Groundwater Flow & Contaminant Transport: Preliminary Evaluation of the Polycyclic Aromatic Hydrocarbon (PAH) Detections at the Aiea 2 Well

Fuel Tank Advisory Committee Meeting
October 9, 2024

Regulatory Process to Investigate PAH Detections

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of compounds produced by the incomplete combustion of organic materials. Scientists commonly link PAHs to a source based on molecular weight.

The detection of PAHs in public drinking water wells is of significant concern. Regulators make decisions after completing an investigatory process to determine the root cause of detections like these. What follows is a summary of our preliminary investigation.

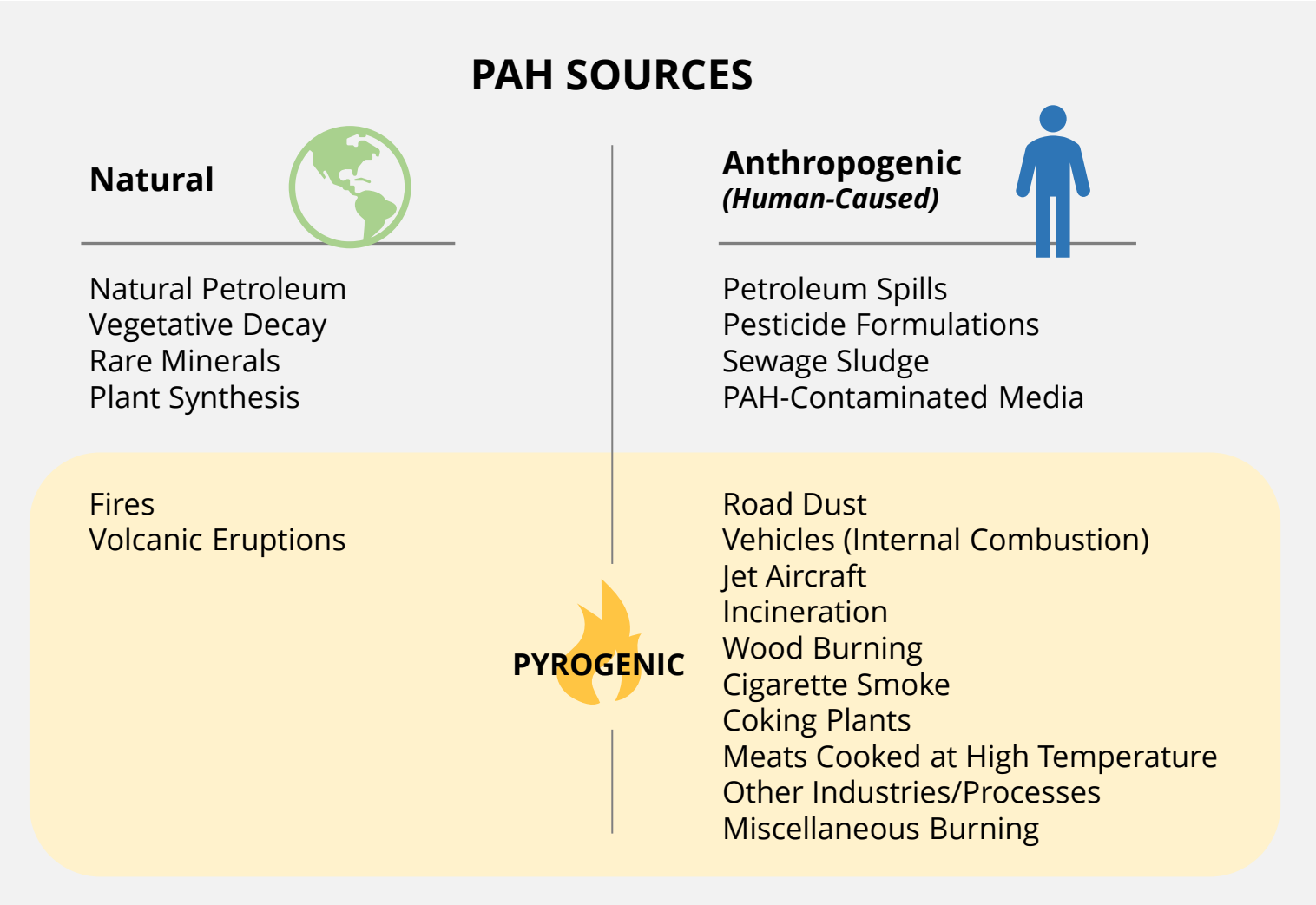
Guiding Question: Is contamination at Red Hill the source of the PAHs observed in the Aiea 2 Well?

