



*Triad-approach (LIF/MIP/MWs) for LNAPL/PHC  
delineation*



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Golder Associates

Virtual SMART Remediation Seminar Series 2021  
February 4, 2021

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**Triad-approach (LIF/MIP/MWs)  
for LNAPL/PHC delineation**

PELEE ISLAND, ONTARIO  
SCUDDER HARBOUR AREA LANDS

CAREY AUSTRINS AND LAURA JONES

February 4 2021

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**AGENDA**

**Site History and Background**

**Summary of HRSC Approaches & Tools**

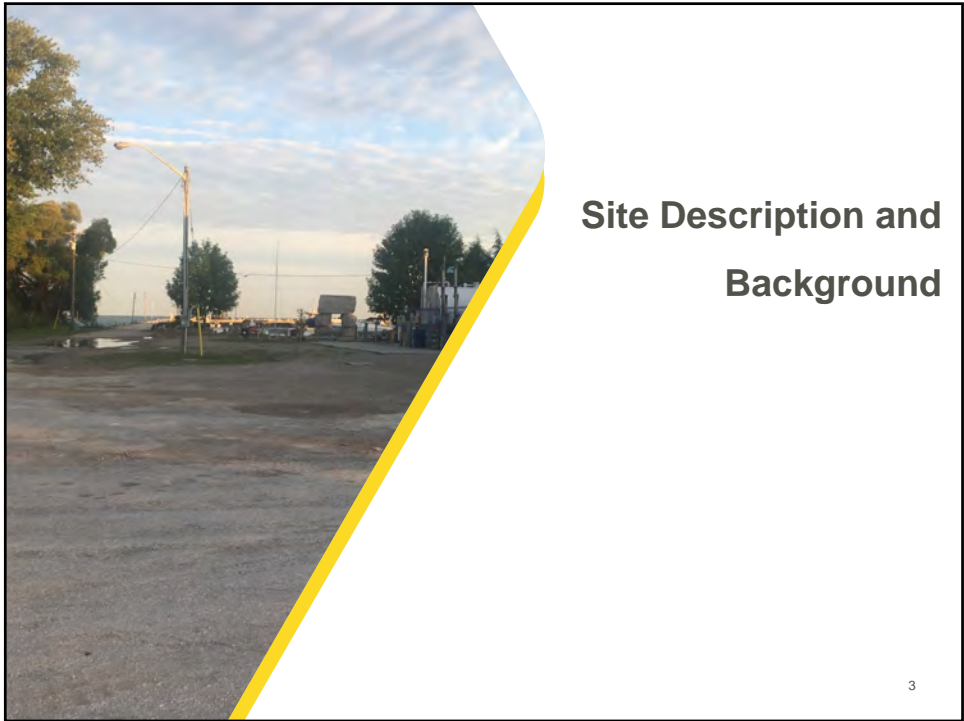
**Investigation Results**

**Next Steps**



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# Site Description and Background

## Site Description - Pelee Island

- Largest and southern-most island in L. Erie
- Area ~ 4,200 hectares (10,300 acres)
- 250 year-round residents
- ½ the island is below lake level
- Canals, drains, dykes and pump stations used to dewater interior portions of island

**The Township of Pelee  
Constructed Drainage Systems**

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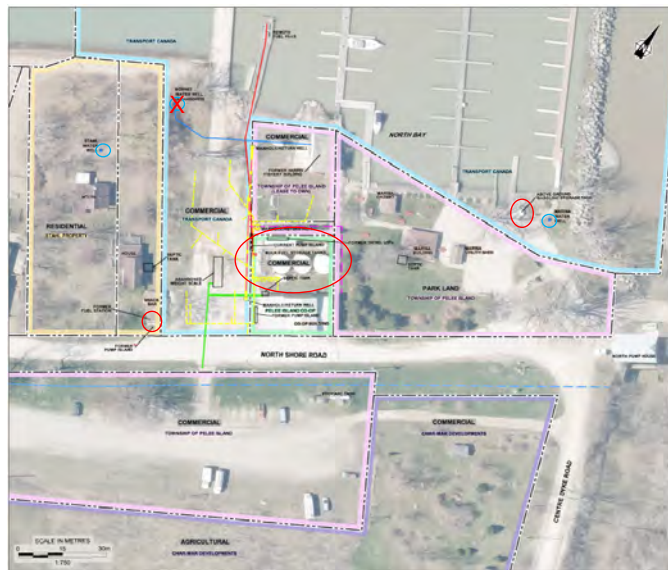
## Background



