



Optimization of Soil and Groundwater Remediation at Former Gas Station and Adjacent Properties, Using a Combination of In Situ and Ex Situ Technologies

Guy Lavoie, C.E.T.
Project Director

2011
REMEDIATION
technologiesymposium



Presentation Overview

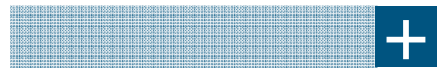
-  + Site Description
-  + Applicable Legislation
-  + Site Environmental Background
-  + Challenges
-  + Remediation Technologies
-  + Results
-  + Conclusions
-  + Questions



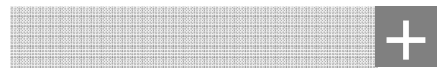
Site Description



Applicable Legislation



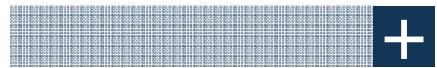
Site Environmental Background



Challenges



Remediation Technologies



Results



Conclusions

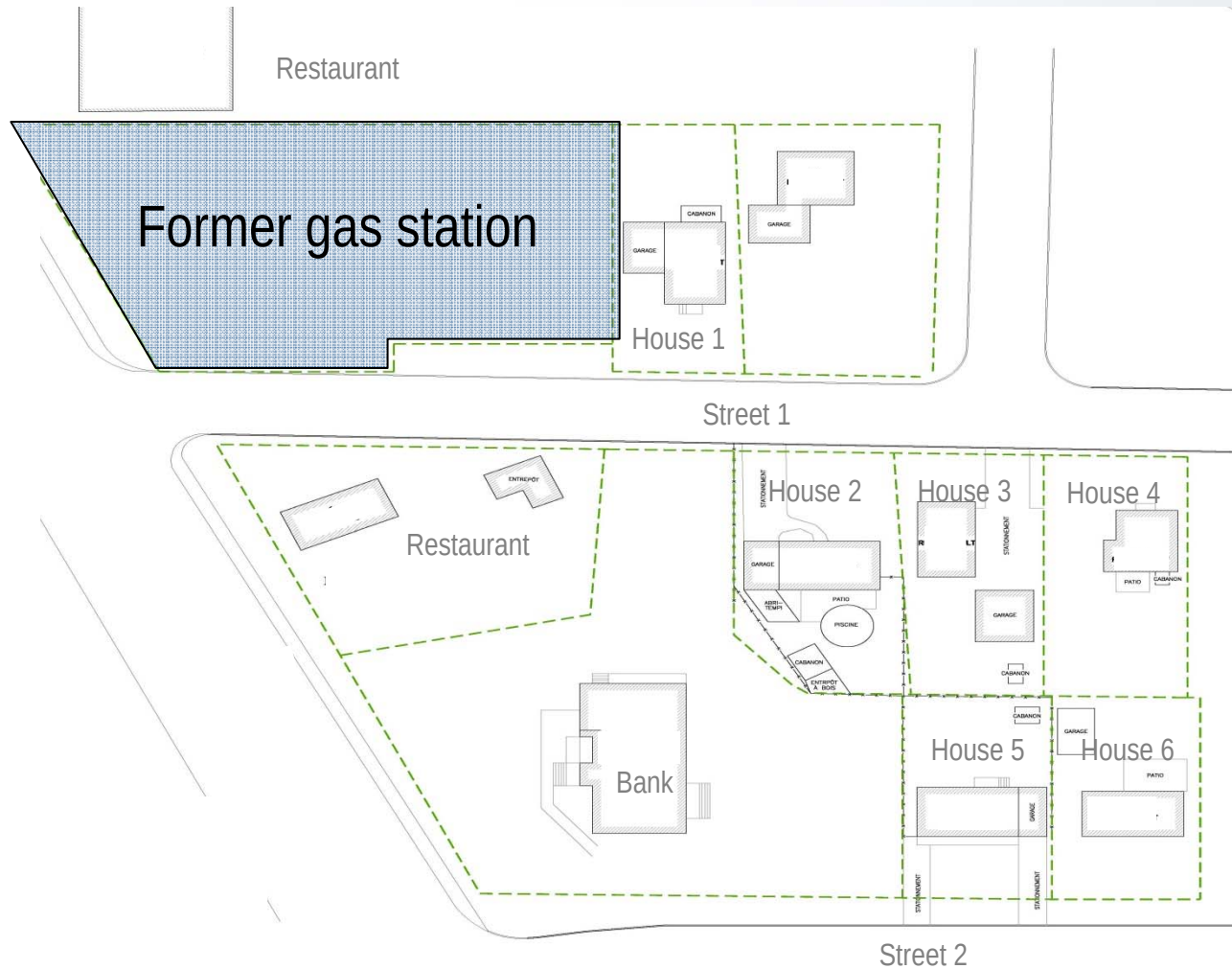


Questions

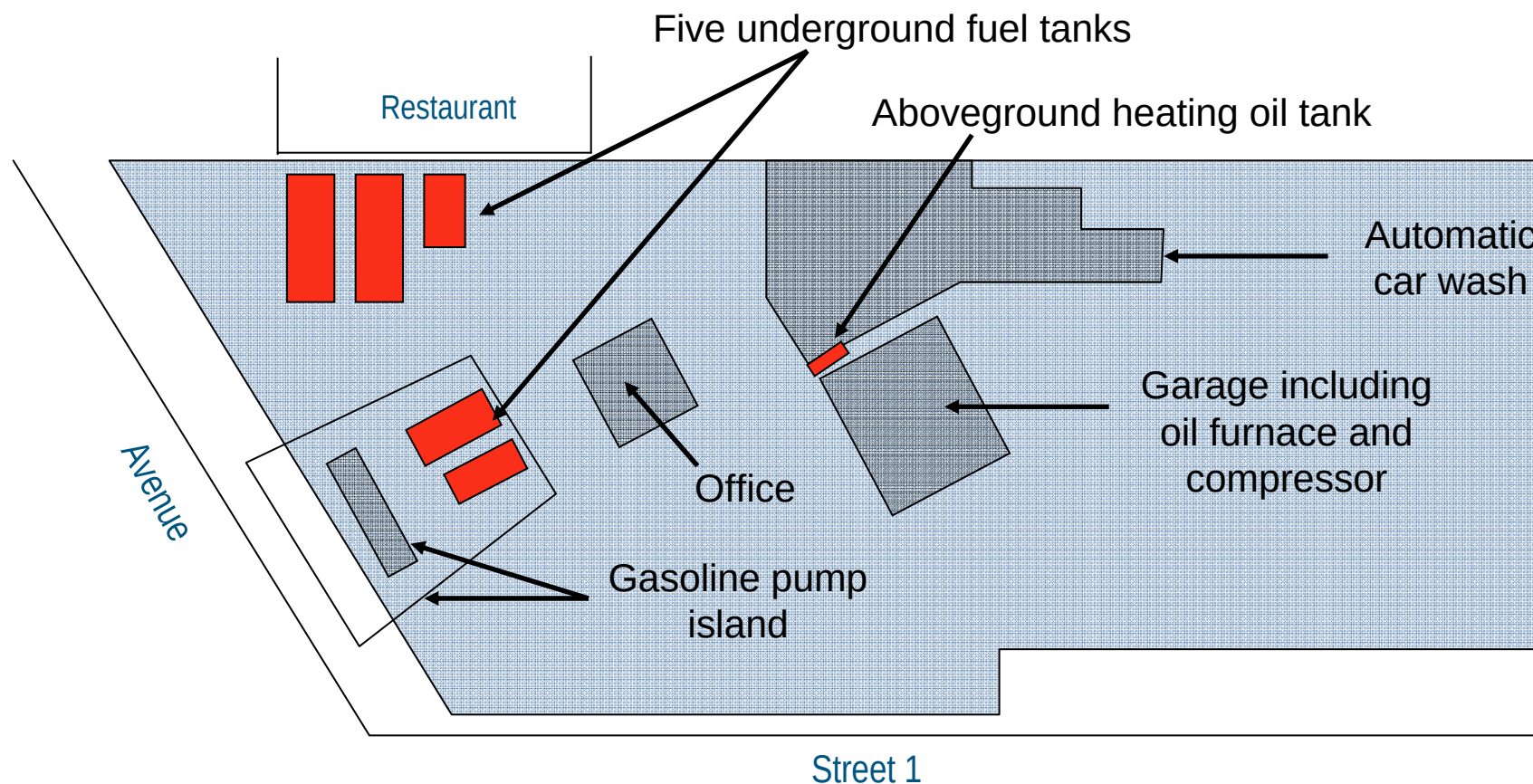
+ Site Location



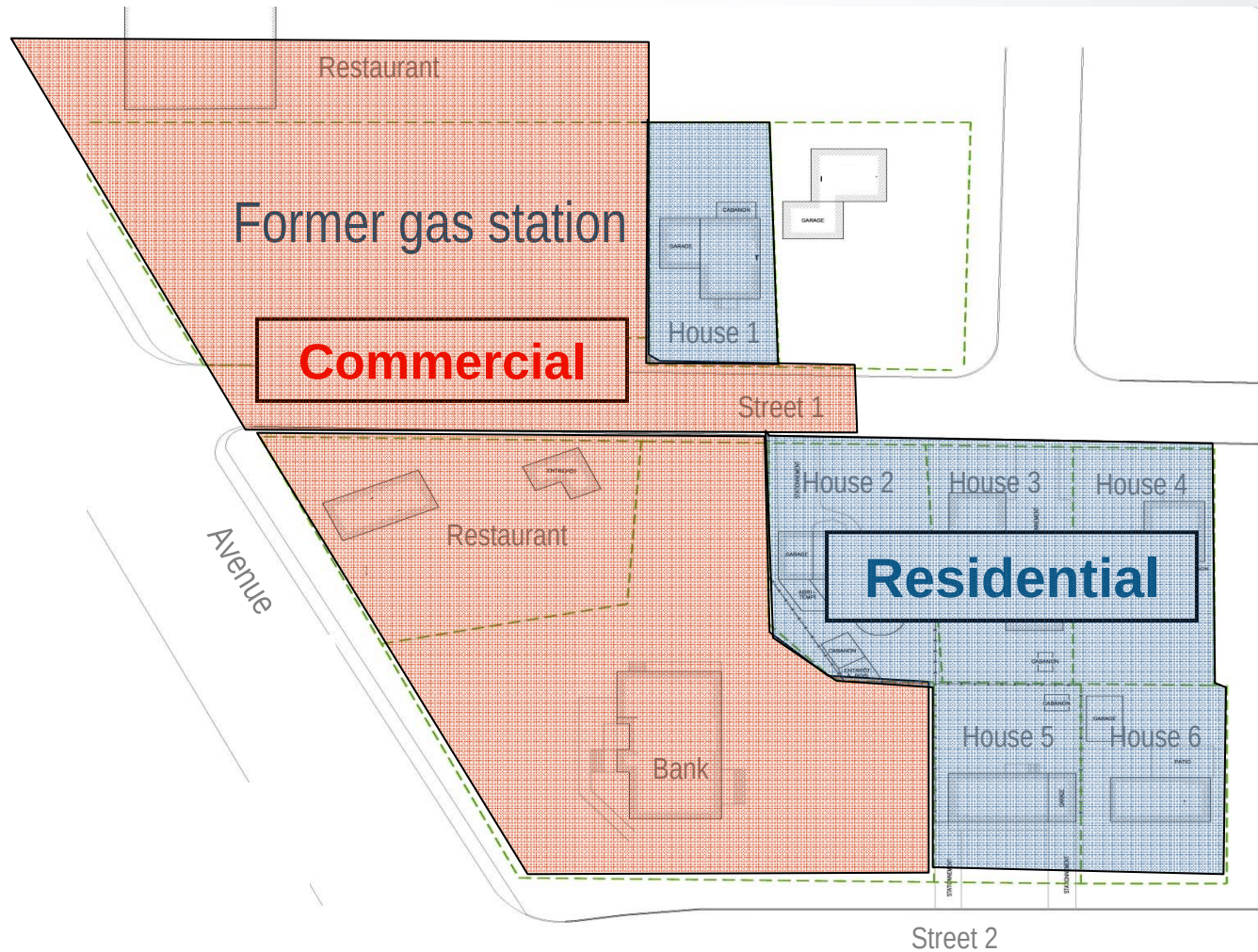
+ Site History



Contamination sources