Regulators examine several factors to determine the source of PAH detections:

1. Data collected in Red Hill and area wells
2. Molecular weight of detected PAHs
3. Concentration of detected PAHs
4. Plume characteristics

Differences in these factors can help evaluate whether the PAH source is nearby or some distance away.

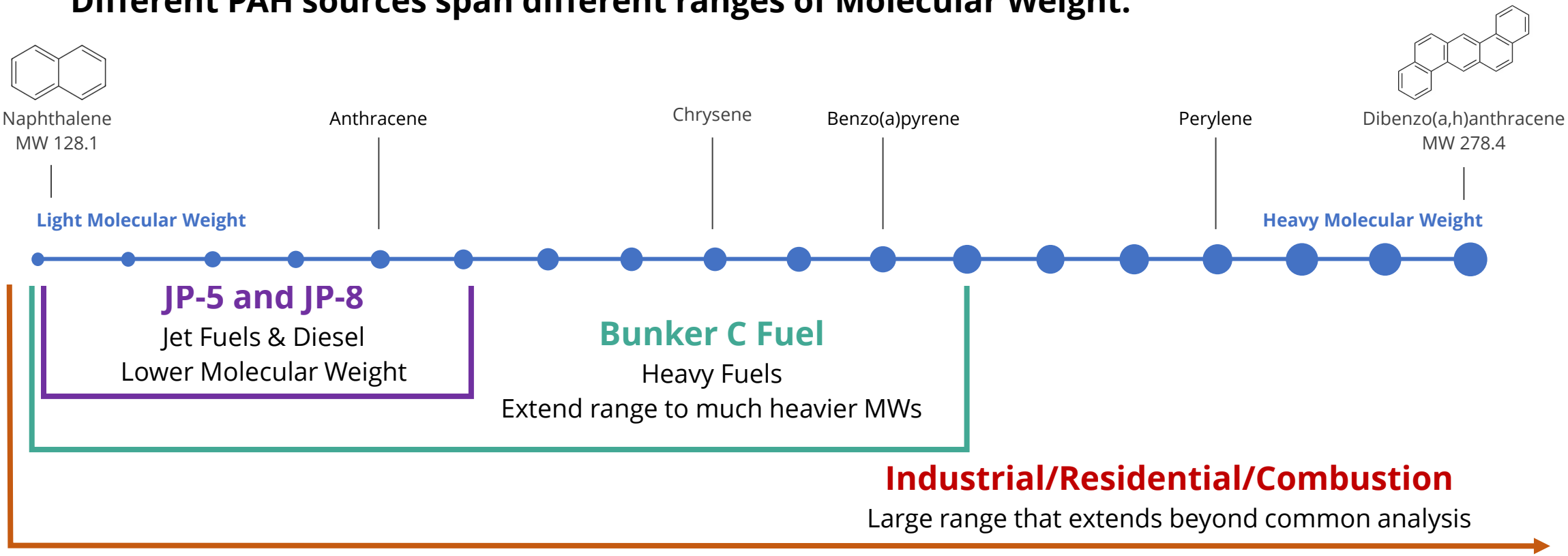
There Are Many Sources of PAHs



- Petrogenic – Product of fuel dissolution
- Pyrogenic – Product of incomplete combustion, such as car exhaust, incinerator smoke, cigarette smoke, etc.
- Many PAHs attach strongly to particles such as stream sediments