- Over 100 years of use at Scudder Harbour Area Lands
- Late 1800's: Scudder Dock constructed
- 1916-present: Co-op formed to service community needs (agricultural, island residents, tourism, etc).
- Co-op has generally been sole supplier of petroleum products on the island since early 1920's
- 1950's-1970's: Former Gasoline Service Station (adjacent property)

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## Site Plan



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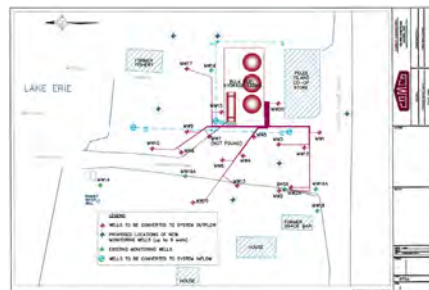
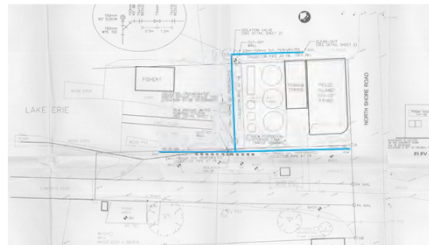
## Potential Petroleum Hydrocarbon (PHC) Sources

- Co-op
  - “Large” fuel spill in 1950’s on-land; reportedly fuel re-supply release on lake in mid-1970’s
  - 900 L gasoline in June 1996 within tank farm
  - Two diesel USTs (1954 to mid-1990’s) – now removed
  - Dispensing pumps and associated U/G piping (past and current)
- Transport Canada
  - Underground fuel re-supply lines to Co-op tank farm (vacuum tests/repairs in early 2000’s)
  - Dock access road – vehicular traffic(past and current), oiling for dust suppression (past)
  - Marina – gasoline AST (current)
- Stahl property
  - Former gasoline service station (1950’s to 1970’s)/UST?
- Recreational Boating (Marina area)

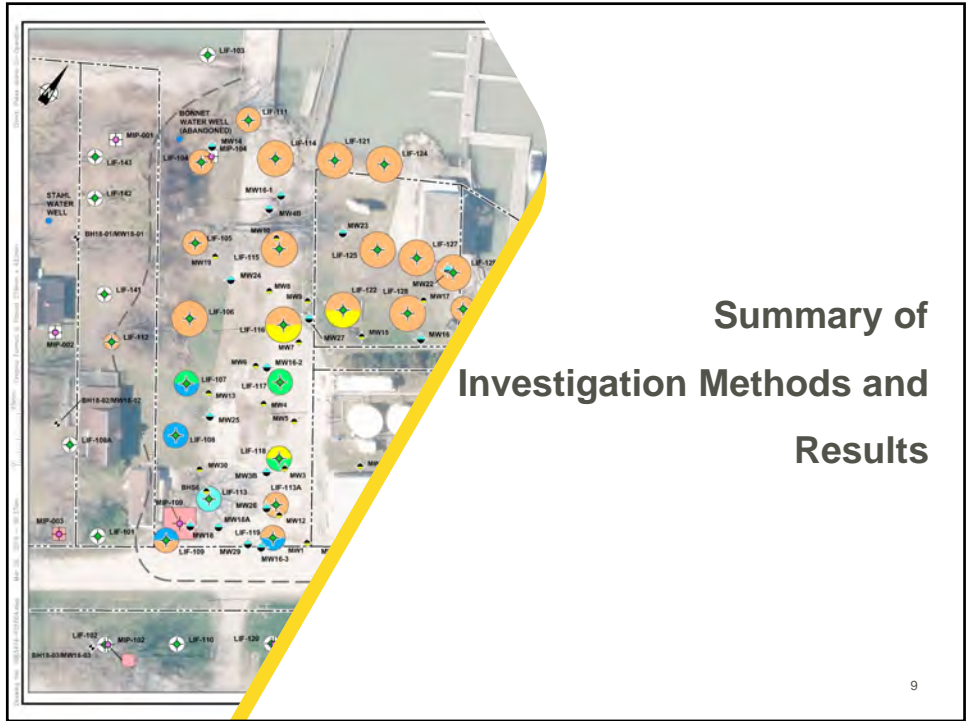
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## Remediation Activities