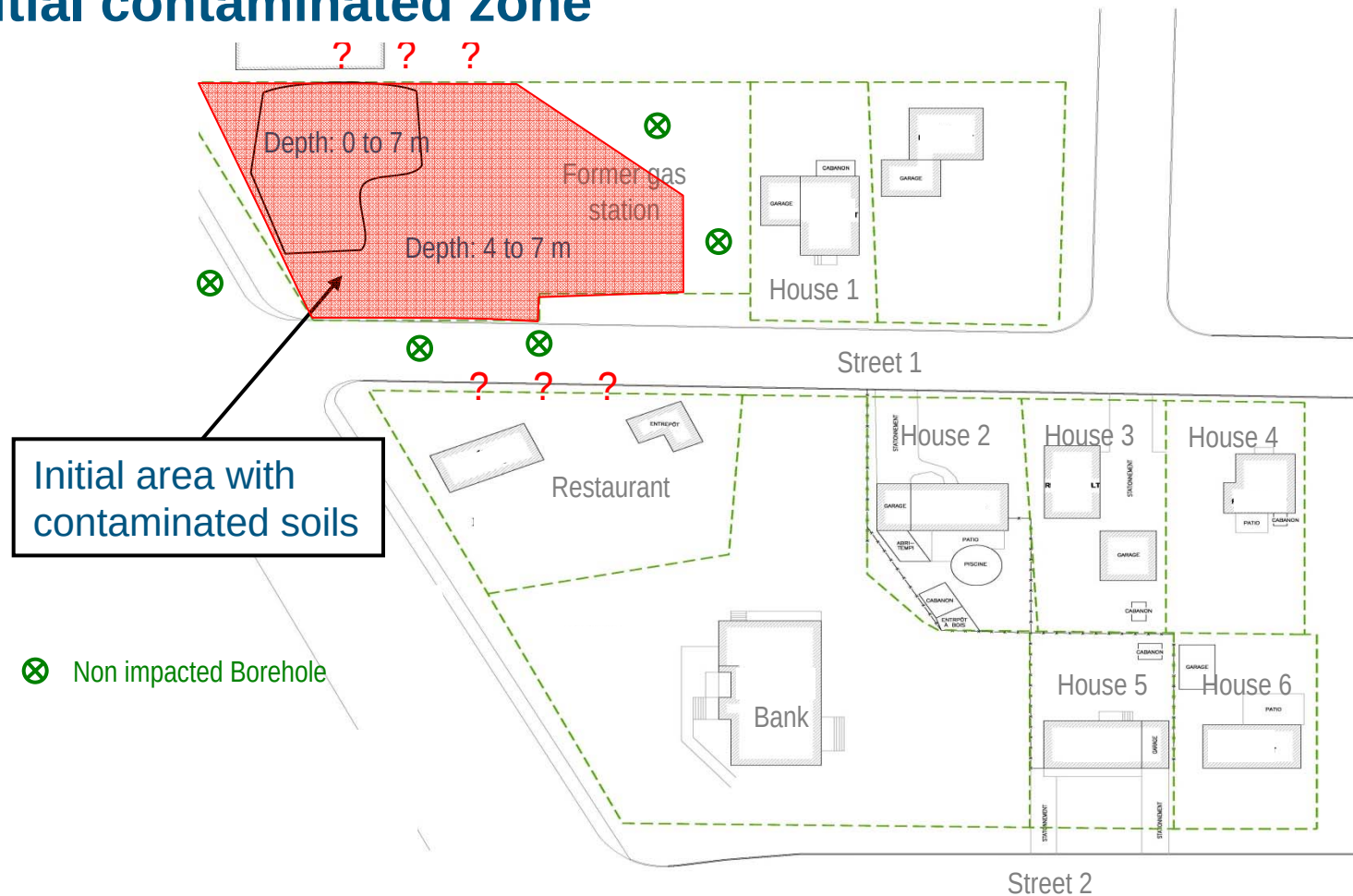


+ Site Description



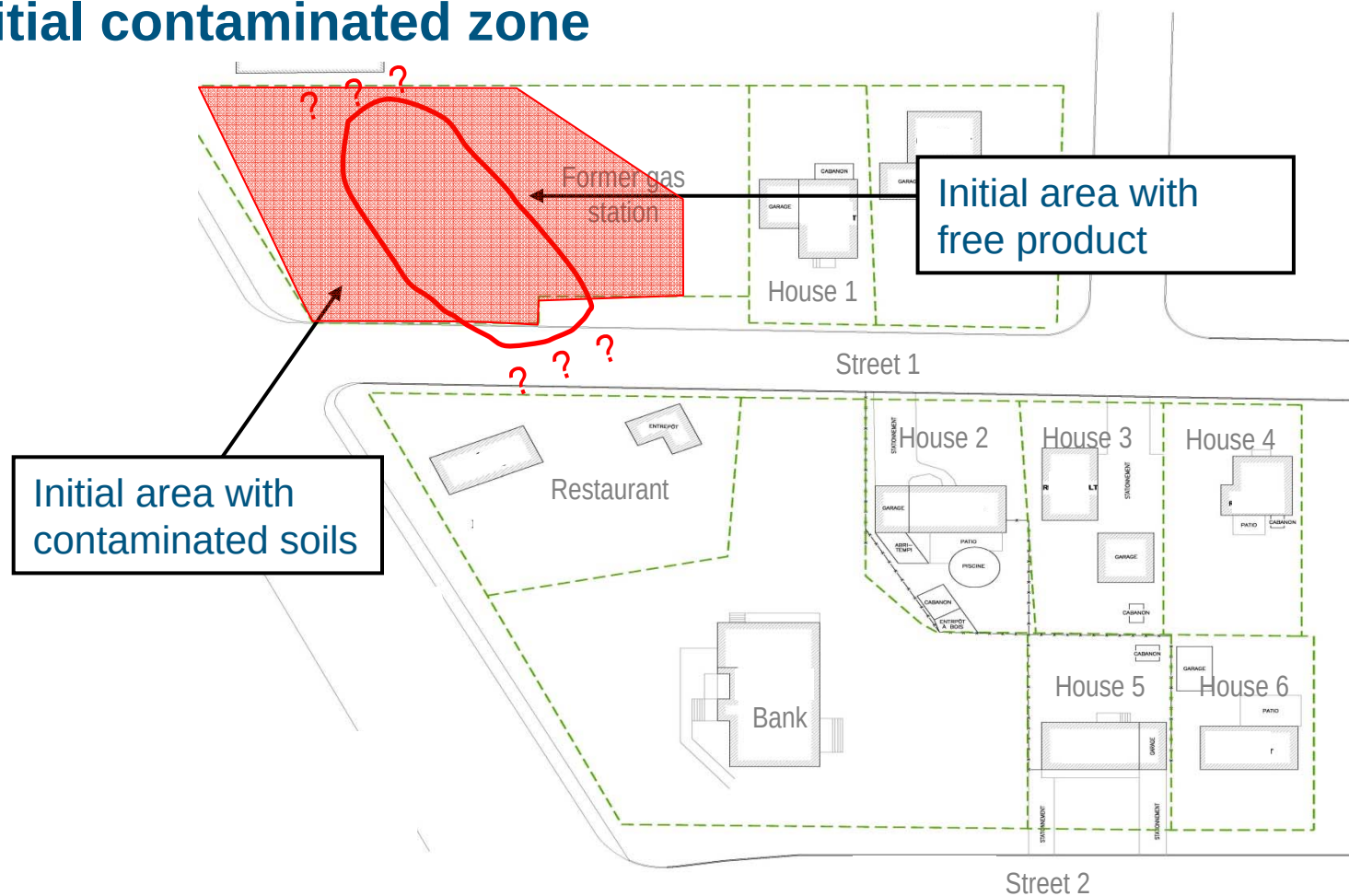
+ Site description

Initial contaminated zone



+ Site description

Initial contaminated zone





Site Description



Applicable Legislation



Site Environmental Background



Challenges



Remediation Technologies



Results



Conclusions



Questions

+ Applicable Legislation

MDDEP's Soil Protection and Contaminated Sites Rehabilitation Policy

+ Soils:

- Commercial properties: level C of the generic criteria
- Residential properties: level B of the generic criteria

+ Groundwater:

- Criteria of the seepage into the surface water or infiltration into sewers

+ Regulations - Quebec vs Alberta

Soil Remediation Guidelines

Paramètres	Units	MDDEP Generic Criteria			Alberta Tier I Guidelines (Coarse)		
		A (Residential)	B (Commercial)	C (Industrial)	Residential	Commercial	Industrial
HP C ₁₀ - C ₅₀	mg/kg	300	700	3,500	-	-	-
F1	mg/kg	-	-	-	24	270	270
F2	mg/kg	-	-	-	130	260	260
F3	mg/kg	-	-	-	300	1700	1700
F4	mg/kg	-	-	-	2800	3300	3300
Benzene	mg/kg	0.1	0.5	5	0.073	0.078	0.078
Toluene	mg/kg	0.2	3	30	0.49	0.49	0.49
Ethylbenzene	mg/kg	0.2	5	50	0.21	0.21	0.21
Xylenes	mg/kg	0.2	5	50	12	28	28

Groundwater Quality Guidelines

Paramètres	Units	MDDEP Generic Criteria		Alberta Tier I (Coarse)	
		Potable GW	Surface water / Infiltration	Residential	Comm/Indust
HP C ₁₀ - C ₅₀	mg/kg	-	3500	-	-
F1	mg/kg	-	-	0.81	0.81
F2	mg/kg	-	-	1.1	1.1
Benzene	mg/kg	5.0	590	0.005	0.005
Toluene	mg/kg	24.0	580	0.024	0.024
Ethylbenzene	mg/kg	2.4	420	0.0024	0.0024
Xylenes	mg/kg	300	820	0.3	0.3



-  Site Description
-  Applicable Legislation
-  Site Environmental Background
-  Challenges
-  Remediation Technologies
-  Results
-  Conclusions
-  Questions

+ Site Environmental Background

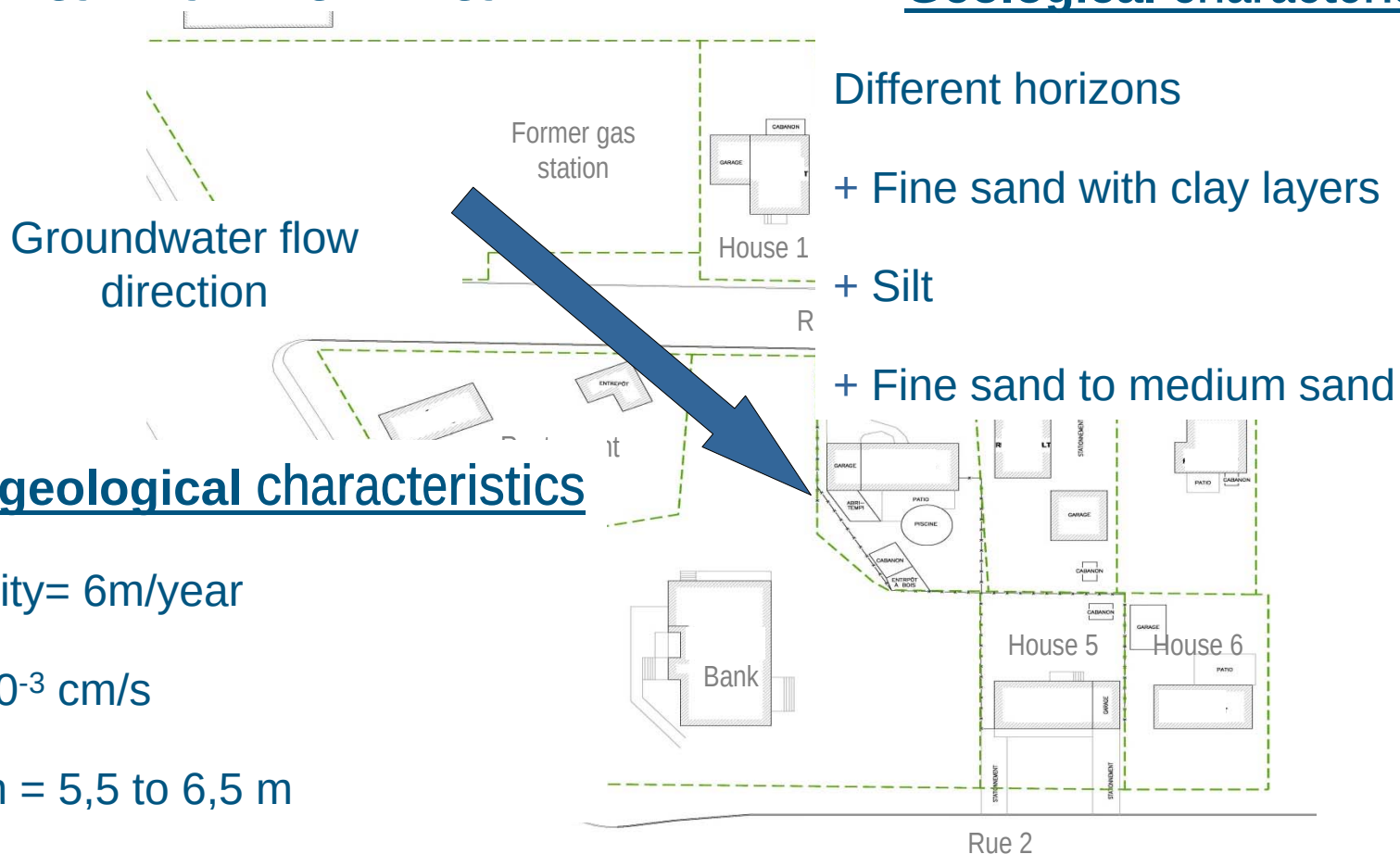
- + Six characterization studies
- + 60 monitoring wells
- + 10 contaminated sites



+ Site Environmental Background

Geology / hydrogeology:

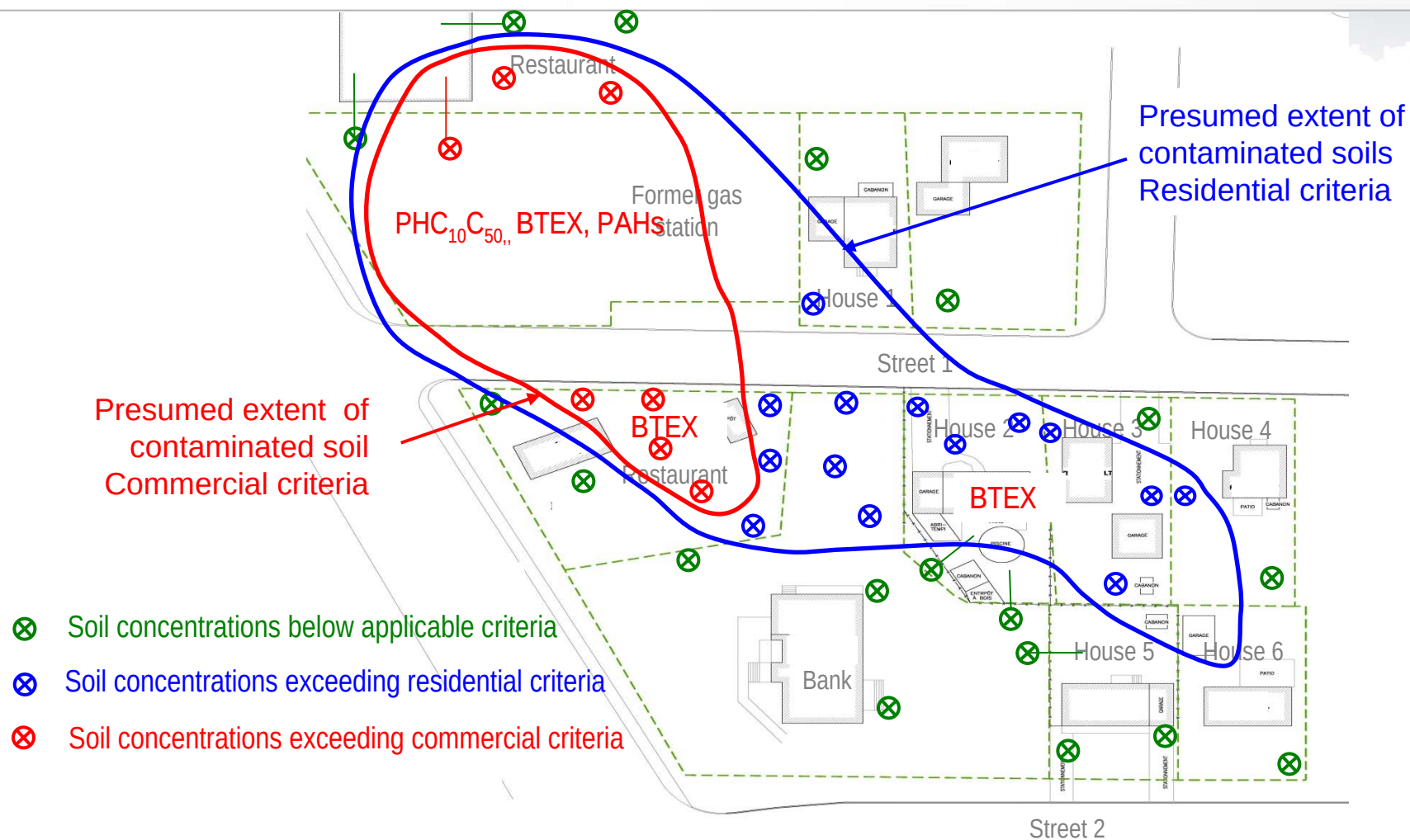
Geological characteristics



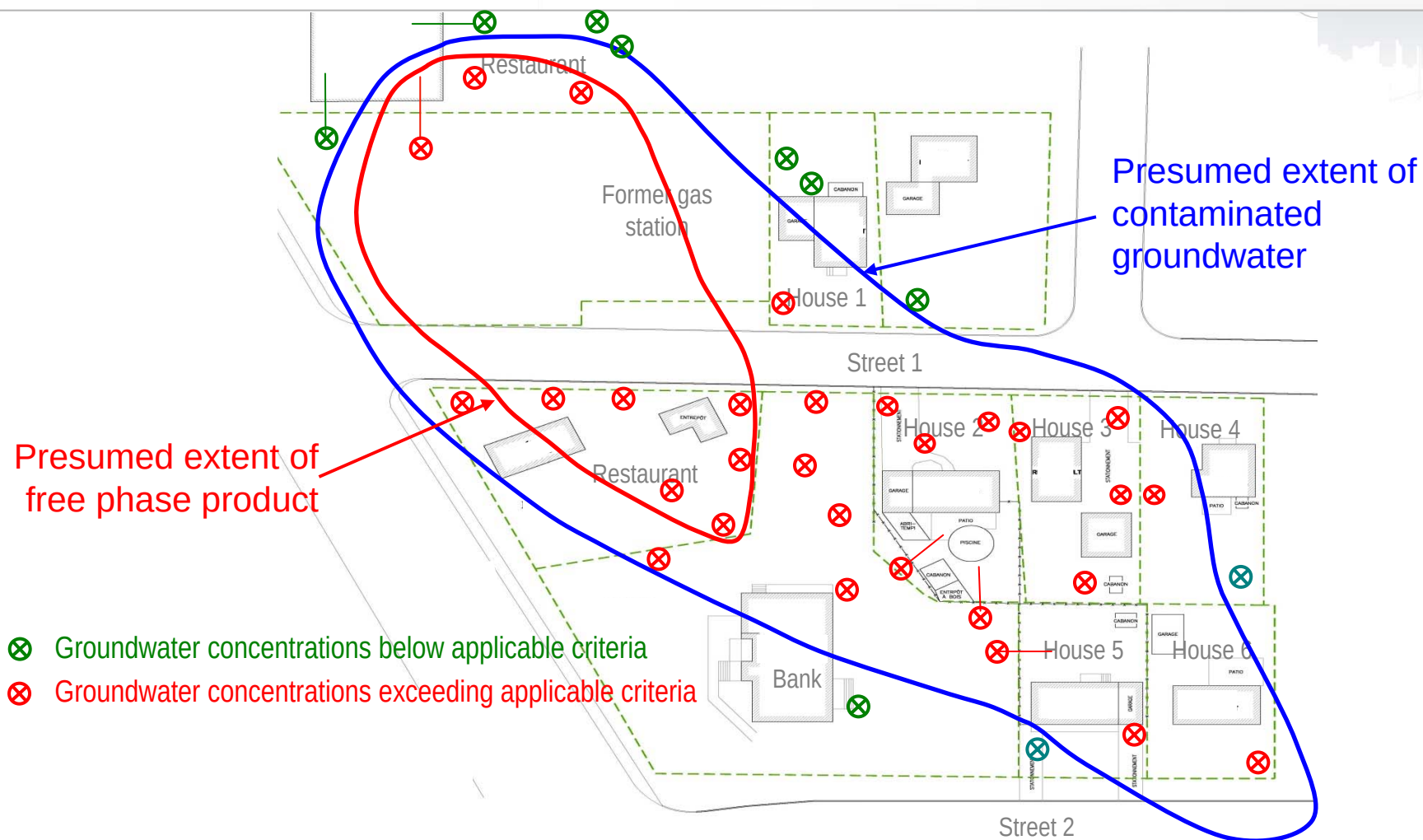
Hydrogeological characteristics

