-14 13-AUG-14 13-OCT-14

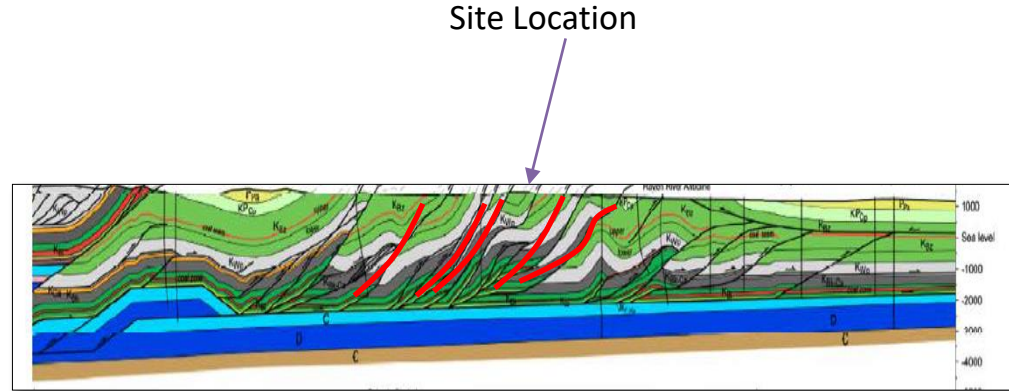
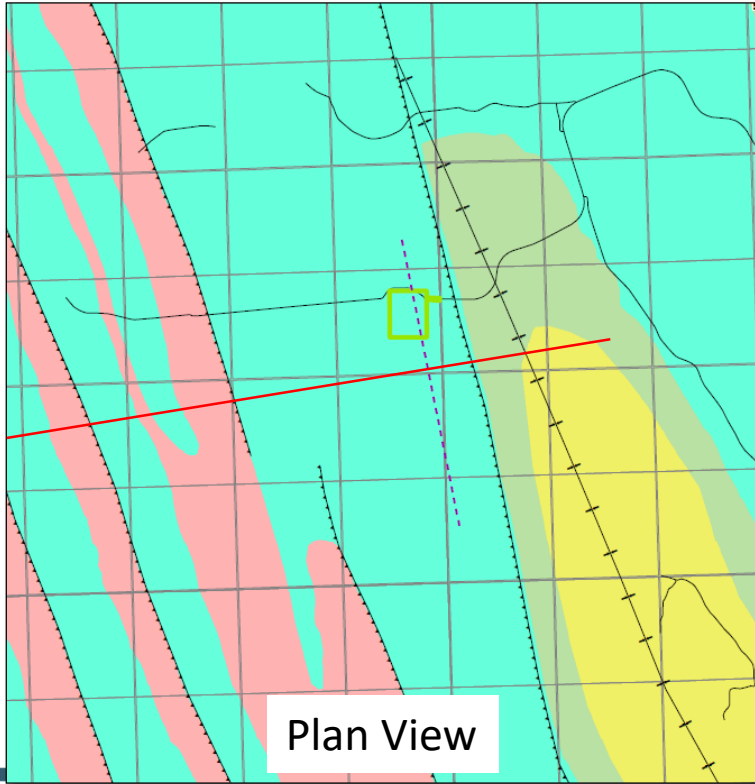


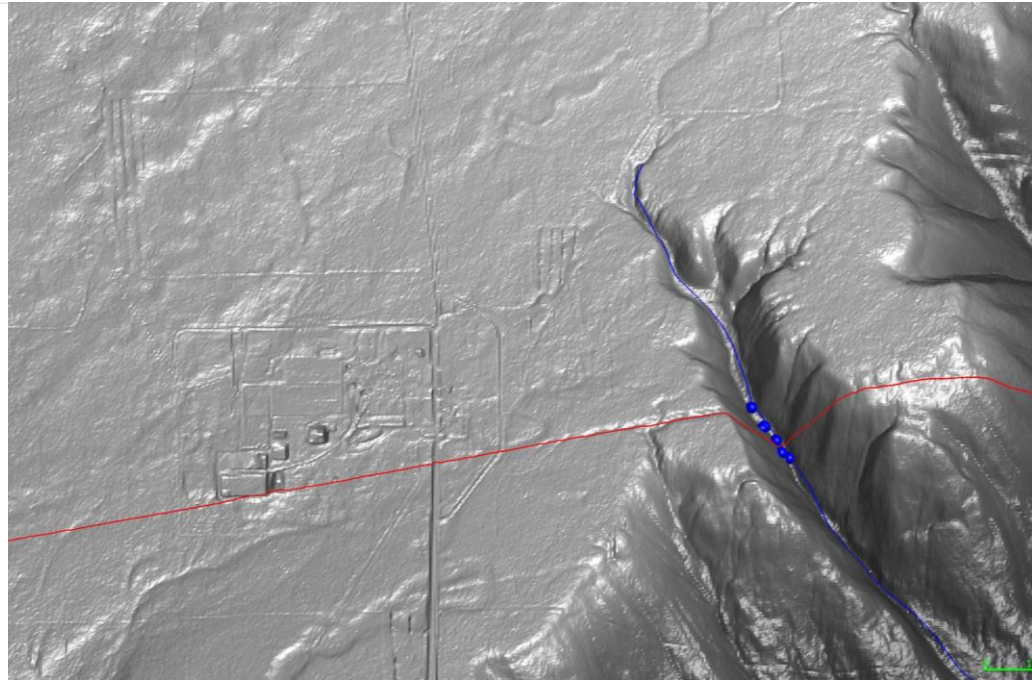
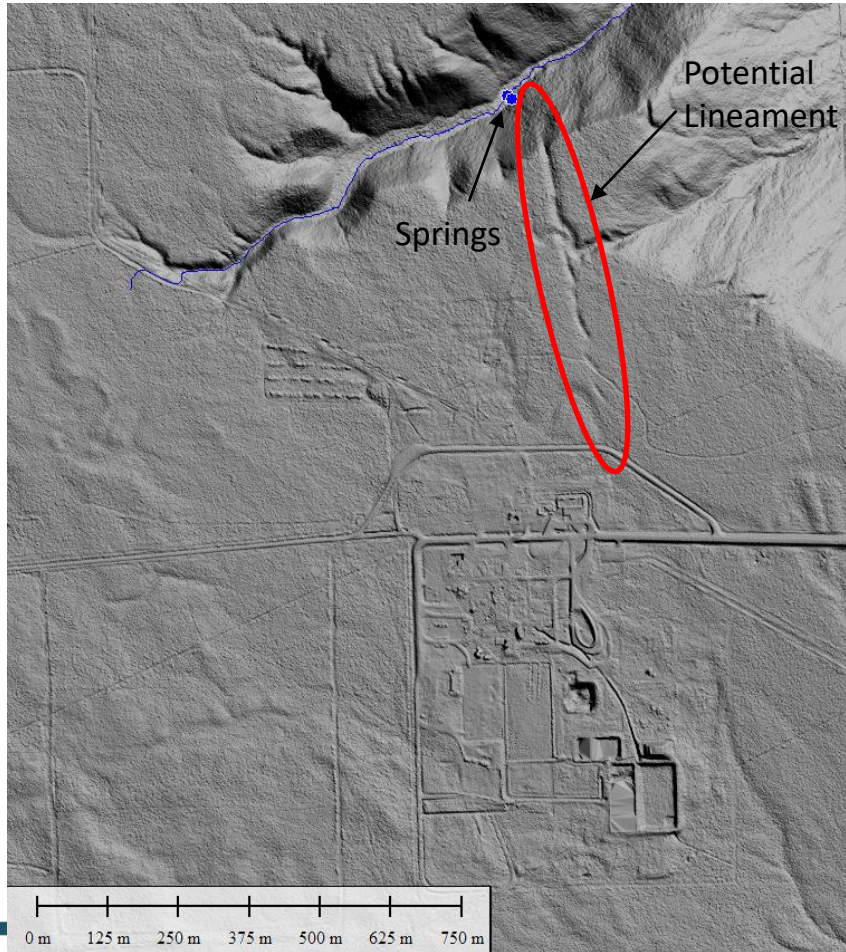
Case Study