- Groundwater Trench Collection System
  - Operated seasonally ~ 5 years (Oct. 1998 to 2003)
  - 3 collection trenches with GW suppression pump
  - ~ 1 million litres of GW recovered
  - No significant LNAPL reportedly recovered
  - Operation discontinued based on evaluation that system was not effective
- Enhanced Bioremediation/Groundwater Recirculation System
  - Operated seasonally from 2006 to 2007, re-configured and operated seasonally from 2013 to 2016. Extraction from collection well, reinjection into wells with groundwater amended with oxygen, nutrients and bacteria
  - Operation ceased due to Ministry concerns about potentially exacerbating the extent of contamination
  - Some locations showed reduced PHC concentrations, other areas no specific trend, and other locations showed recent (2015) increasing trends



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## 2018 Subsurface Investigation – Objectives

1. Develop robust conceptual site model (CSM) to assist in risk mitigation / remedial planning
2. Evaluate the potential presence of LNAPL
3. Delineate extent of PHC impacts
4. Evaluate potential various source areas and groundwater plumes
5. Assess natural attenuation of groundwater plumes
6. Evaluate potential for soil vapour intrusion

Due to financial limitations and remote location, goal was to complete the above in single mobilization with subcontractors and minimize follow-up sampling events.

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## 2018 Subsurface Investigation – Scope

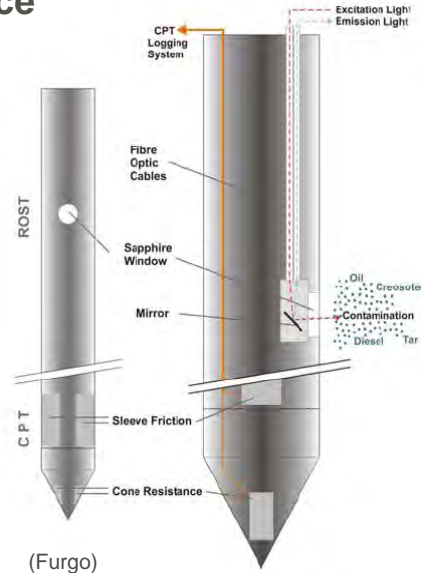
- Initial field effort completed in 11 days
  - LIF-UVOST: 41 locations to delineate extent of LNAPL (Sept. 25-27)
  - MIP: 14 locations to facilitate defining the extent of PHC impacts (Sept. 27-28)
  - Soil Boreholes/New Monitoring Wells: 6 perimeter locations to confirm lateral extent of PHC impacts (Sept 29)
  - Soil Vapour Probe Installation/Sampling: installed 4 vapour pins/one implant
- Follow-up groundwater and soil vapour sampling 3 days
  - Groundwater Monitoring: Oct. 3-5; Dec. 5-7 (to assess “dry” wells in Oct.) to confirm groundwater flow direction and assess presence/absence of LNAPL in wells
  - Soil Vapour Probe Installation/Sampling: installed 4 vapour pins/one implant to assess potential soil vapour intrusion (VI) impacts; sampled Oct. 4-5.