- + Velocity= 6m/year
- + $K = 10^{-3}$ cm/s
- + Depth = 5,5 to 6,5 m

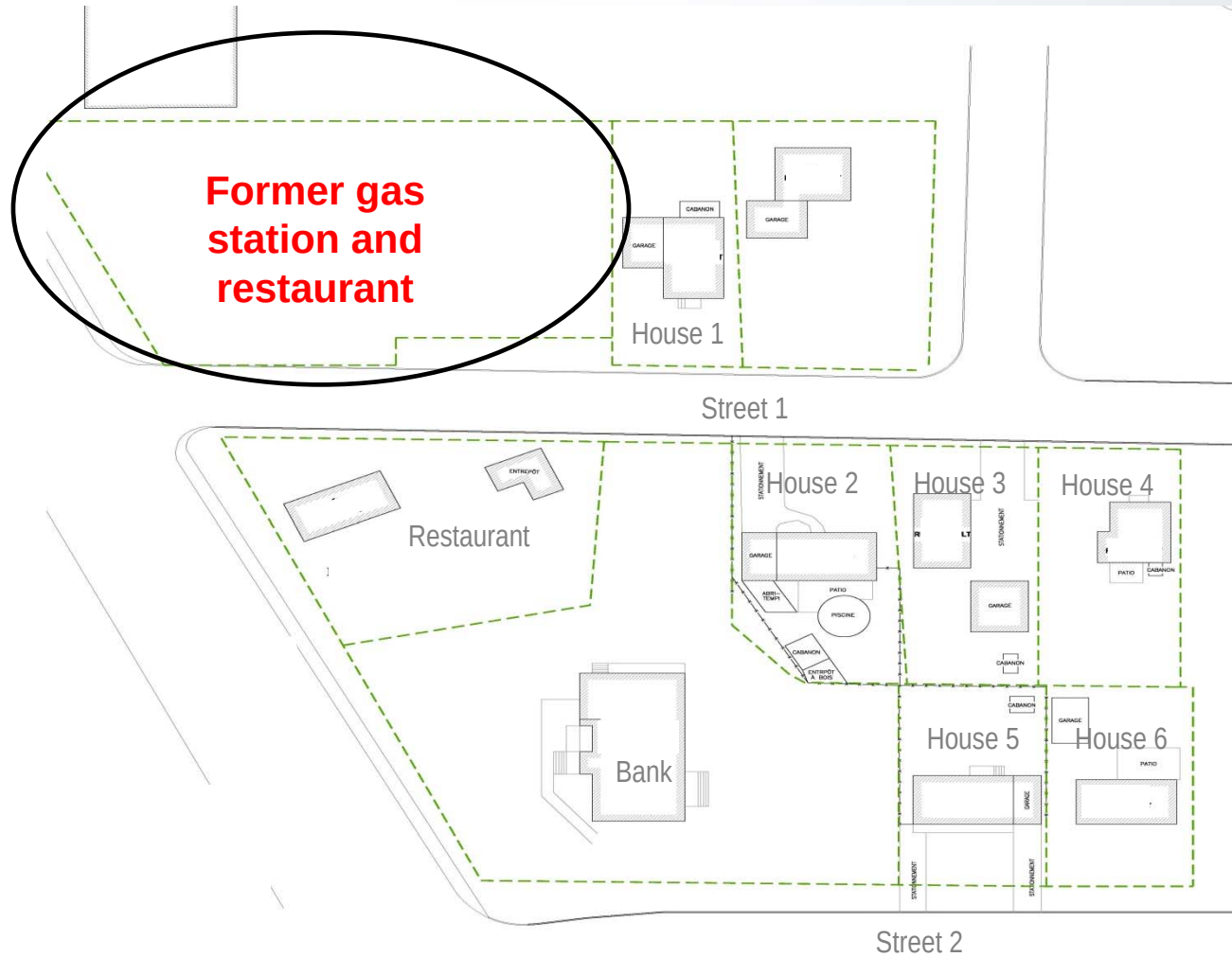
+ Site Environmental Background