- Former gas plant; decommissioned in 2014
- Complex hydrogeology
- Conservative contaminant (low adsorption, high solubility)
- Nearby receptors
- Residual source



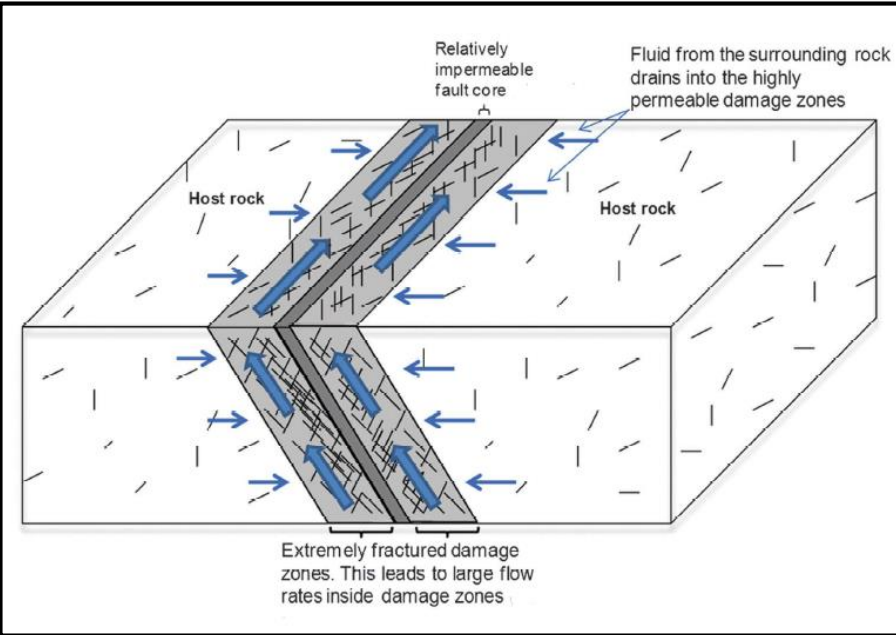
Structural Geology



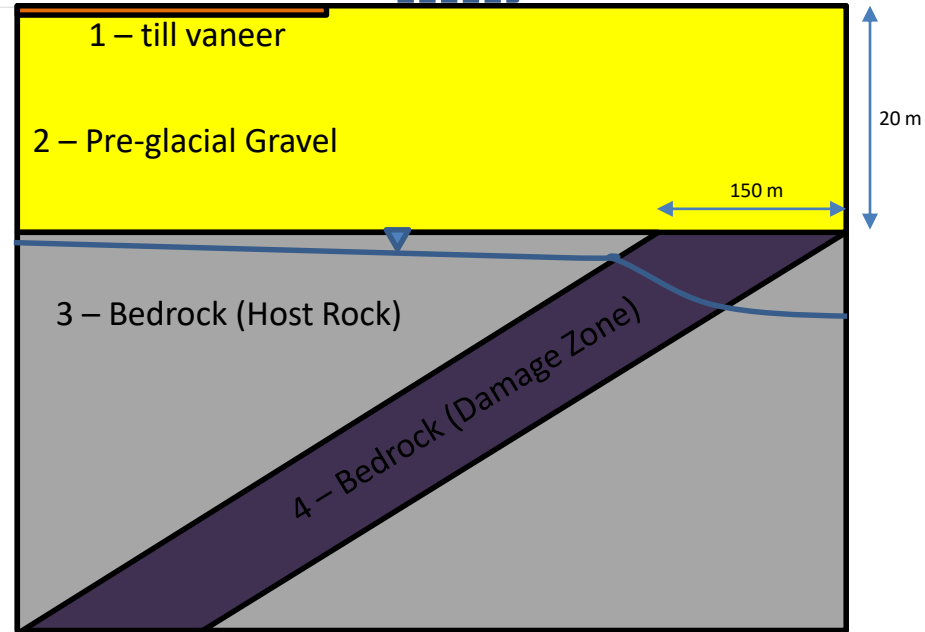


Hydrostratigraphy

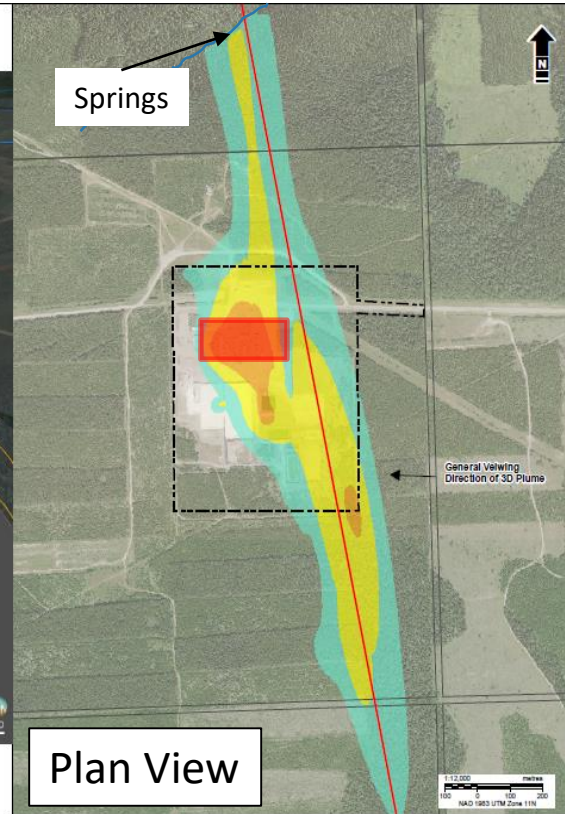
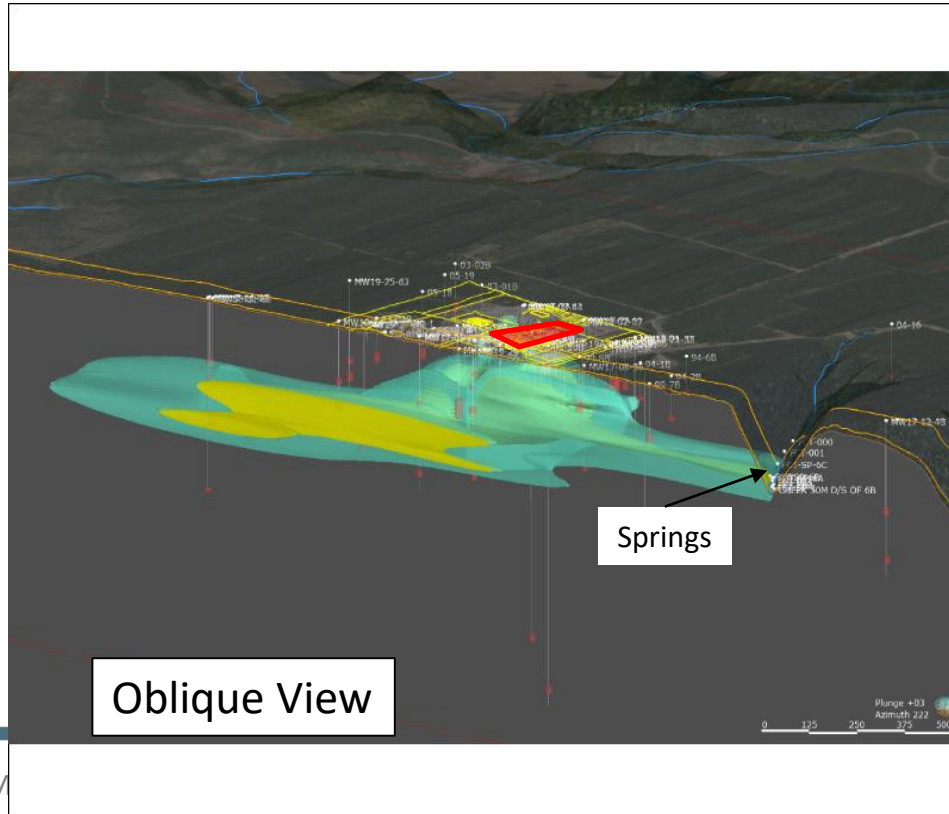
Former Process Area