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## Laser Induced Fluorescence

### BACKGROUND

- Laser pulse (excitation light) passes through fiber optic cable strung within rods.
- Light exits via sapphire window as probe is advanced at a continuous rate (e.g., 2 cm/sec).
- If fluorescent compounds exist adjacent to window, light (fluorescence) with a longer wavelength is emitted and transmitted back to surface for measurement.
- IDEALLY, get a sample of the NAPL, send to vendor first

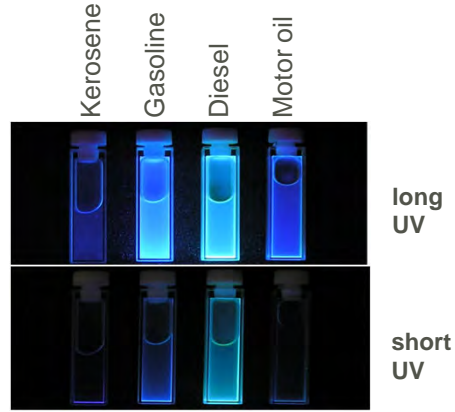


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## Laser Induced Fluorescence

### BACKGROUND

- Aromatic molecules (ring structures) fluoresce well – especially PAHs
- The PAHs mixtures in PHCs generates an emission spectrum or “type signature” that facilitates identification



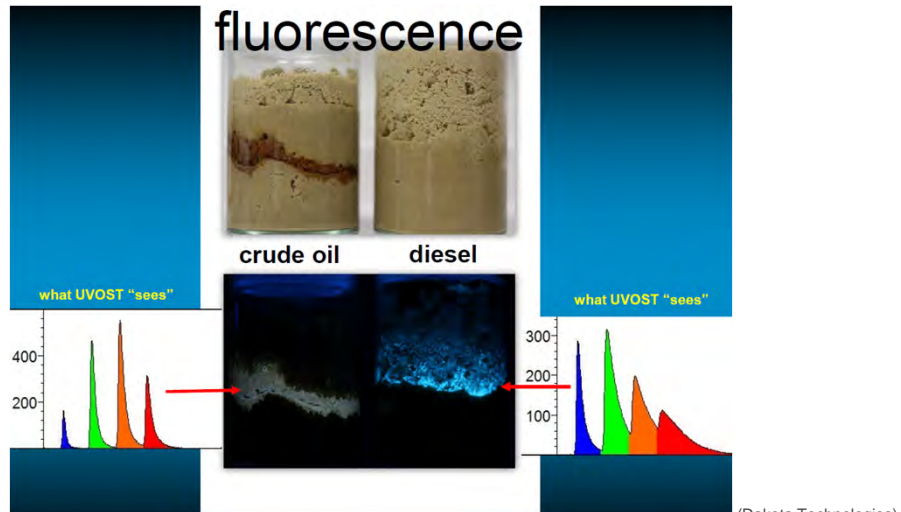
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## Laser Induced Fluorescence - UVOST

### BACKGROUND



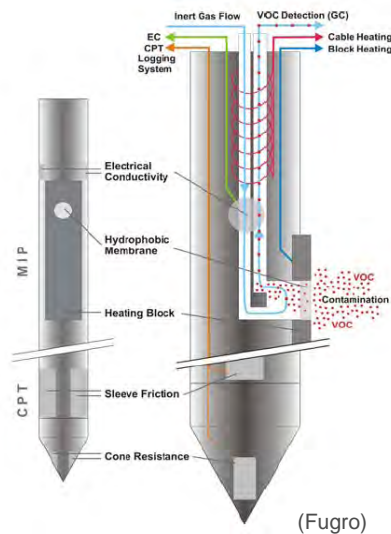
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## MIP – Background



- Start-stop advancement ~ 1ft/min. over various intervals (1 to 5 ft).
- VOCs in contact with heated surface of semi-permeable membrane, partition and diffusive into it.
- VOCs partition into carrier gas that sweeps back-side of membrane.
- VOCs carried to surface via “trunkline” to reach gas-phase detectors at ground surface.
- Relative contaminant levels (contact time, membrane temperature, gas flow rate, age of membrane, type of subsurface media).



