Partitioning of Residual Crude Oil between Groundwater and Soils in a Shallow Coastal Environment

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Water Sciences & Insights

Overview of Site and Objectives

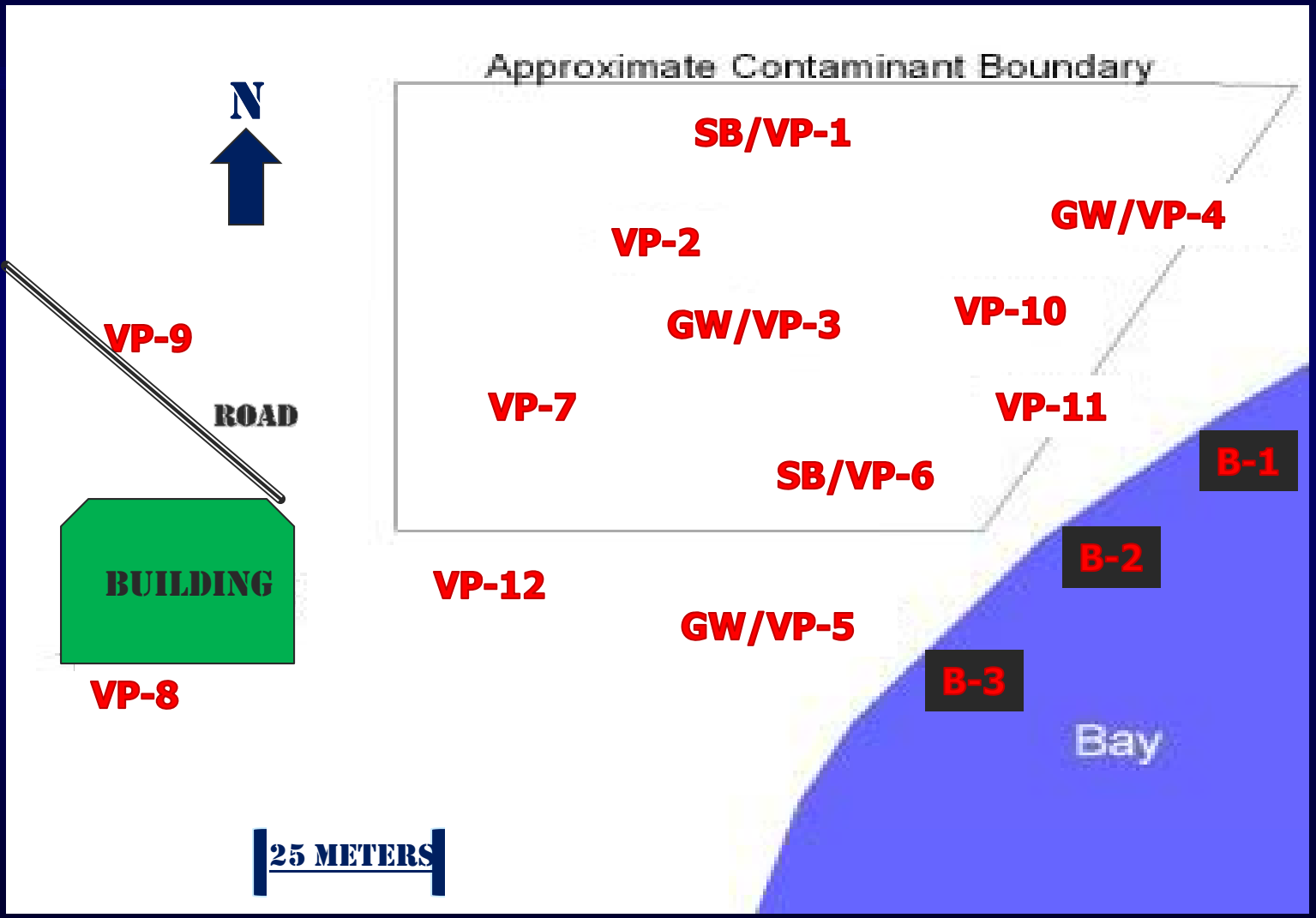
- Oil in shallow soils associated with storage, spillage, and fill (~40 years ago)
- Groundwater at <3 meters deep; hydraulic connection to coastal lagoon waters
- Soils consist of sands and finer-grained fill
- Concerns regarding HC transport to above-ground air and nearby lagoon waters