Johri et al. 2014

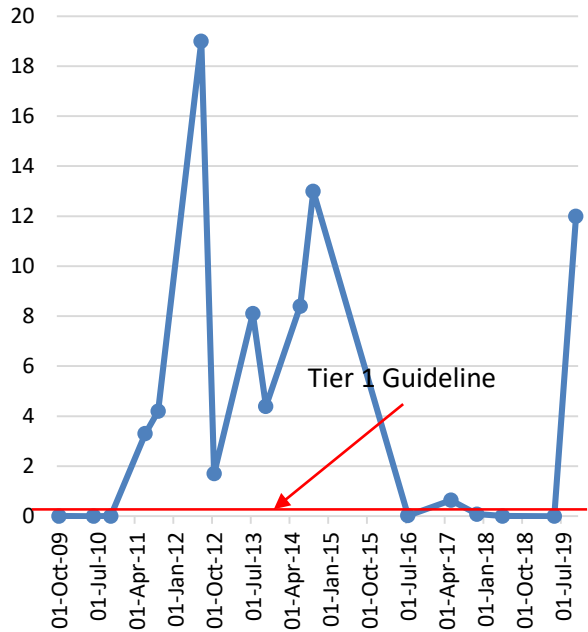


Dissolved Phase Impacts

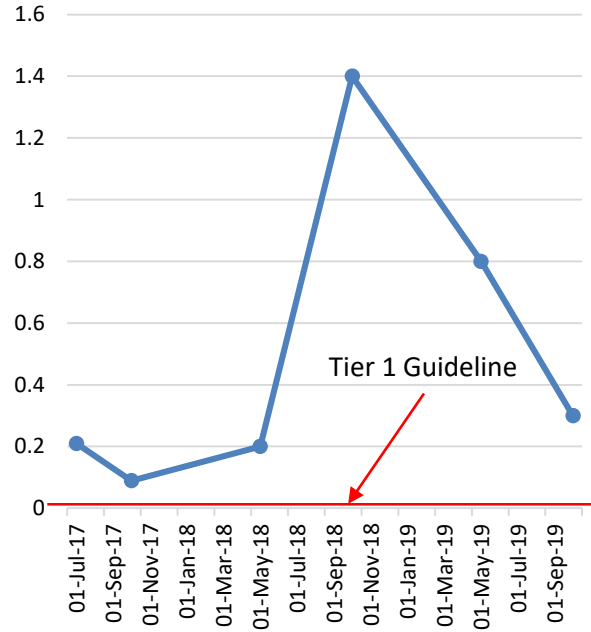


Bi-Annual Concentration Variability

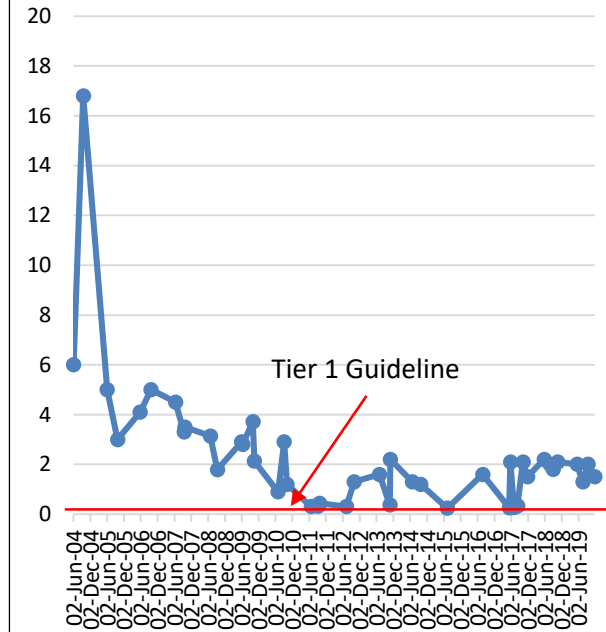
Concentrations in GW Near Source



Concentrations in GW in Damage Zone