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## 2018 Subsurface Investigation – Implementation

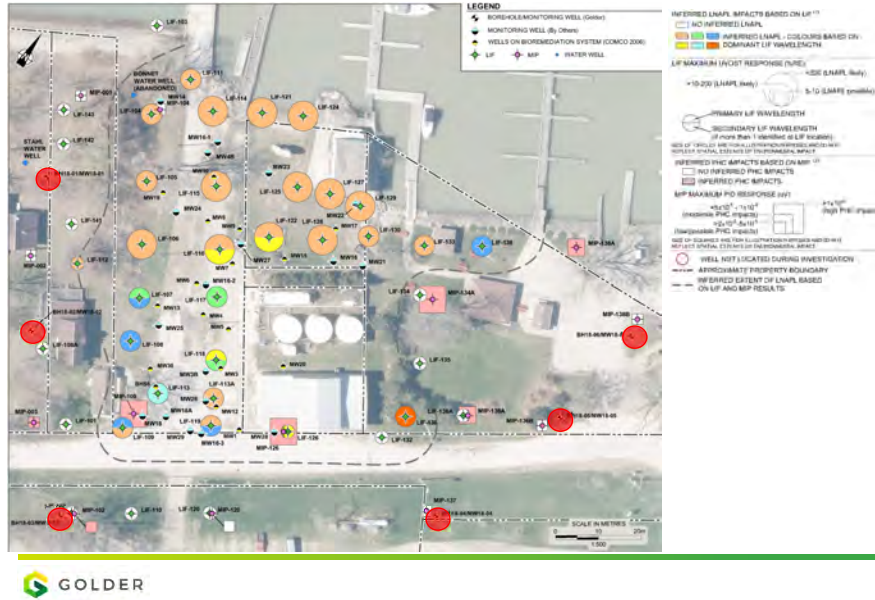


- Real-time coordination with field supervisor to confirm step-outs/depth
- Experienced field supervisor was able to minimize standby-time and have drillers complete alternative tasks (e.g., soil vapour probe installs)



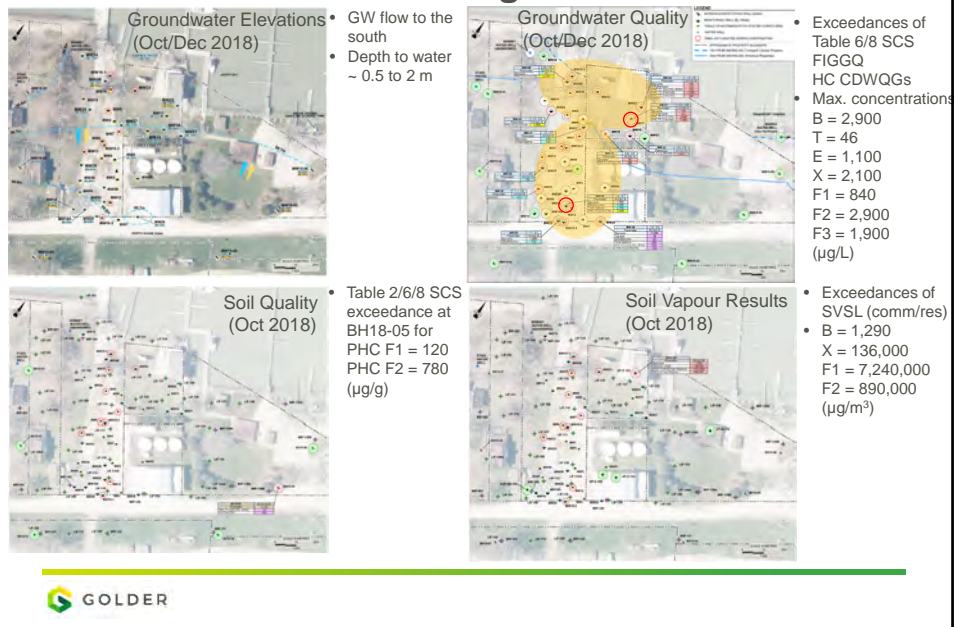
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## 2018 Subsurface Investigation – Key Findings



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## 2018 Subsurface Investigation – Results