Bay View from Contaminated Area

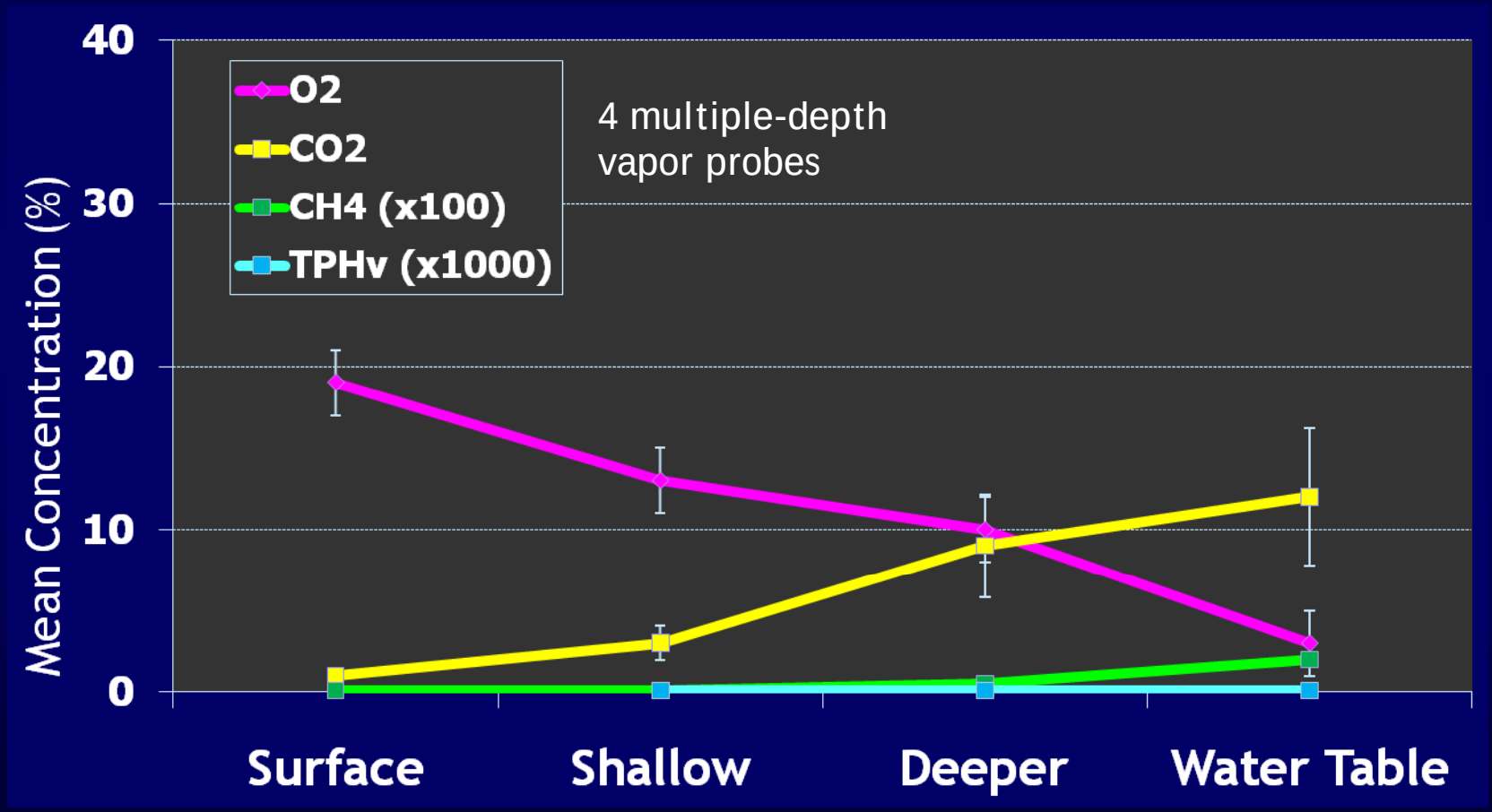
Nuances of Site Dynamics

- Groundwater influenced by recharge from tidal cycle (12 to 18 g/L TDS)
- Net groundwater flow is toward lagoon
- Fill soils contain elevated organics (former dredge spoils and perhaps fuel wastes)
- Occasional reports of hydrogen sulfide odor by workers in adjacent buildings