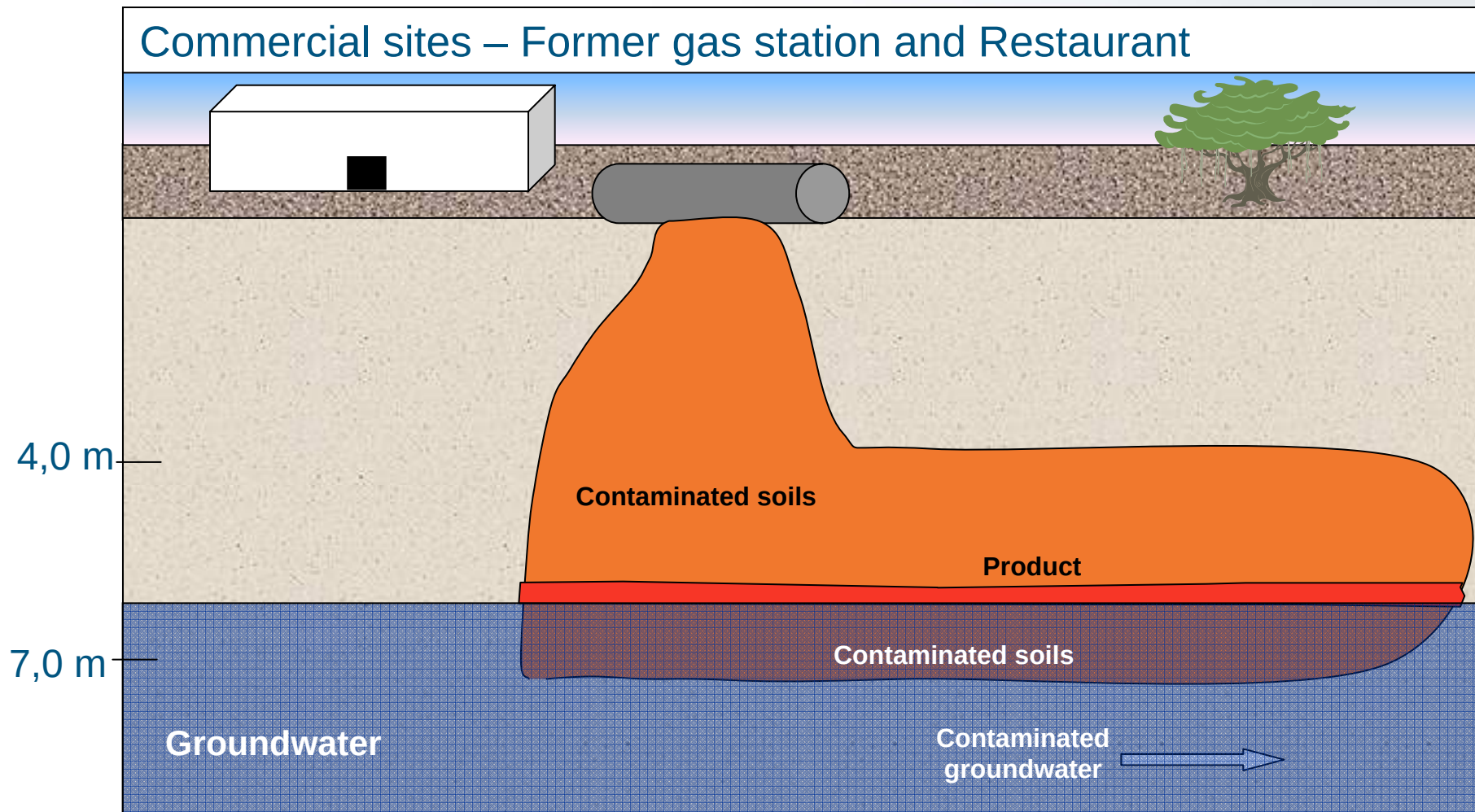
+ Site Environmental Background



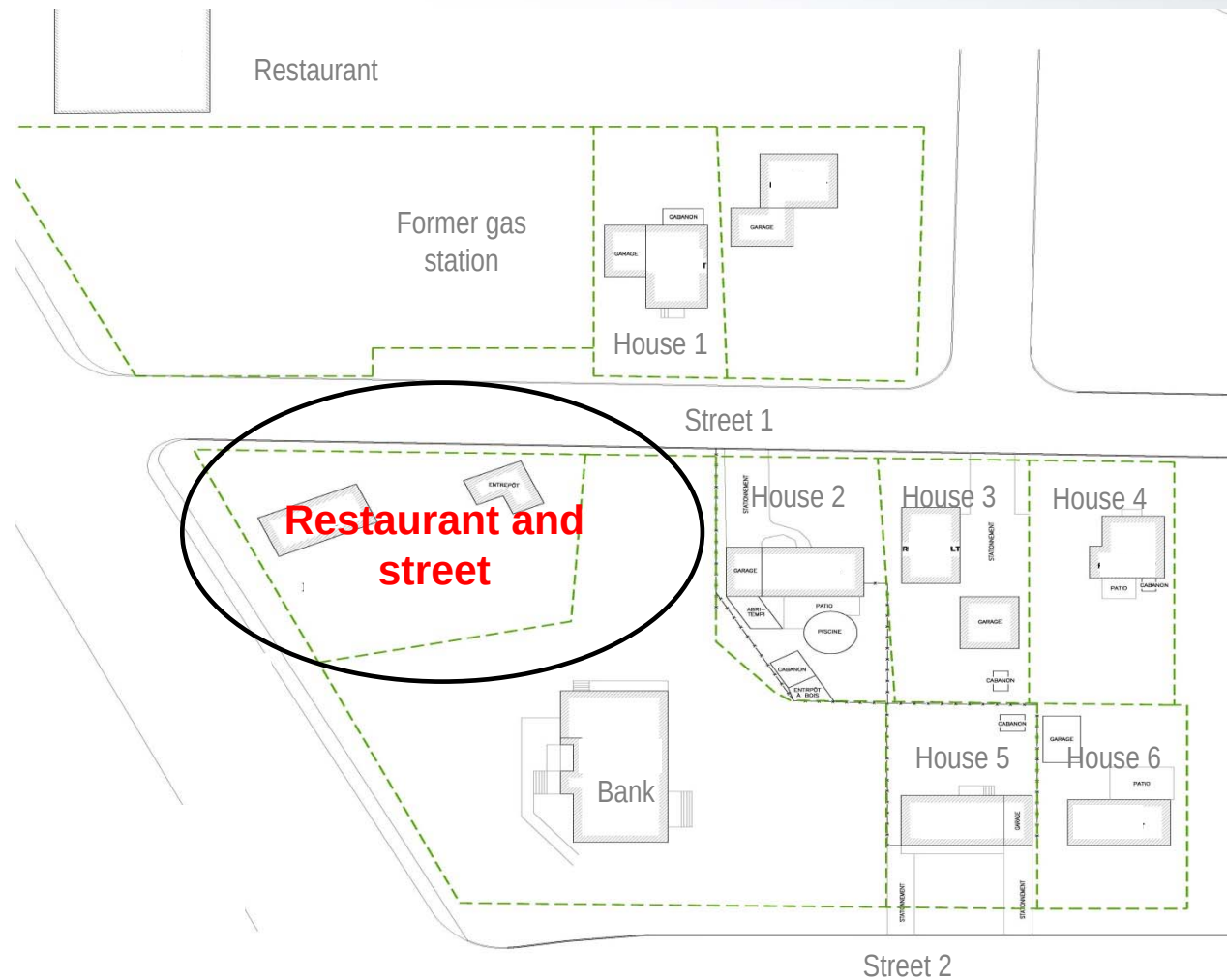
+ Site Environmental Background