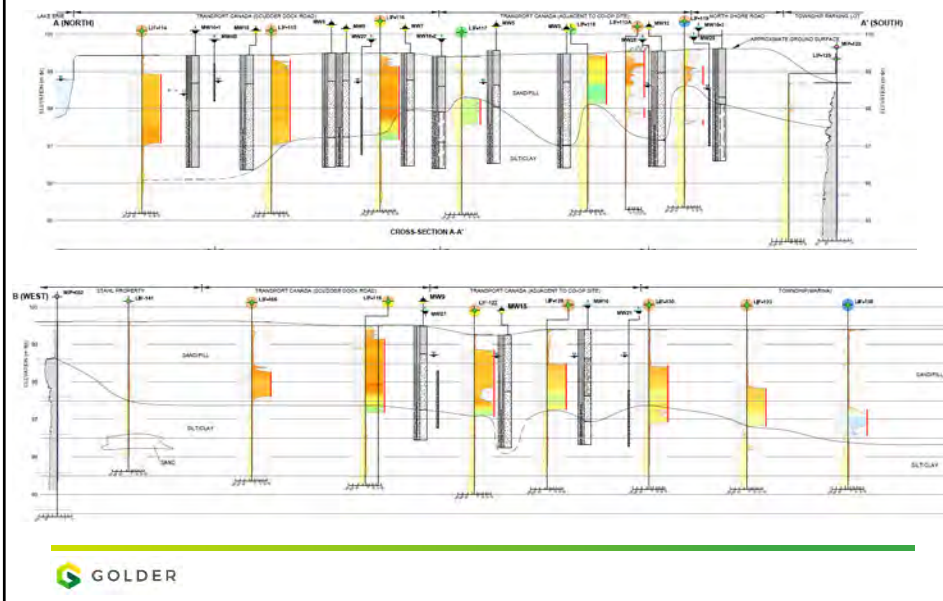
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## 2018 Subsurface Investigation – Key Findings

- Evaluate Presence of LNAPL – LNAPL was inferred to extend over the majority of the Site based on the LIF-UVOST data.
- Evaluate the various source areas and groundwater plumes – at least two distinct areas, potential sources not clearly identifiable:
  - Heavier-end PHC impacts (e.g., diesel) occur primarily in areas north of the Co-op property
  - Lighter-end PHC impacts (e.g., gasoline) occur to the west of the Co-op property
- Evaluate potential for an offsite source related to former gas station to the west – likely offsite source based on LIF-UVOST data (e.g., LIF-108)
- Assess natural attenuation of groundwater plumes – likely occurring based on PHC/BTEX concentration trends (mostly stable/decreasing) and reducing conditions
- Evaluate potential for soil VI – Based on single sampling event (October 2018), there is the potential for VI issues at the former Harris Fishery building.
- Develop robust conceptual site model (CSM) to assist in remedial planning
  - Based on various lines of evidence, LNAPL does not appear to be mobile. Limited extent of groundwater PHC impacts (localized “halo”). LNAPL extends to shoreline of Lake Erie.
  - Primary potential risk drivers - vapour intrusion (e.g., Former Harris Fishery Bldg.) and groundwater/surface water interaction.

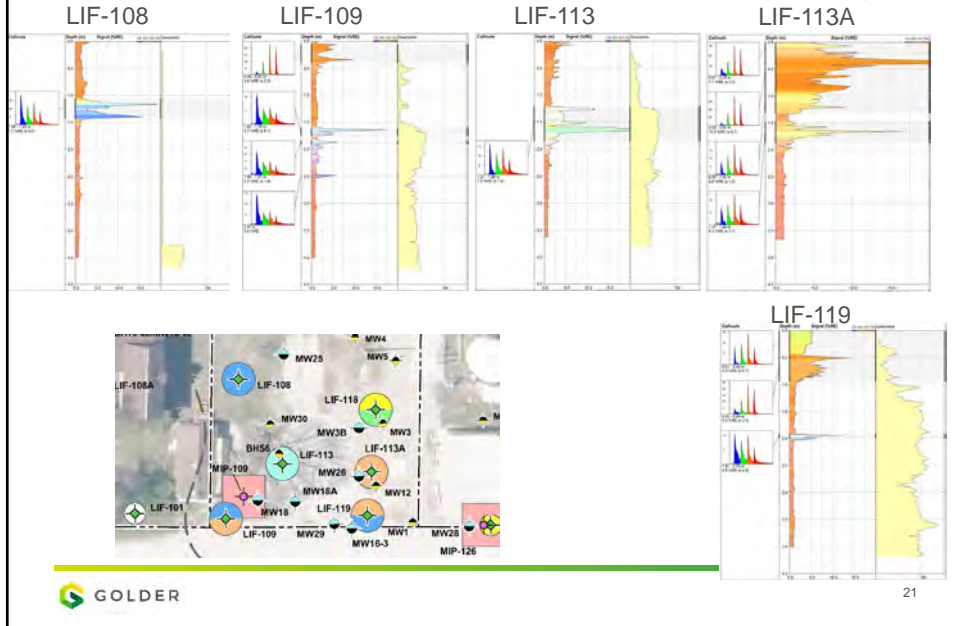
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## 2018 Subsurface Investigation – Key Findings