Concentrations at Spring

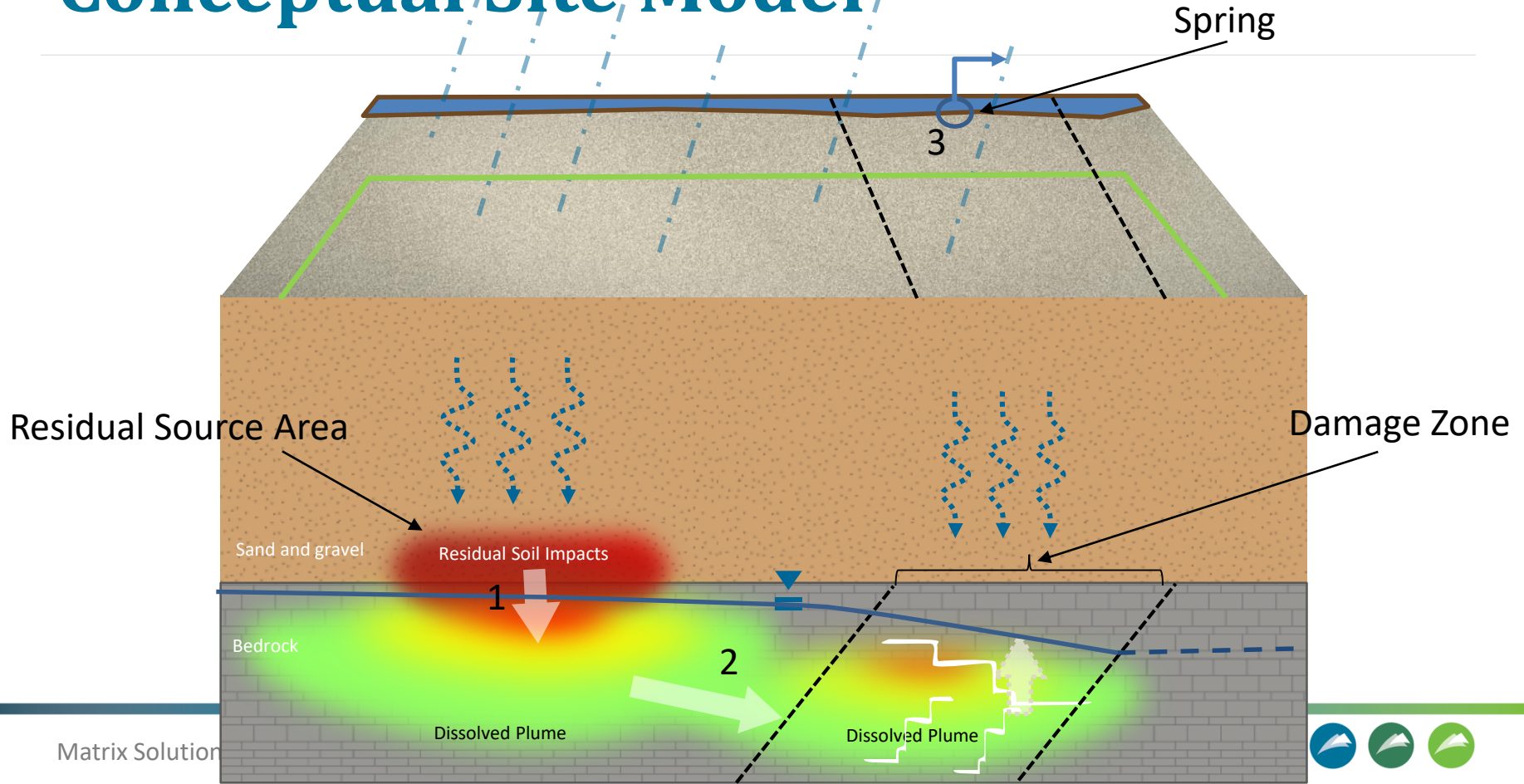


Objectives

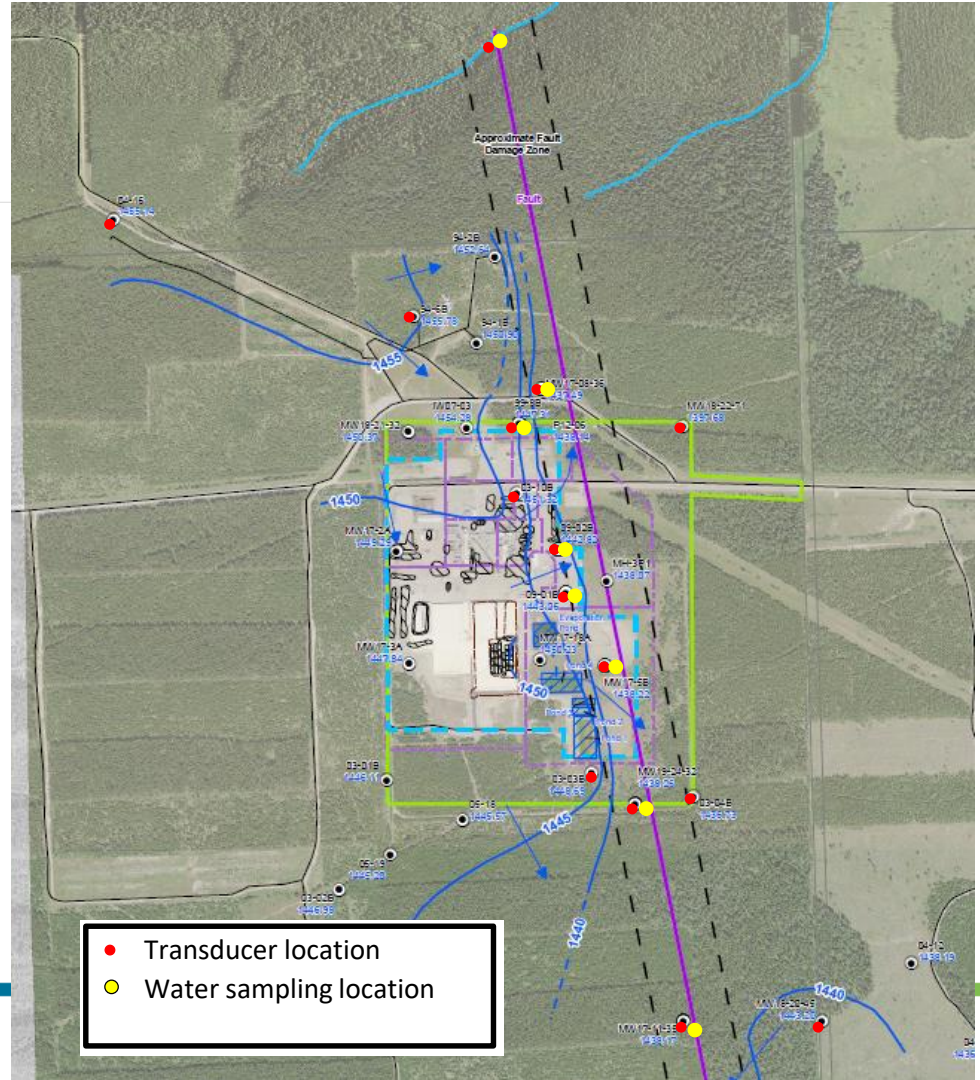
- Better characterize seasonal variability in plume dynamics and contaminant flux
- *In the Meantime and In Between Time*