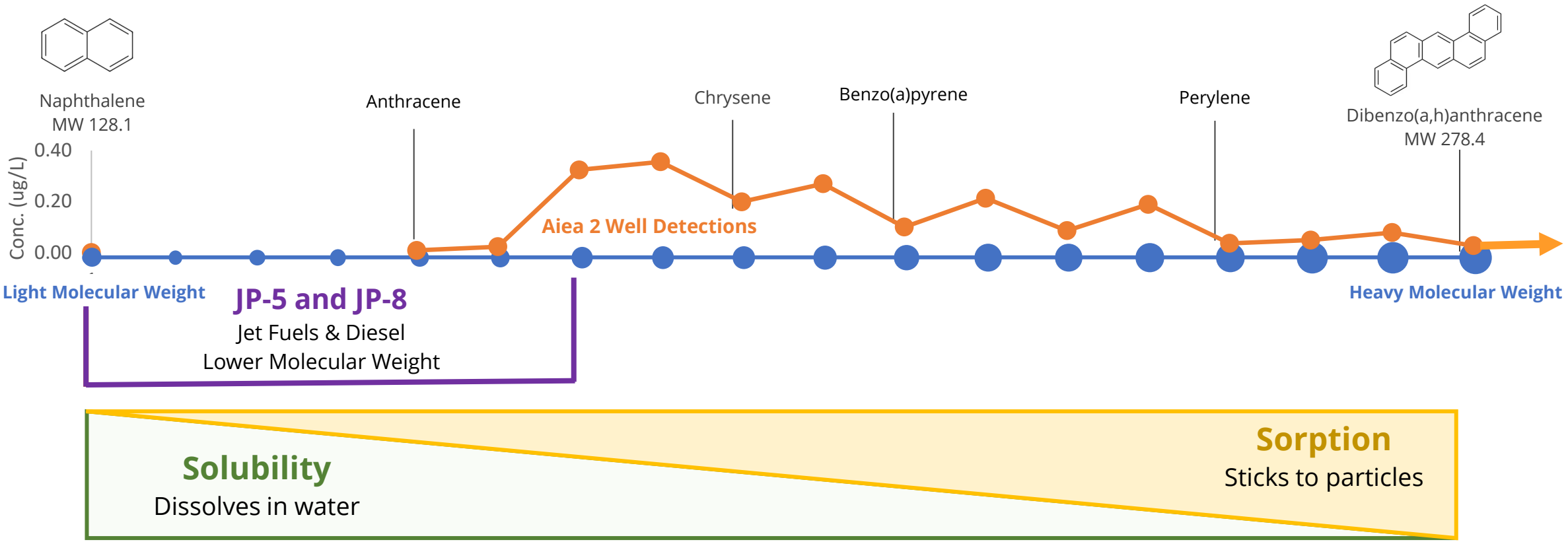
PAHs Are Classified by Molecular Weight

Different PAH sources span different ranges of Molecular Weight.