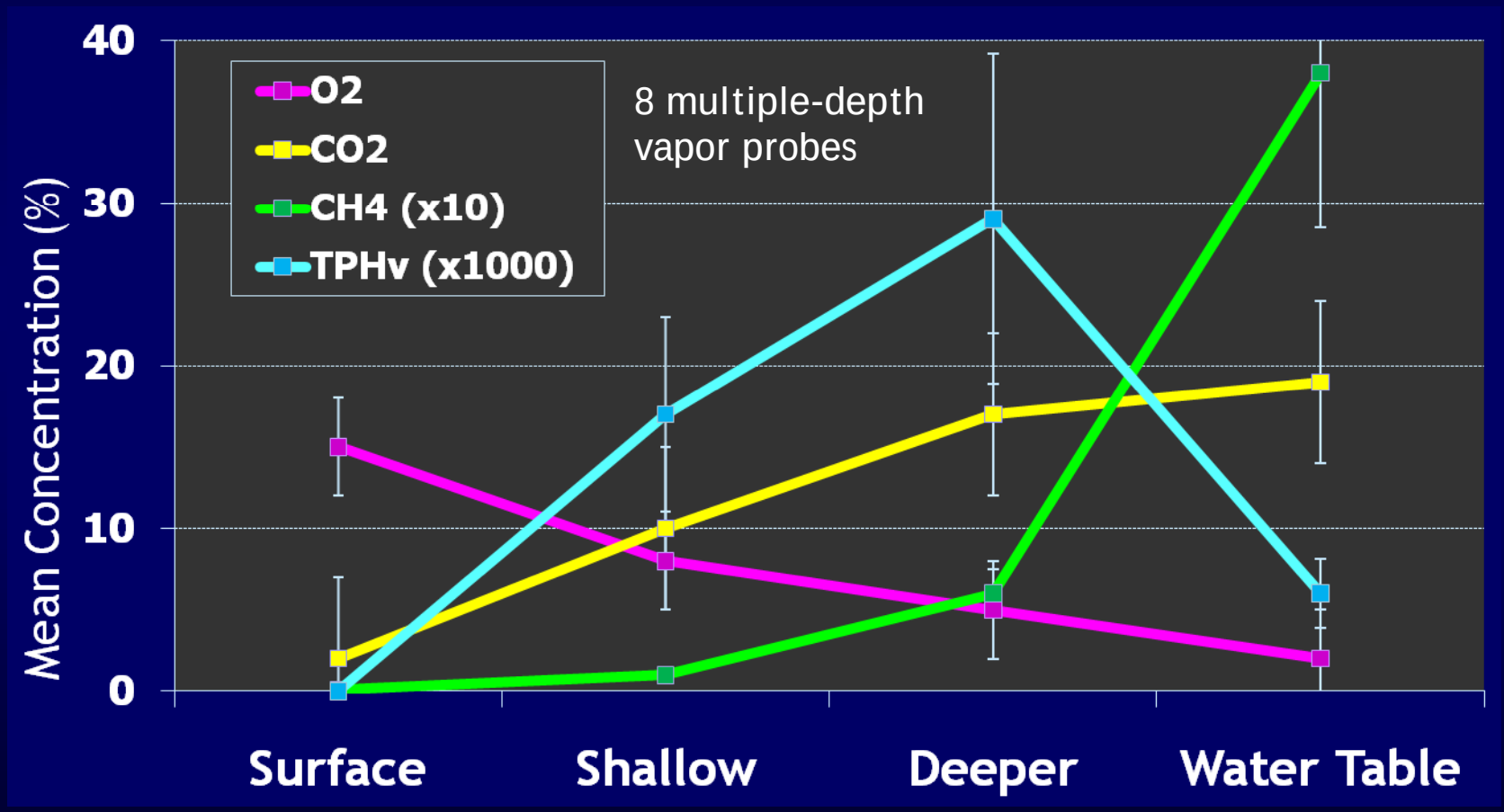
Site Schematic