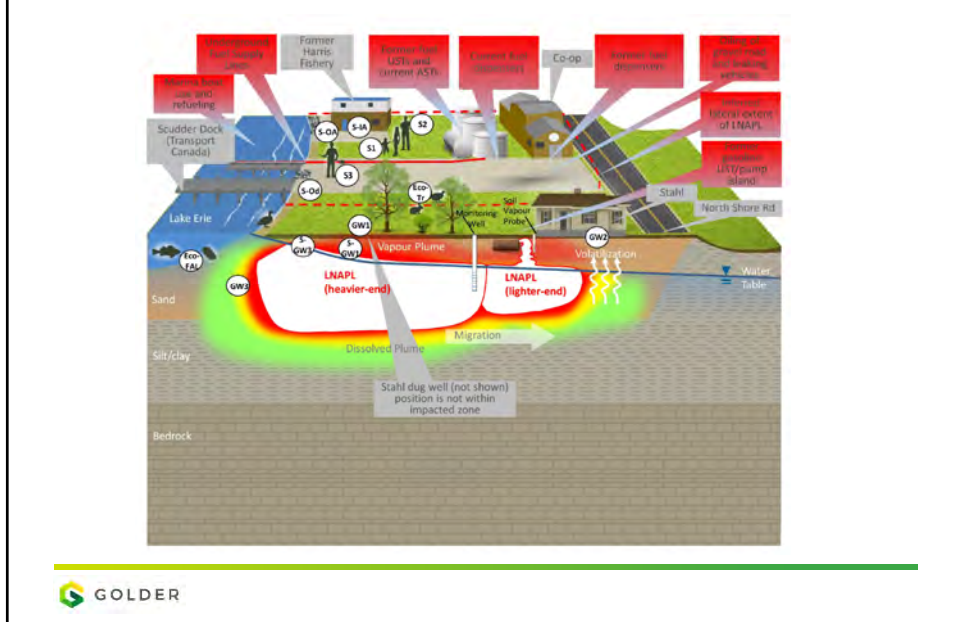
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## 2018 Subsurface Investigation – Key Findings



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## Conceptual Site Model



## Summary of Key Potential Risk Drivers and Site Considerations

- Drinking water wells
  - Risk appears low based on historical and current available data (shallow site wells)
- Soil vapour intrusion
  - Potential risk at Harris Fishery building, and uncertainty for Stahl residences (potential offsite source considerations, limited assessment data)
- LNAPL presence (direct contact (soil/gw); long-term source)
  - LNAPL does not appear to be mobile; however it will act as long-term source
- Groundwater/Surface Water interactions
  - LNAPL extends to shoreline of Lake Erie and therefore risk assessment approach will likely "fail"; complicated by marina/boating/remnant fuel spill effects
  - Sediment assessment work completed for Transport Canada Water Lot (2008/2017) indicated ecological risks associated with sediment contamination is low/negligible and did not warrant further investigation

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## Next Steps

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## Next Steps

- Address Data Gaps
- Soil vapour intrusion
  - Harris Fishery building (very high sub-slab levels)
    - Indoor air sample(s) & vapour pin sample
    - Mitigation?
  - Stahl residences
    - Field screening of crawl-space areas, deploy short/long-term air samples.
    - Indoor Air? Mitigation?
- LNAPL management and soil/groundwater quality
  - Assuming no short-term risk, evaluate viability of long-term semi-passive enhanced bioremediation and/or natural source zone depletion.
  - Pilot test using sulphate planned for Summer 2021 to Summer 2022 pending funding

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Questions?

Thank you  
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Federation of Canadian Municipalities  
Green Municipal Fund

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