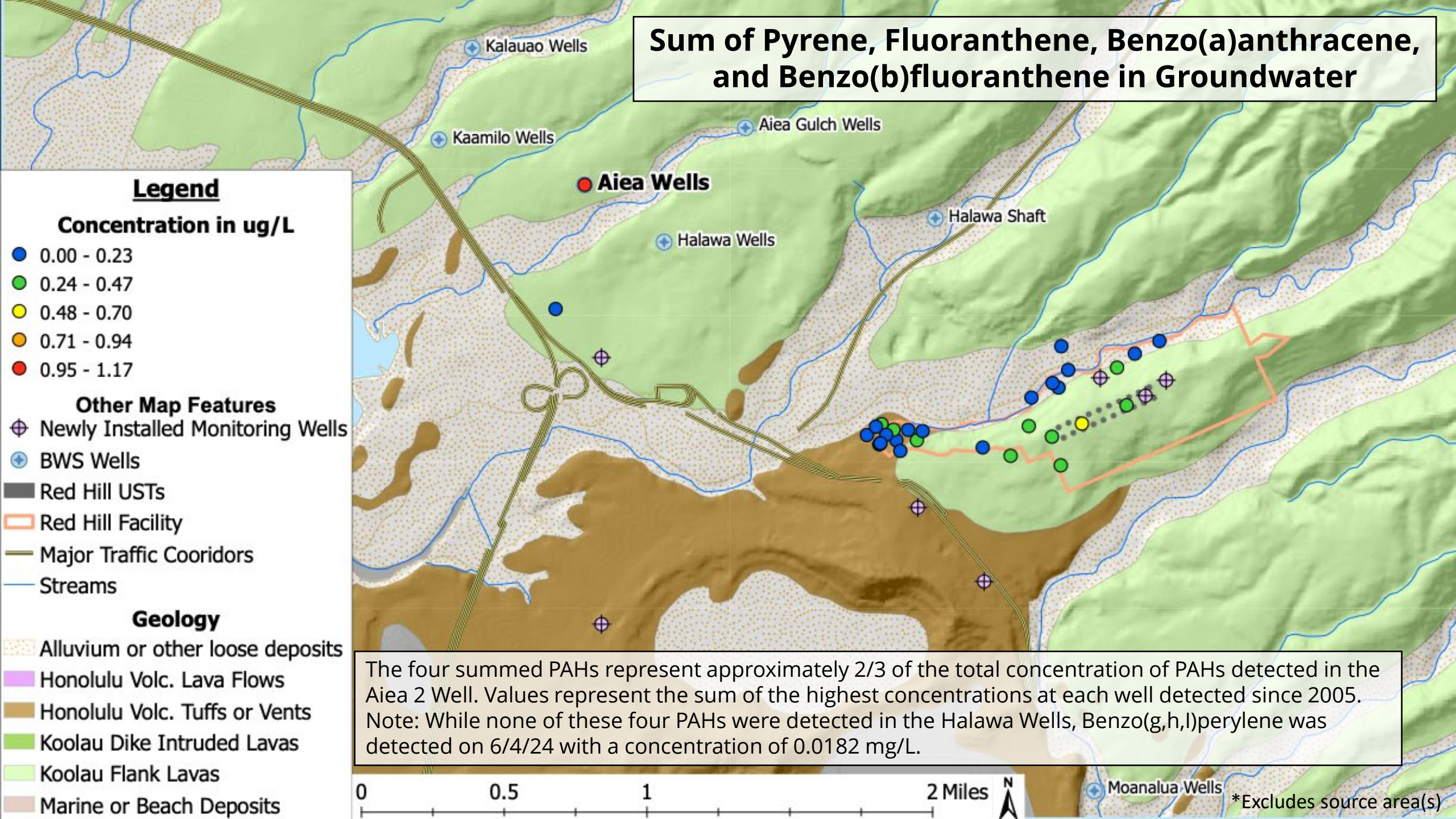


PAHs Are Classified by Molecular Weight

As Molecular Weight increases, solubility decreases, and PAHs are more likely to stick to soil.