Conceptual Site Model



- Continuous groundwater level monitoring
- High frequency water sampling
- Hydrometric monitoring in Creek and Spring

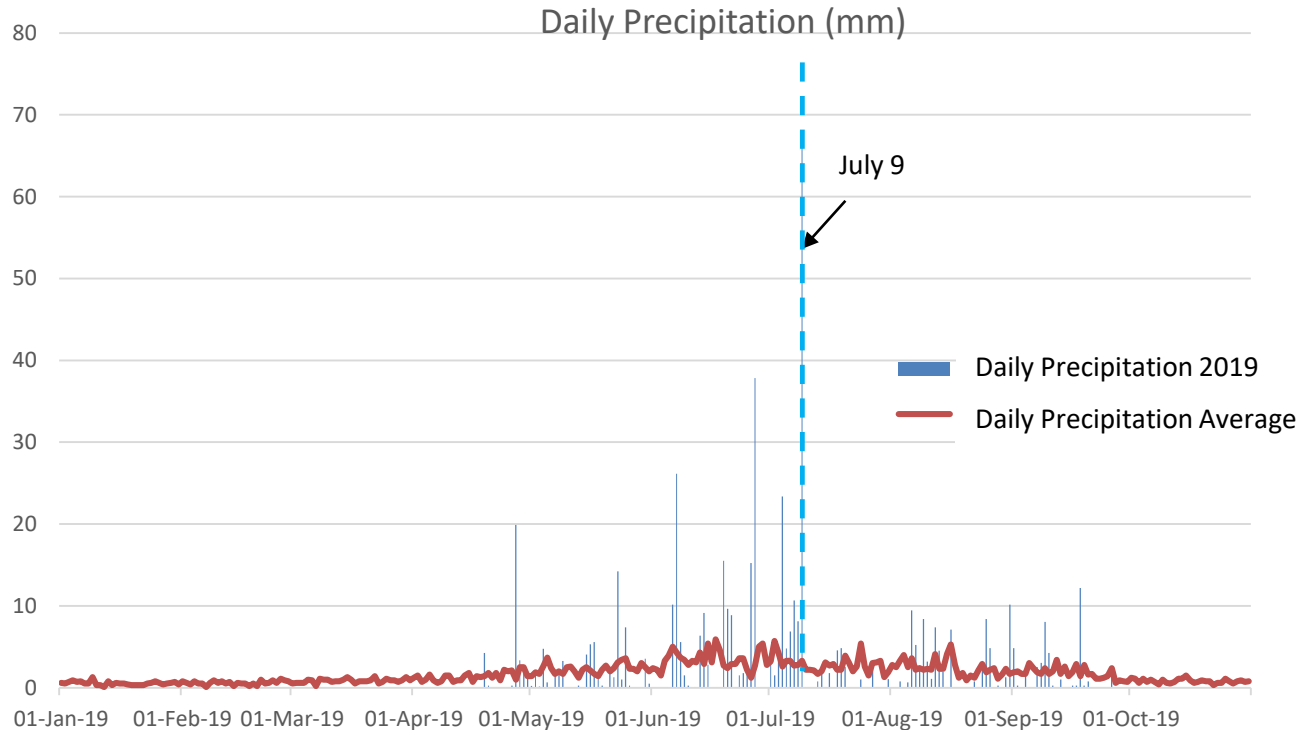


Results

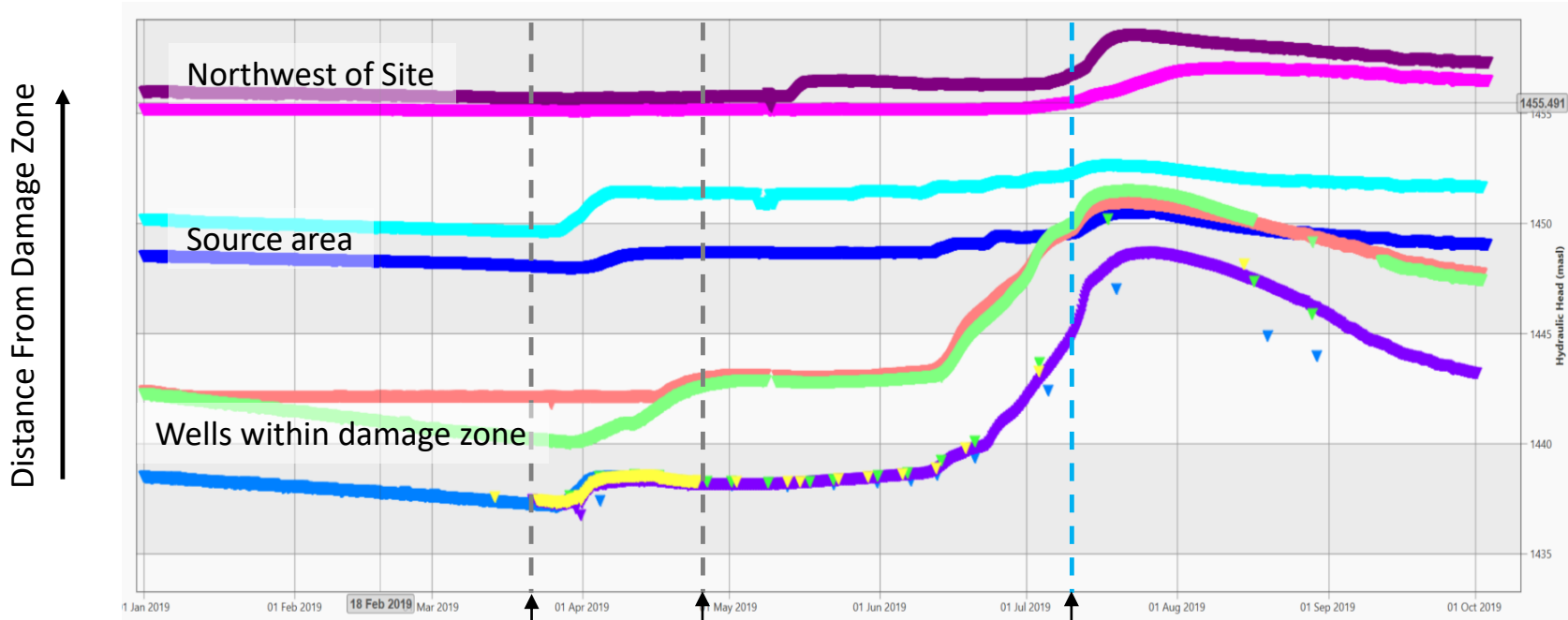
- Seasonal fluctuations in groundwater elevations
- Seasonal fluctuations in concentrations
- Conceptual Flux Model