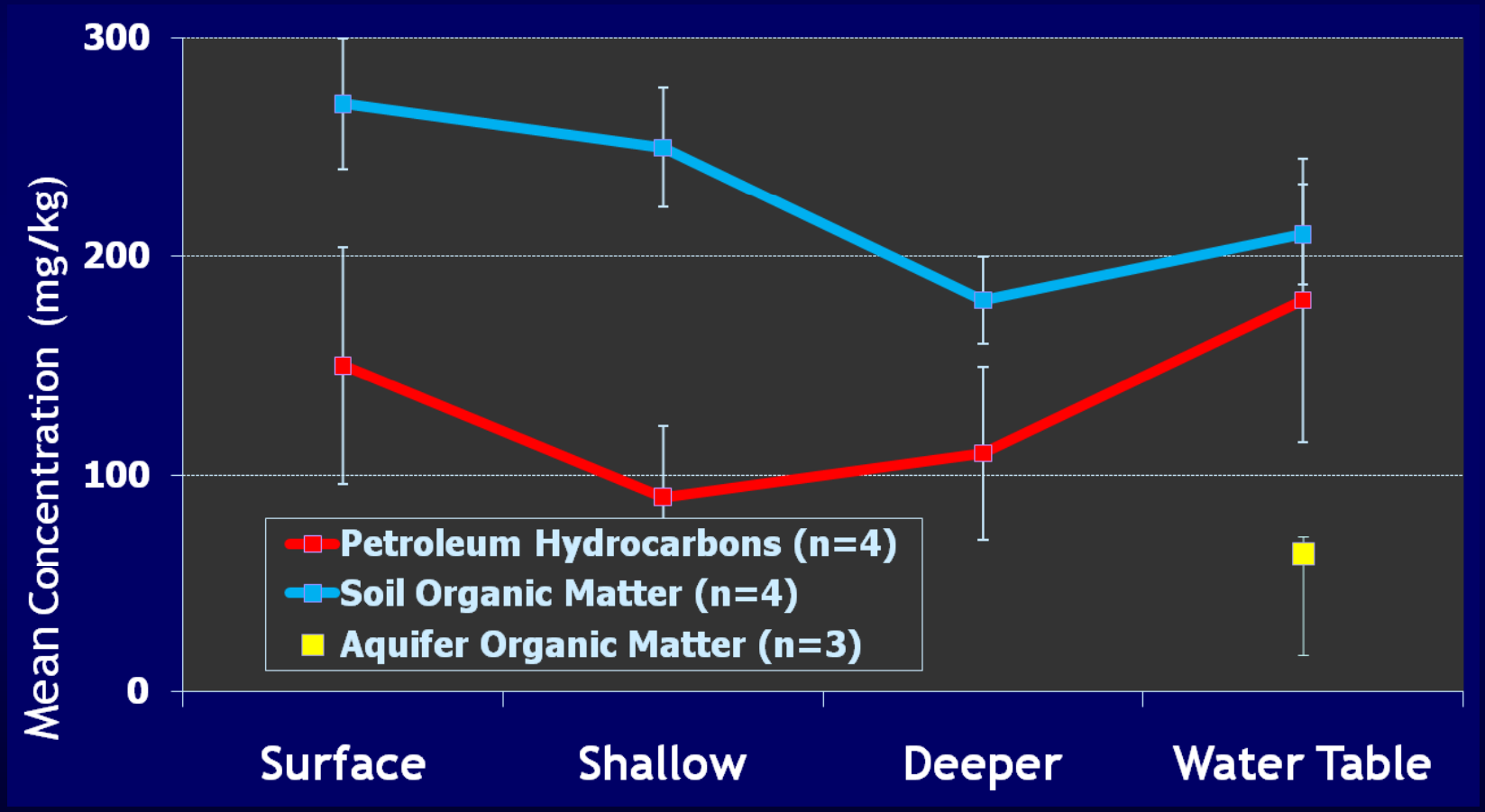
Light TPH and Fixed/Biogenic Gases in Background Soils