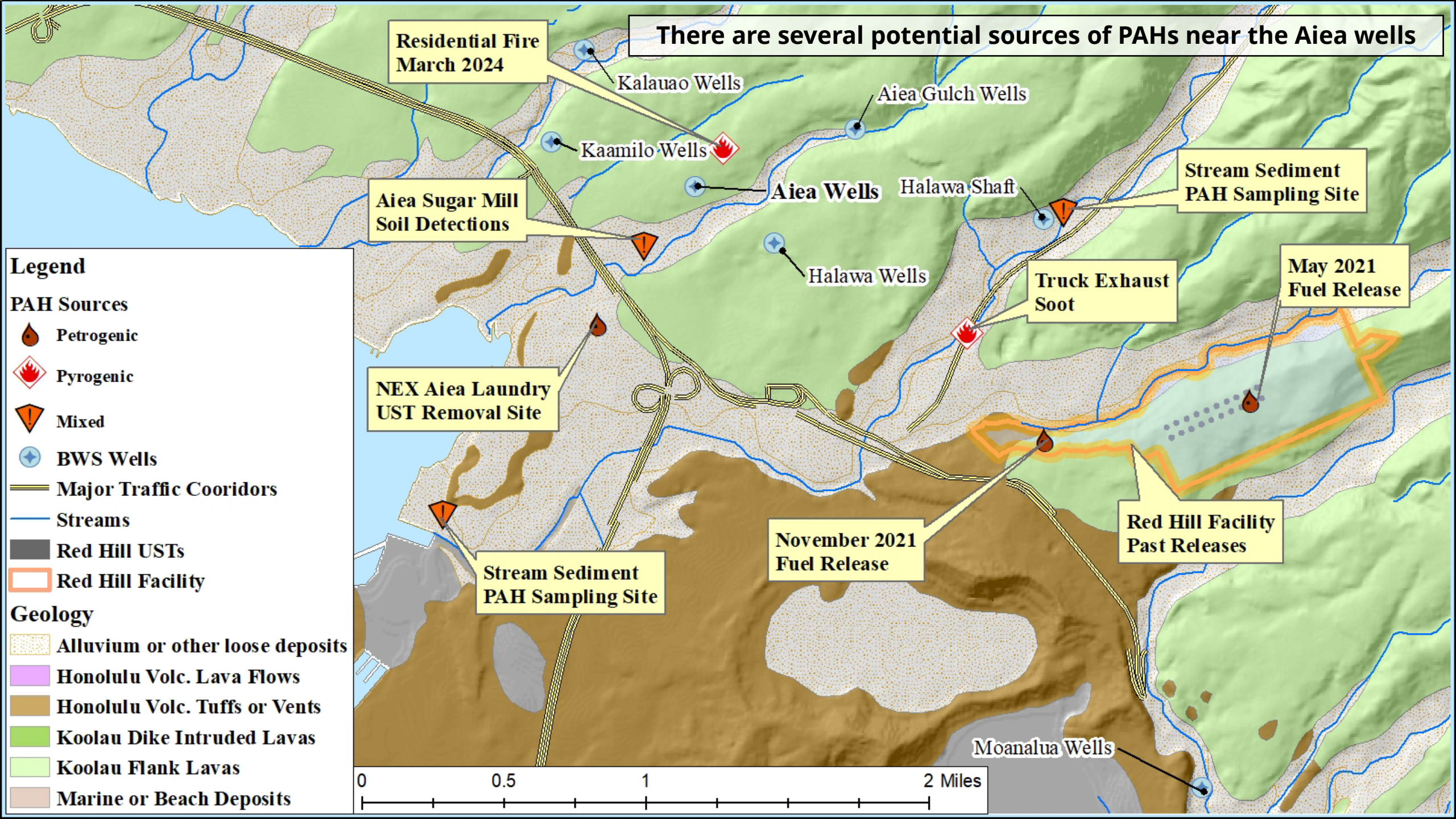


Sum of Pyrene, Fluoranthene, Benzo(a)anthracene, and Benzo(b)fluoranthene in Groundwater



The four summed PAHs represent approximately 2/3 of the total concentration of PAHs detected in the Aiea 2 Well. Values represent the sum of the highest concentrations at each well detected since 2005. Note: While none of these four PAHs were detected in the Halawa Wells, Benzo(g,h,I)perylene was detected on 6/4/24 with a concentration of 0.0182 mg/L.

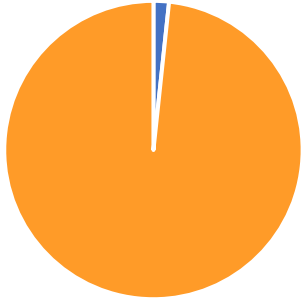
*Excludes source area(s)


There are several potential sources of PAHs near the Aiea wells
Residential Fire March 2024
Kalauao Wells
Aiea Gulch Wells
Kaamilo Wells
Aiea Wells
Halawa Shaft
Stream Sediment PAH Sampling Site
Aiea Sugar Mill Soil Detections
Halawa Wells
Truck Exhaust Soot
May 2021 Fuel Release
NEX Aiea Laundry UST Removal Site
November 2021 Fuel Release
Red Hill Facility Past Releases
Stream Sediment PAH Sampling Site
Moanalua Wells
Legend
PAH Sources
Petrogenic
Pyrogenic
Mixed
BWS Wells
Major Traffic Cooridors
Streams
Red Hill USTs
Red Hill Facility
Geology
Alluvium or other loose deposits
Honolulu Volc. Lava Flows
Honolulu Volc. Tuffs or Vents
Koolau Dike Intruded Lavas
Koolau Flank Lavas
Marine or Beach Deposits
0
0.5
1
2 Miles

