2026-02-04_Gasco: Dissolution Modeling

Meeting Title:	Gasco: Dissolution Modeling
Date/Time:	February 4, 2026 / 12:30 - 2:00 pm
Attendees:	AQ: Halah Voges, Ryan Barth, Mike Gefell, Matt Davis, Dave Estrella, Alireza Meyal EE: Rob Ede DEQ: Wes Thomas, Amber Lutey, Dan Hafley, Dave Lacey, Sarah VanGlubt GEI: Carissa Mason, Andy Adinolfi, Paul Jensen
Location:	MS Teams

Meeting Notes:

- AQ recaps the purpose of the evaluation. The DNAPL dissolution modeling was originally developed to determine the feasibility of restoring beneficial groundwater uses over reasonable timeframes. After DEQ reviewed the original evaluation as part of the draft Gasco OU FS, the purpose of the evaluation was expanded to identify whether more targeted DNAPL treatment could restore groundwater beneficial uses, or how far away from receptors (or compliance points) does DNAPL need to be treated to meet remedial goals at that point of compliance. The last time AQ/EE/DEQ/GEI met (October 8, 2025), DEQ and GEI were interested in identifying empirical DNAPL and groundwater data on the site that could be used to validate the model. Unfortunately, the DNAPL and groundwater datasets do not lend themselves to such an evaluation. DNAPL contours are estimated using inverse distance weighting. This technique is useful for most FS-level evaluations, but there is a high degree of uncertainty about the true lateral limits/extents of the DNAPL. In addition, monitoring well screens are not quite screened in the best intervals downgradient of isolated DNAPL observations. Based on those factors, AQ pivoted to perform the modeling evaluation on a water-bearing zone (WBZ)-basis to refine potential attenuation distances on a finer scale.

- AQ simulated the groundwater plumes downgradient of hypothetical DNAPL sources in each water bearing zone. The model inputs were adjusted to reflect the hydrogeologic differences between the WBZs, and also to reflect the nature of DNAPL within each WBZ (for example, effective solubility assumptions, DNAPL saturations). AQ simulated the no action alternative and an ISS alternative. The flow rates through the DNAPL zones were set to the groundwater predicted velocities for the no-action alternative. ISS flow rates were adjusted to simulate changes in groundwater velocities as a result of lowering hydraulic conductivity to 1×10^{-6} cm/s. DNAPL saturation and total porosity are not changed, so the total volume of water in the ISS zone doesn't change. the ISS prism were assumed to extend 10 feet beyond the DNAPL extent (so the ISS would include 10 feet of non-DNAPL soils downgradient of the DNAPL mass).

- AQ shared preliminary results for naphthalene for the Fill WBZ, Upper Alluvium WBZ, and Lower Alluvium WBZs. AQ notes that the results for the Fill WBZ and Upper Alluvium WBZ are similar. The model for those two WBZs are different for certain parameters, like DNAPL saturation. But the resulting change in relative permeability and slightly different groundwater velocities offset the effect of different DNAPL saturations.

- AQ notes that the model evaluations were also performed for benzene, but that in all cases, naphthalene attenuation distances were larger than benzene. Preliminary results and select input parameters are summarized below:

Water Bearing Zone	DNAPL Saturation (%)	Effective Solubility (ppm)	Groundwater Velocity (ft/d)	Alternative	Distance to CUL (ft)	Flow Rate through NAPL zone (gpm)
Fill	16	5.6	0.27	No Action	221	1.81
Fill	16	5.6	0.27	ISS	1	<0.01
Upper Alluvium	9	6.2	0.18	No Action	196	1.13
Upper Alluvium	9	6.2	0.18	ISS	3	<0.01
Lower Alluvium	16	12	1.2	No Action	>700	8.03
Lower Alluvium	16	12	1.2	ISS	187	0.01

- AQ interprets the results to mean that if DNAPL 200 feet from the riverbank were treated with ISS in the Fill or Upper Alluvium WBZs, then the DNAPL further away should not result in naphthalene cleanup level exceedances in monitoring wells along the top of the riverbank.