Precipitation

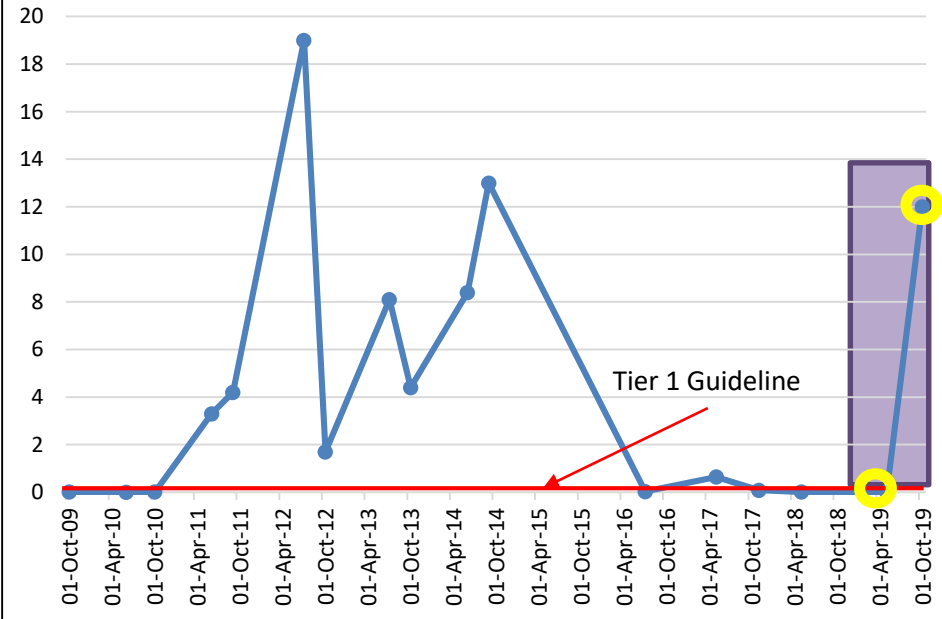


Groundwater Elevations

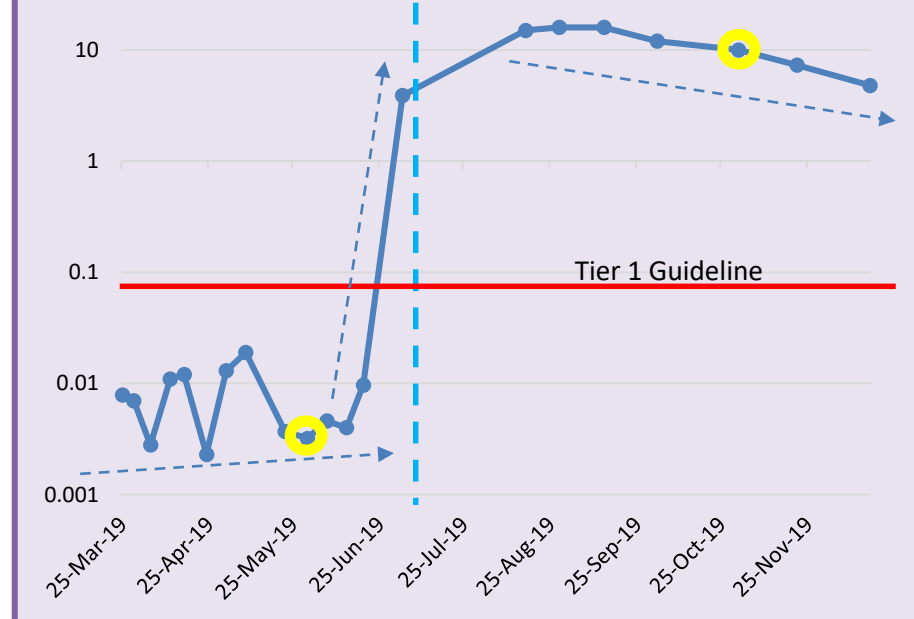


Groundwater Quality – Source Zone

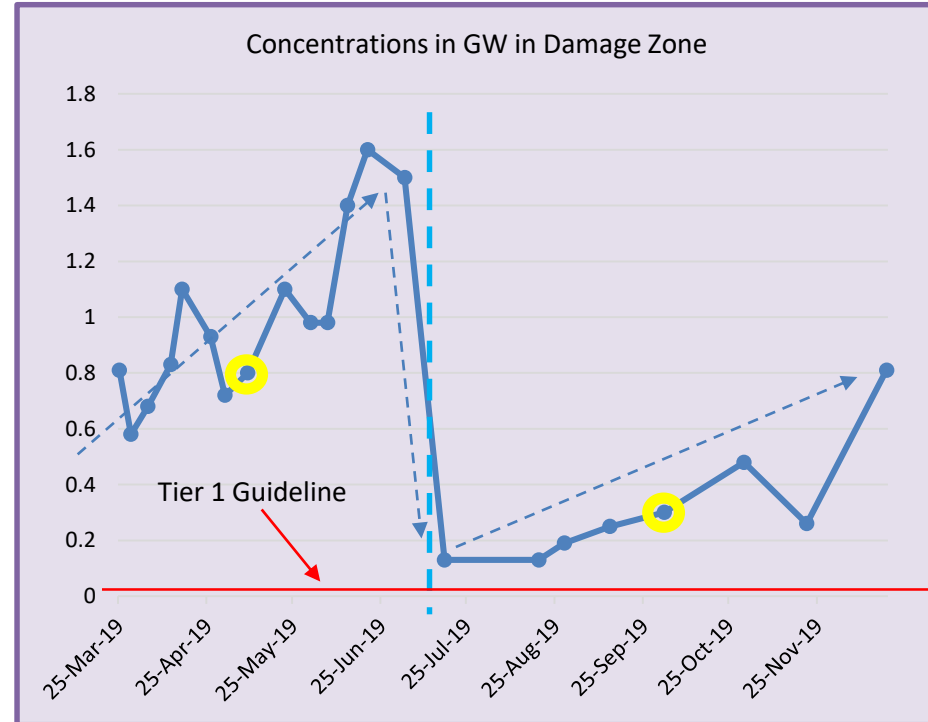
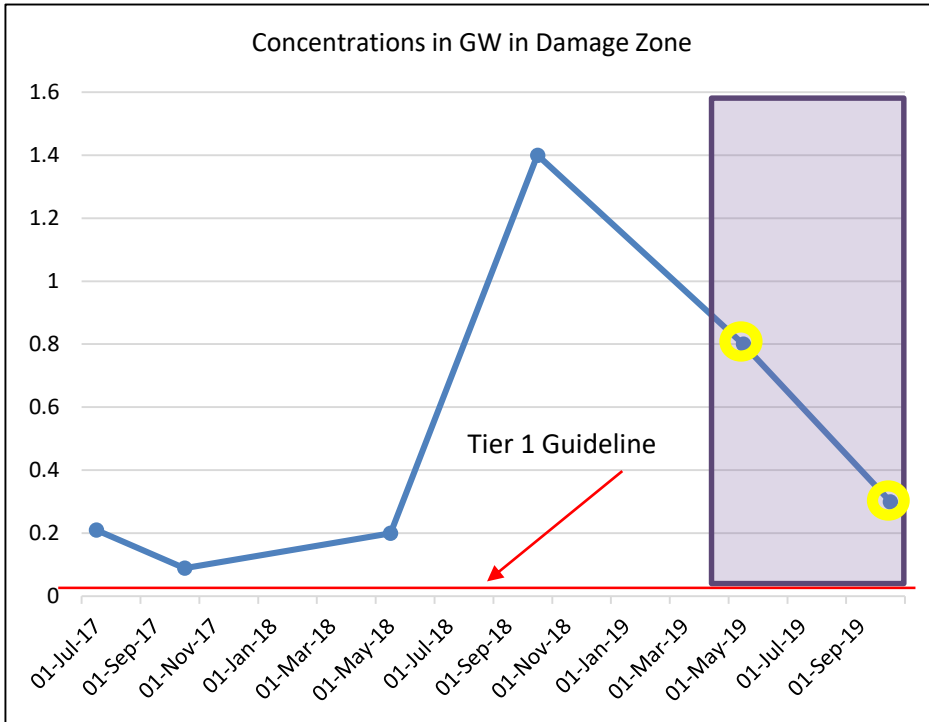
Contaminant Concentrations in Groundwater