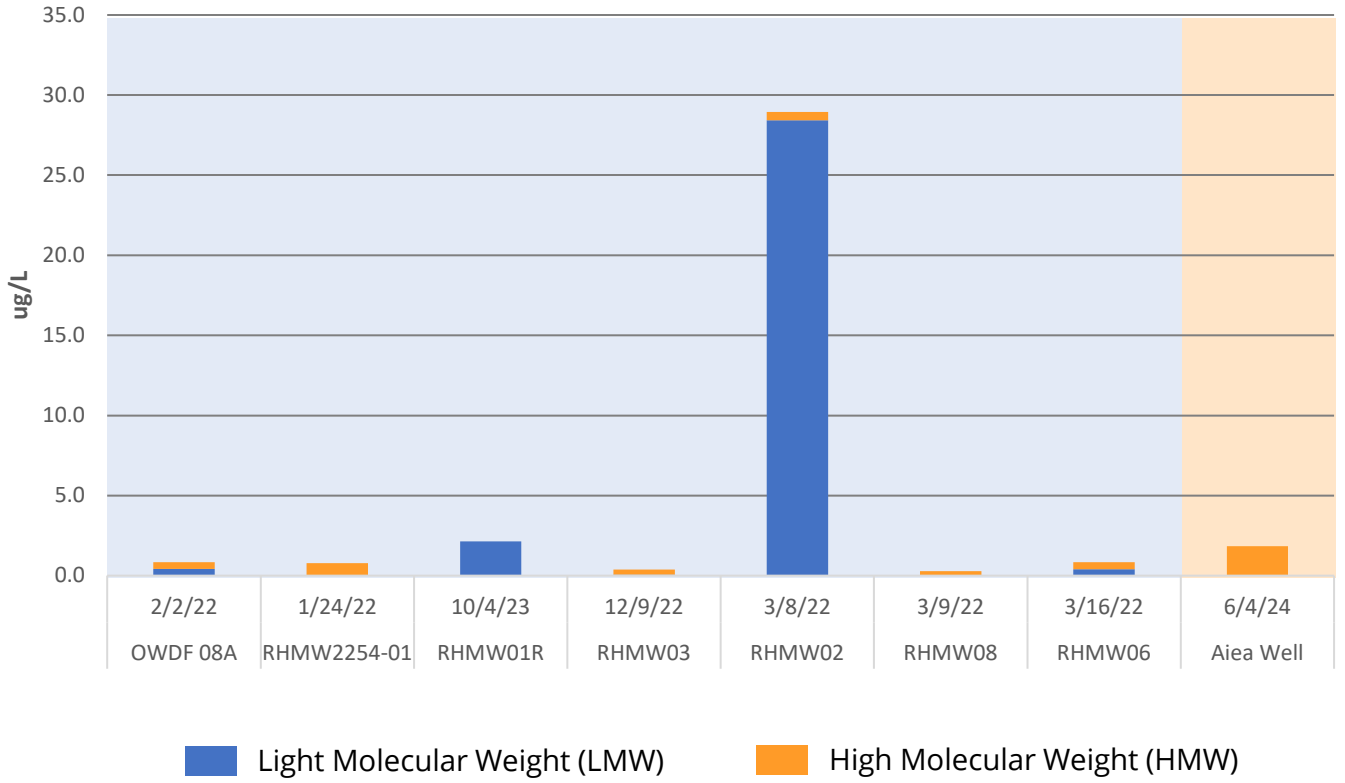
The PAHs found at Red Hill are typically different from the PAHs found in the Aiea Well.

RH Wells Average PAH Percentage

Aiea Wells Average PAH Percentage



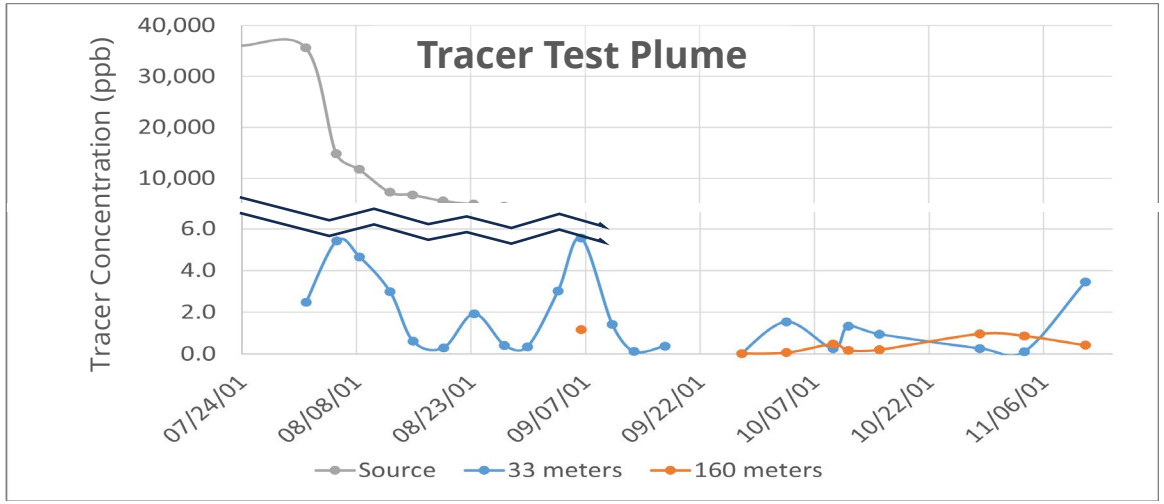
Highest Total PAHs Concentration Detected at Each Monitoring Well