- AQ provides the following clarifications based on DEQ questions:
  - The modeled attenuation distances include anaerobic degradation. Anaerobic degradation rates were selected based on the reducing conditions observed in groundwater along the shoreline. The model assumes that biodegradation occurs in the aqueous phase within the NAPL body, and that no biodegradation occurs within the ISS monolith.
  - The model includes hydrogeological properties like diffusion and dispersion.
  - The model assumes DNAPL saturations based on the 'average' DNAPL saturation for each water-bearing zone. The model is not highly sensitive to DNAPL saturation, but the DNAPL saturation assumptions have an effect on other input parameters. As DNAPL saturation increases, the relative permeability of the matrix decreases (because DNAPL is taking up a higher proportion of available pore space). Therefore, at higher DNAPL saturations, advective flux decreases. Conversely, at lower DNAPL saturations, advective flux increases. The attenuation distances increase or decrease relative to increase or decreases in advective flux. In practice, the plume becomes slightly longer at lower DNAPL saturations.
  - The results of the model represent steady-state (or close to steady-state) such that longer model runs would not increase the length of the plumes.
  - Fill WBZ parameters were established using average conditions. For groundwater velocity, which is the most sensitive parameter, assumed values were taken from the groundwater model predicted velocities along the riverbank.
  - The model is most sensitive to groundwater velocities. The Fill WBZ and Upper Alluvium WBZ have similar velocities and similar attenuation distances.

- GEI notes that the model assumes a uniform DNAPL distribution across the full thickness of WBZs. GEI suggests looking at a distribution of conditions (for example, discs of DNAPL at varying saturations stacked on top of each other). That would simulate preferential pathways in discs with lower DNAPL saturations. GEI also asks if there are available literature studies or controlled experiments that empirically show attenuation distances downgradient of MGP DNAPL that could be cross referenced?
  - AQ will consider those suggestions.

- AQ describes the differences in the results for the Lower Alluvium WBZ compared to the Fill and Upper Alluvium WBZs. The attenuation distances for the Lower Alluvium WBZ are much larger. AQ points out that these differences in the results are primarily a result of groundwater velocities (the Lower Alluvium WBZ has much higher groundwater velocities). Other differences include a much higher effective solubility (about double). The combination of increased groundwater velocity and increased effective solubility results in a much higher mass flux from the DNAPL zone. AQ provides the following clarifications based on DEQ questions:
  - Groundwater velocities are based on predicted velocities using the groundwater model in the zone along the riverbank. That zone includes the tar ponds are and a little bit of the Siltronic GSA. The model layers that correspond with the Lower Alluvium WBZ are 6, 7, and 8. The DNAPL dissolution model uses the highest steady state velocity for those three layers. AQ believes this is a conservative approach.

- DEQ questions whether the limited effective solubility data (only one sample from MW-PW-2L) is adequately representative.
  - AQ notes that it is the only result available, and the number of Lower Alluvium WBZ wells with DNAPL entry are limited.

- DEQ compares the DNAPL model results for the Lower Alluvium WBZ to an example on the Siltronic GSA. Potentially mobile DNAPL was observed in WS-15-140 in both the 75 to 100 feet below the base of the Fill WBZ interval and the 100 to 125 feet below the base of the Fill WBZ interval. The WS-24 well cluster comprises three angled wells projected under the Fab 1 building with screen intervals beginning at 111 feet bgs, 126 feet bgs, and 155 feet bgs. These wells would be approximately 300 feet downgradient of the DNAPL at WS-15-140. Naphthalene at all three of the WS-24 wells screened in the Lower Alluvium WBZ is below the cleanup level of 12 µg/L. These results suggest that the model may overestimate the attenuation distance for naphthalene.
  - AQ responds that vertical and horizontal dispersity is small, and it is possible that the naphthalene plume is not captured by the well screens.

- DEQ acknowledges the response, but points out that with three screened intervals in the Lower Alluvium, we would expect to at least see some indication of a naphthalene plume.
- EE/AQ will consider that feedback.