
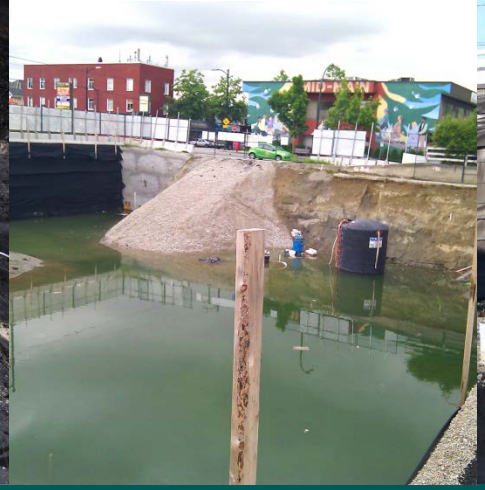
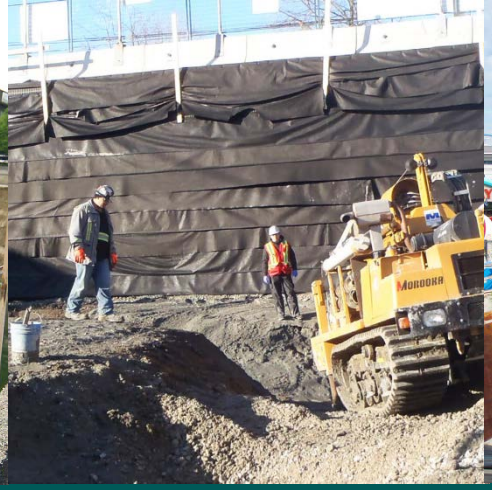


Remedial Methods for Mitigating Vapour Intrusion to High Density Urban Developments

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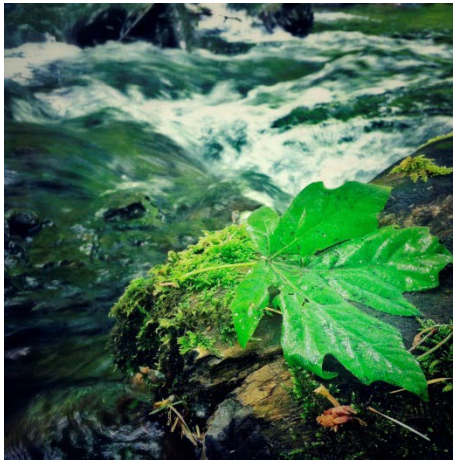
Agenda



- Vapour intrusion is a relatively new area of science.
- The investigation design, assessment of results, and remedial measures are changing.
- The following examines:
  - Regulatory Environment
  - Practical Example

Regulatory Environment & Research

British Columbia Regulations

- **BC MOE Technical Guidance 4 (2010)**
  - What to investigate and how to interpret the data.
  - Allows for other guidance from other sources
- **CSAP Soil Vapour Advice (2009)**
  - Address practical issues of what to test for, shallow samples, and non traditional foundations

British Columbia Research

- **Science Advisory Board**
  - Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings (2011)
- **High Density Residential Soil and Vapour Quality Standards**
  - Attenuation Factor for Parking Garages (Still under Review)

US EPA (2013 – Draft for Discussion)

- **List of volatile chemicals**
- **Remedial Options**
  - Pressurization
  - Passive barriers
  - Venting Layers
  - Parking Garages used as a highly ventilated, low-occupancy area at ground level (parking garage)

US EPA (2011 – Background Air)

Compound	95th Percentile	Standard	Compound	95th Percentile	Standard
Benzene	9.9-29 (14)	1.5	Methylene chloride	2.9-45 (130)	20
Carbon Tetrachloride	<RL-1.1	0.65	PCE	4.1-9.5	600
Chloroform	4.1-7.5	1	Toluene	79-144 (6)	5000
Dichloroethane, 1,1-	<RL	500	Freon 113	<RL-3.4	30000
Dichloroethane, 1,2-	<RL-0.2	0.4	Trichloroethane, 1,1,1-	3.4-28	2000
1,1-DCE	0.7	1	TCE	0.56-3.3 (0.6)	0.5
Cis 1,2-DCE	<RL-1.2	20	Vinyl chloride	<RL-0.09	1
Ethylbenzene	12-17 (320)	1000	Xylene, m/p-	21-63.5 (60*)	100*
MTBE	71-72	3000	Xylene, o-	12-20 (60*)	100*

All vales are ug/m^3 and for residential areas. RL = reporting limit * total xylenes (bracketed values) Vancouver Area measured background sites