Characteristics of a Plume in the Groundwater

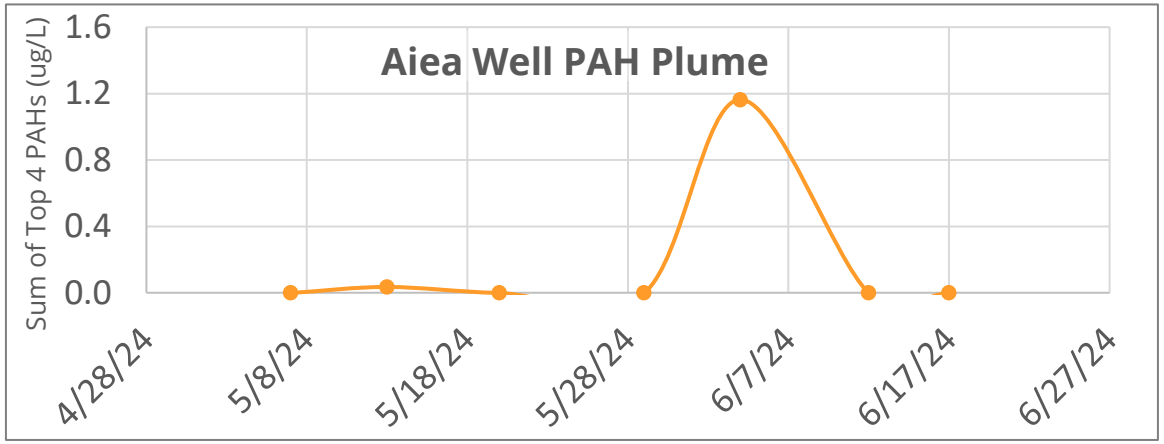
Tracer Test Conducted in Central O‘ahu

- ~ 12,000 gallons of dye injected over a period of 3.5 days
- Concentrations drop dramatically as distance from the source increases.
- The shape of the trace becomes smoother, that is less spikey
- Plume persisted for months



Aiea Well PAH Detections

- Plume is “spikey” and short
- Plume characteristics more consistent with nearby source
- Concentrations of several PAHs were greater than those measured in the Red Hill monitoring Wells indicating a nearby source other than Red Hill.



Indications PAHs Originated from an Alternative Source

1. **To date, Aiea Well petroleum related detections have consisted only of PAHs.** There have been no detections of other expected petroleum constituents.
2. **BWS Aiea Wells have been shut off since 2021**, decreasing the dilution effect of water drawn from upslope thereby increasing the relative impact of local contamination sources.
3. **There are several nearby sources of PAHs:**
    1. Former Aiea Sugar Mill (quarter mile SE of BWS Aiea Wells)
    2. Surface runoff from roads and parking areas
    3. Structure fires
    4. Inadvertent sampling error
4. **Sustained rainfall and recharge before detections,** will move nearby surface contamination downward into the aquifer.
5. **Only a minor PAH detection at the Halawa Well Field located between Aiea Wells and Red Hill** – The detection at the Halawa Well Field occurred after the first detection at the Aiea Wells and was very minor, not supporting the contention of a plume moving from Red Hill to Aiea.
6. **Groundwater Flow Direction** – is not well defined and is being investigated by the University of Hawaii. However, the groundwater model results used to support the hypothesis of a plume moving from Red Hill to the Aiea Wells and bypassing the Halawa Well Field have been rejected by the Regulators and BWS.

Summary

It is unlikely to reasonably believe that Red Hill was the source of the detected PAHs.

- The Aiea detections are more consistent with urban/industrial activities and/or combustion sources.
- The characteristics of the Aiea detections are inconsistent with long-distance travel from Red Hill.
- No expected petroleum related compounds other than PAHs have been detected in the Aiea Wells.