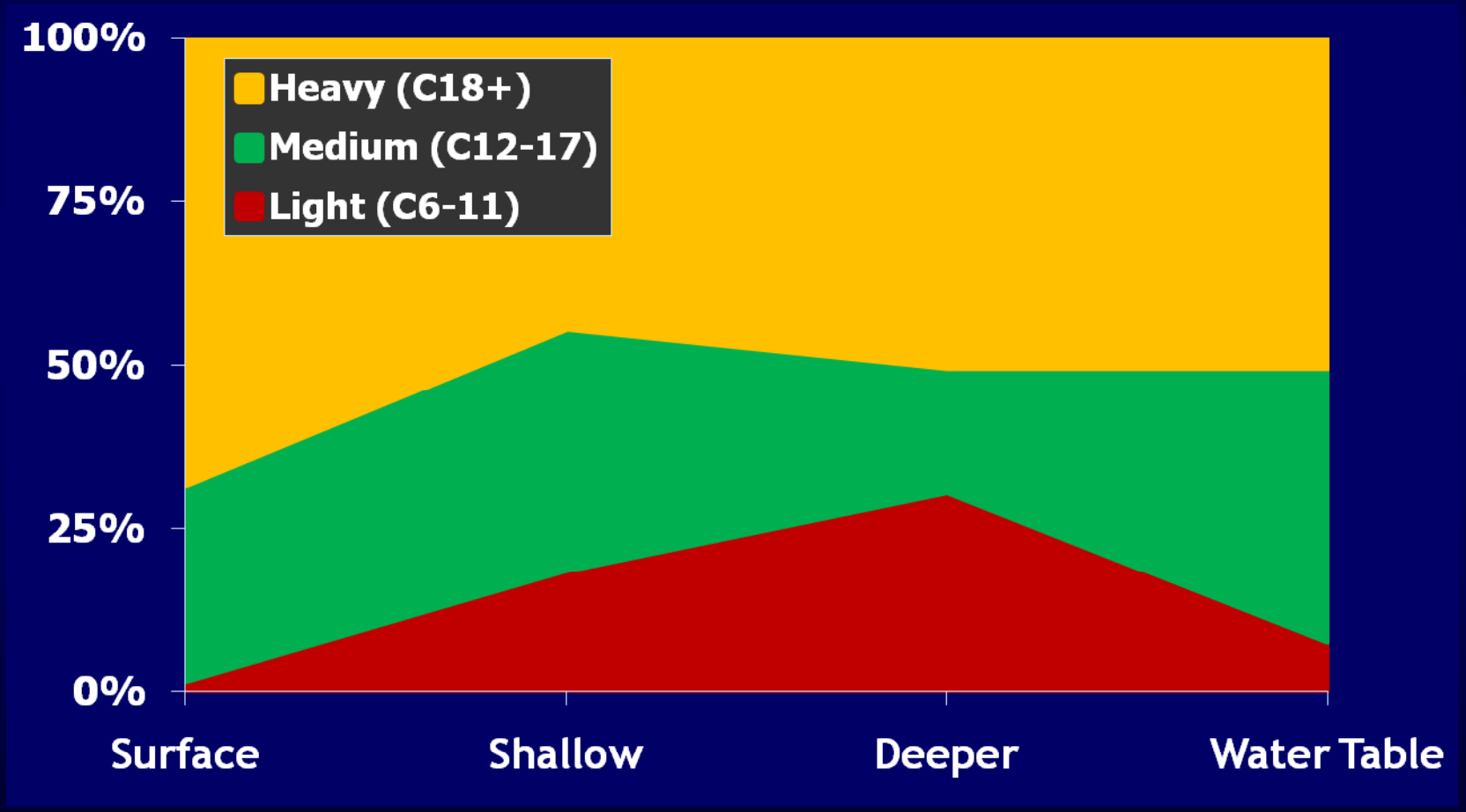
Light TPH and Fixed/Biogenic Gases in Contaminated Soils



TPH and TOC Concentration Profiles in Contaminated Soils



Relative Hydrocarbon Composition in Contaminated Soils



TPH and TOC Concentration Profiles in Contaminated Soils

Compound	Diffusive Flux ($gC/m^2/year$) at Surface	Pore Water (µg/L) Concentration from 3 Aquifer Wells	Seawater (µg/L) Concentration in Discharge Zone
Methane	10-50 (redox potential)	500-5,000 (interface) 50-2,000 (wells)	1-500 (temporally variable)
Light HCs (C6-C11)	0.05-0.5 (soil moisture)	100-5,000 (interface) 10-500 (wells)	1-50 (spatially variable)
Medium HCs (C12-C17)	<0.01 (soil matrix TOC)	10-100 (interface) 1-20 (wells)	1-20 (detections related to DOC)
Heavy HCs (C18+)	Insignificant	1-10 (interface) Not detected (wells)	Not detected

Preliminary Observations

- Based on groundwater flow rates and HC sorption, transport requires months/years
- Dissolved HCs are elevated at submarine discharge points, but less so in lagoon
- Volatile HCs are detectable under paved surfaces, but not in ambient air
- TPH degradation will continue to produce volatile/soluble daughter products

Strategies Under Consideration

- Removal of contaminated soil in areas that are contributing HCs to groundwater
- In-situ vapor extraction of volatile HCs and in-situ chemical oxidation of other HCs
- Establishing a system of interceptor wells and treating groundwater with GAC
- Monitoring seawater and groundwater, but permitting HCs to biodegrade naturally