ITRC (2007)

- **Conceptual Site Model**
  - Where can contaminants come from and how enter
- **Remedial Systems Pros/Cons**
  - Passive, pressurization, depressurization
- **Seasonal Variation (soil vapour)**
  - If soil gas is a factor of 10 below risk based screening levels, seasonal sampling is not required

California EPA – Vapor Intrusion (2011)

- **Eleven Step Approach to Assessing Vapours**
  - Consider Existing Building and Future Building
  - For future buildings need o look at what will be adjacent the building and not what soil and groundwater is there now.
    - What will create vapours in future
    - Lateral wells rather than vertical

Final: Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)

Other Sources of Information

- **Health Canada 2010**
  - Model soil/groundwater to vapour
- **Washington Department of Ecology (2009)**
- **Oregon State (2010)**
- **ASTM (2008)**
  - Investigation and Remediation

Final: Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)

Practical Example High Rise Vancouver

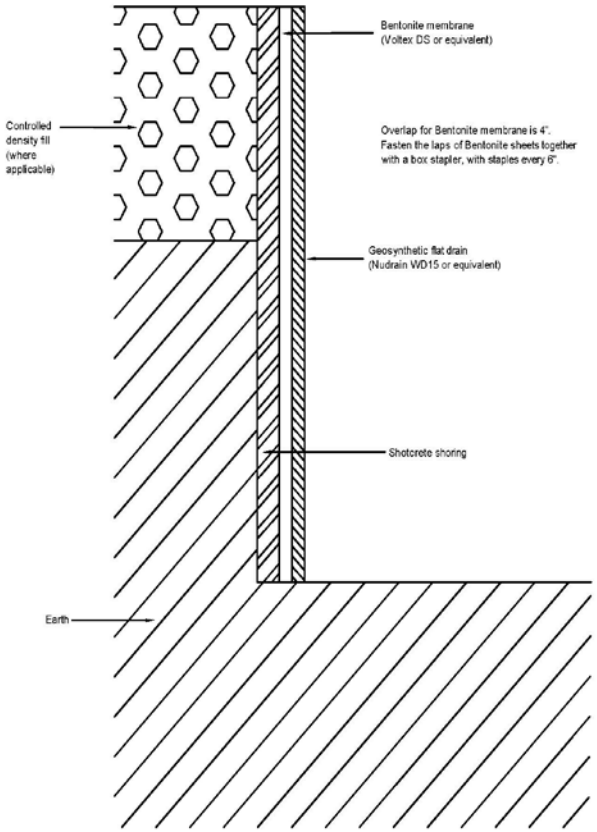
Traditional Vapour Barrier

- **Service Station Upgrade**
  - Interior service station renovation.
  - Extensive contamination under footings and exterior.
  - Protect indoor workers
  - Geomembrane barrier

Barrier Wall

- **Service Station Property Redevelopment**
  - Potential for vapours migrating on-site from off-site groundwater contamination under the road.
  - Road contamination being remediated in-situ.
  - Needed barrier to allow redevelopment.

Barrier Wall

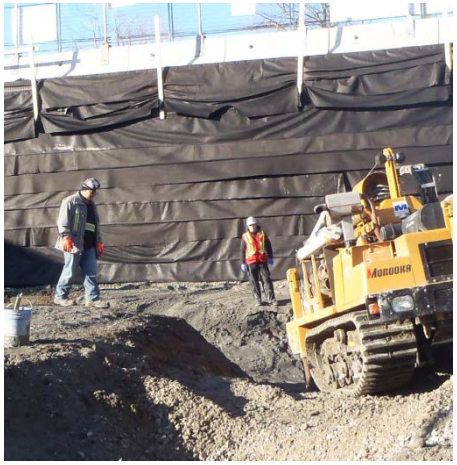


- **Barrier design based on a four layers**
  - Shotcrete – Keep soils in place
  - Bentonite – Barrier
  - Drain – Preferential pathway for vapours up and out. Also building isolation.
  - Concrete for building foundation
  - Interior isolated from exterior

Redesign of Parking Garage

- **Service Station Property Redevelopment**
  - Vapours migrating on-site from off-site contamination under the road.
  - Road contamination being remediated in-situ.
  - Biggest concern is vapours from groundwater

Redesign of Parking Garage



- **Redesigned Parking Garage**
  - Lowered drainage pipe
  - Dedicated pump to supress groundwater and discharge
  - Pump isolated with dedicated vent and gasket. Explosion proof.
  - Separate pump for all garage drains and elevator sump

Thank you. Questions?

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