Contaminant Concentrations in Groundwater

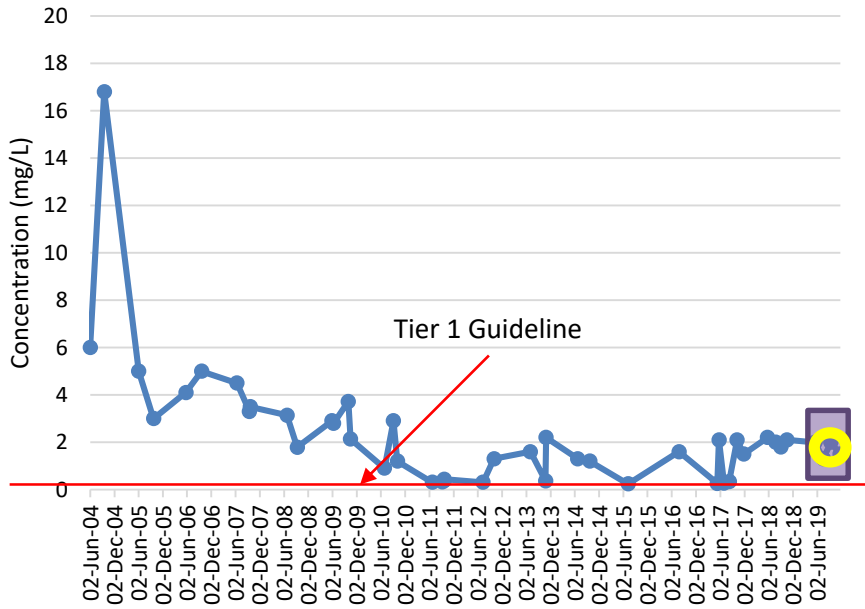


Groundwater Quality – Damage Zone



Water Quality - Spring

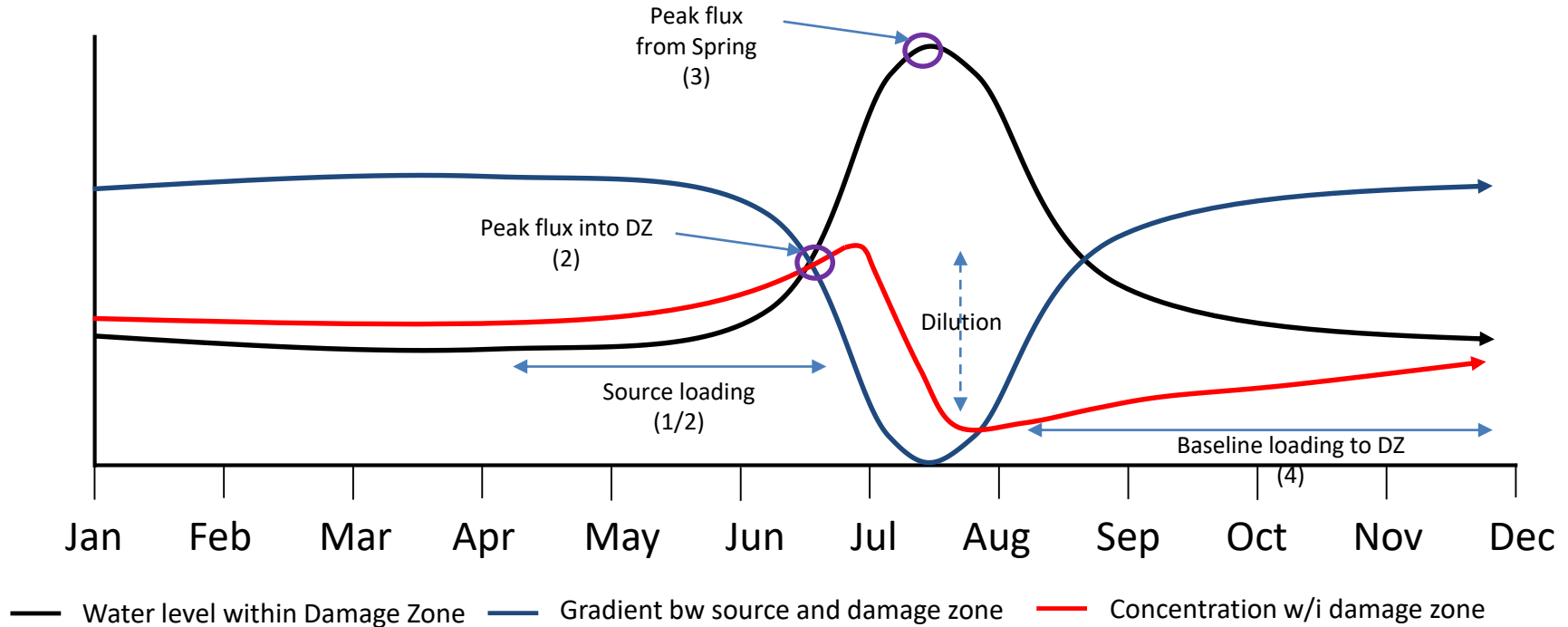
Contaminant Concentrations at Spring

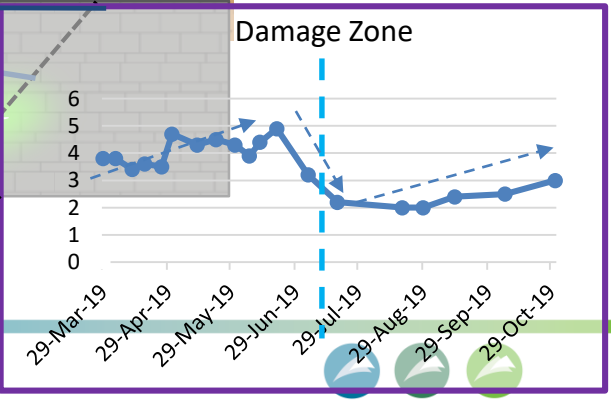
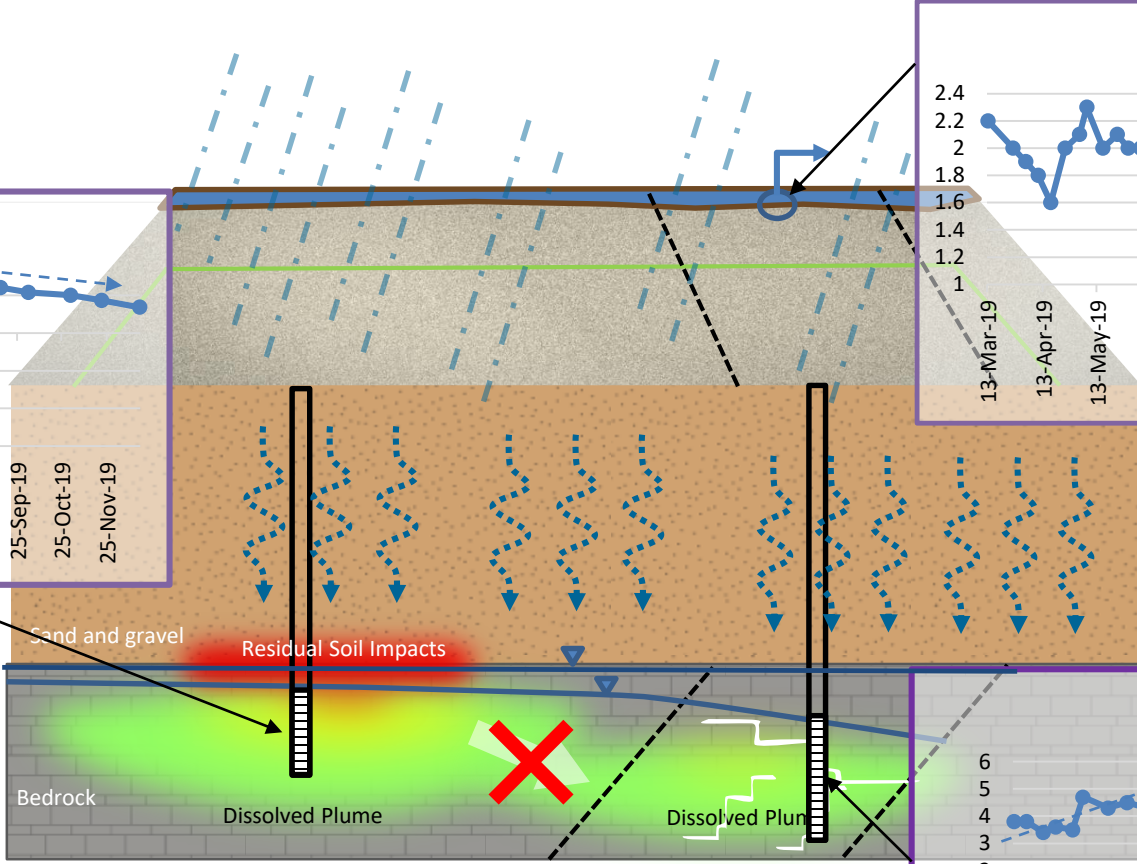
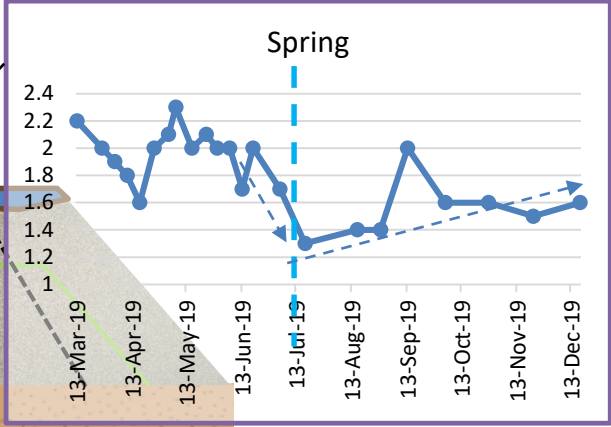
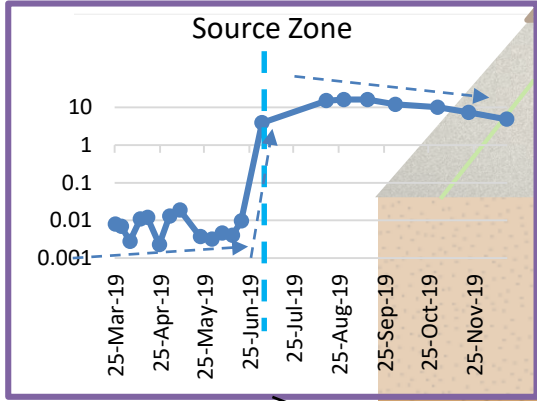


Contaminant Concentrations at Spring



Conceptual Flux Model





Why was this important?

- Helped to explain significant concentration changes in groundwater and springs.
- Allowed development of conceptual flux model to refine CSM
- Helps to inform risk management decisions (ex. more focused monitoring programs)



Conclusions

- Seasonal fluctuations can be significant, especially at complex sites
- Higher risk/complexity warrants higher level of characterization
- Higher frequency monitoring → More certainty in CSM → More certainty in risk management