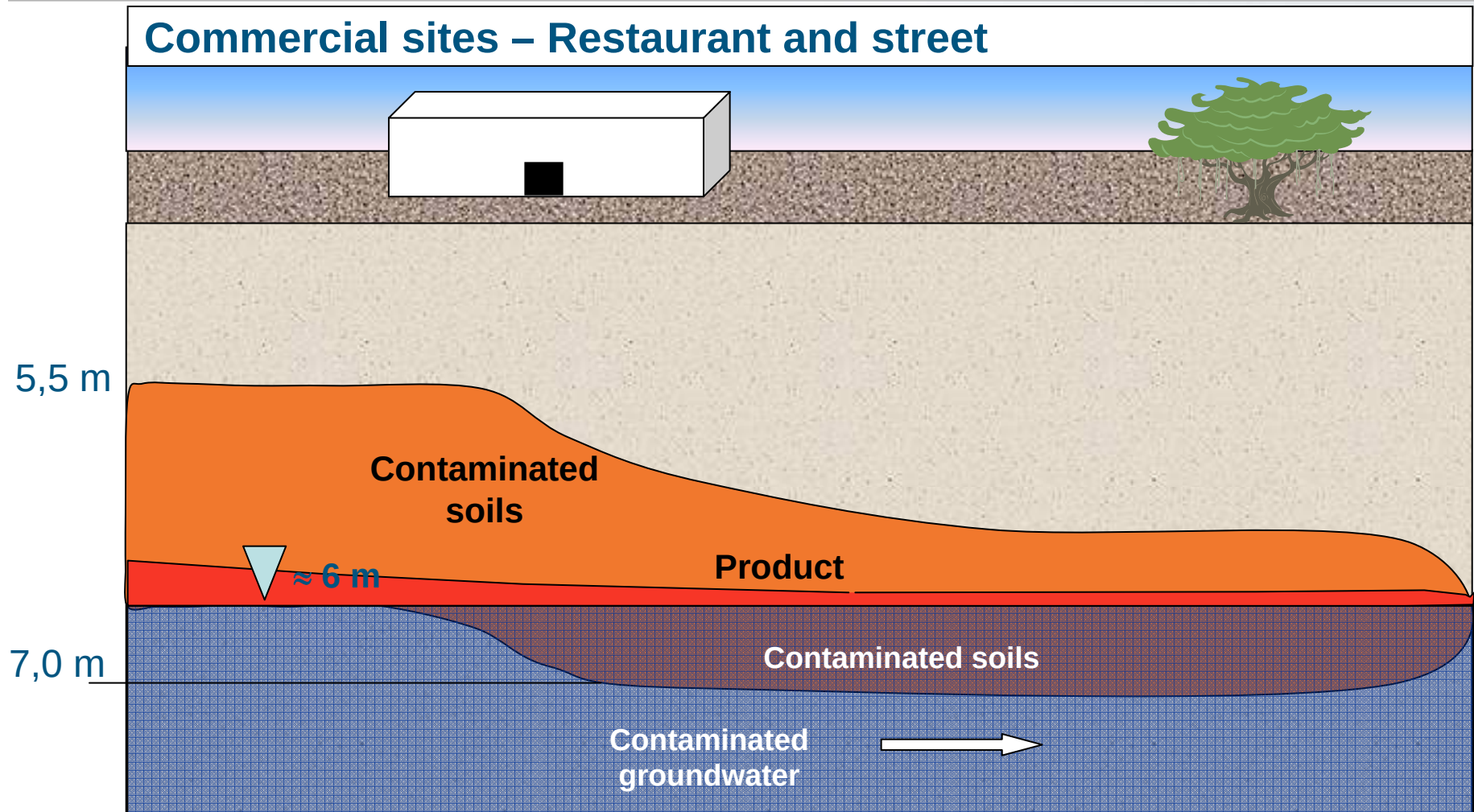
+ Site Environmental Background



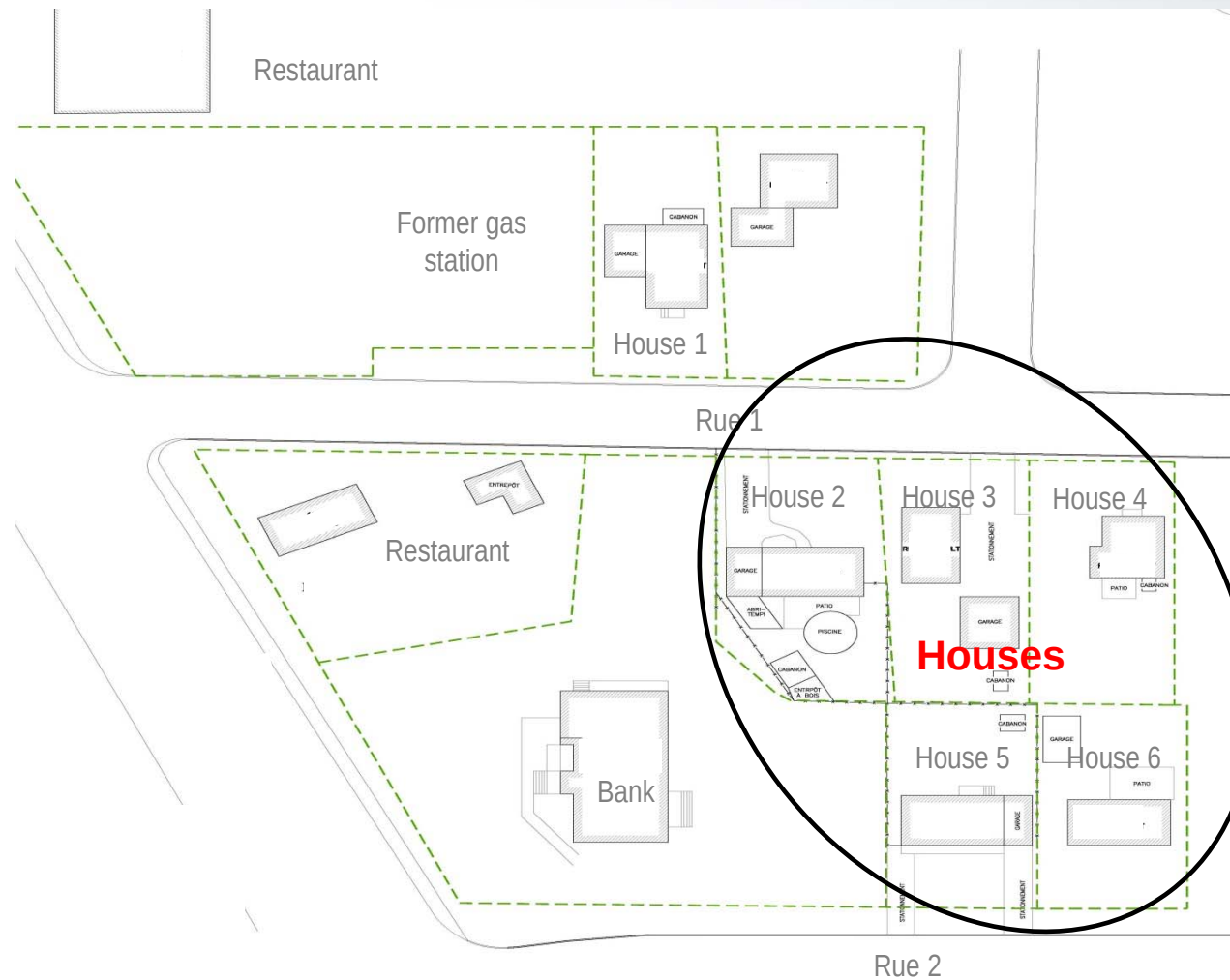
+ Site Environmental Background



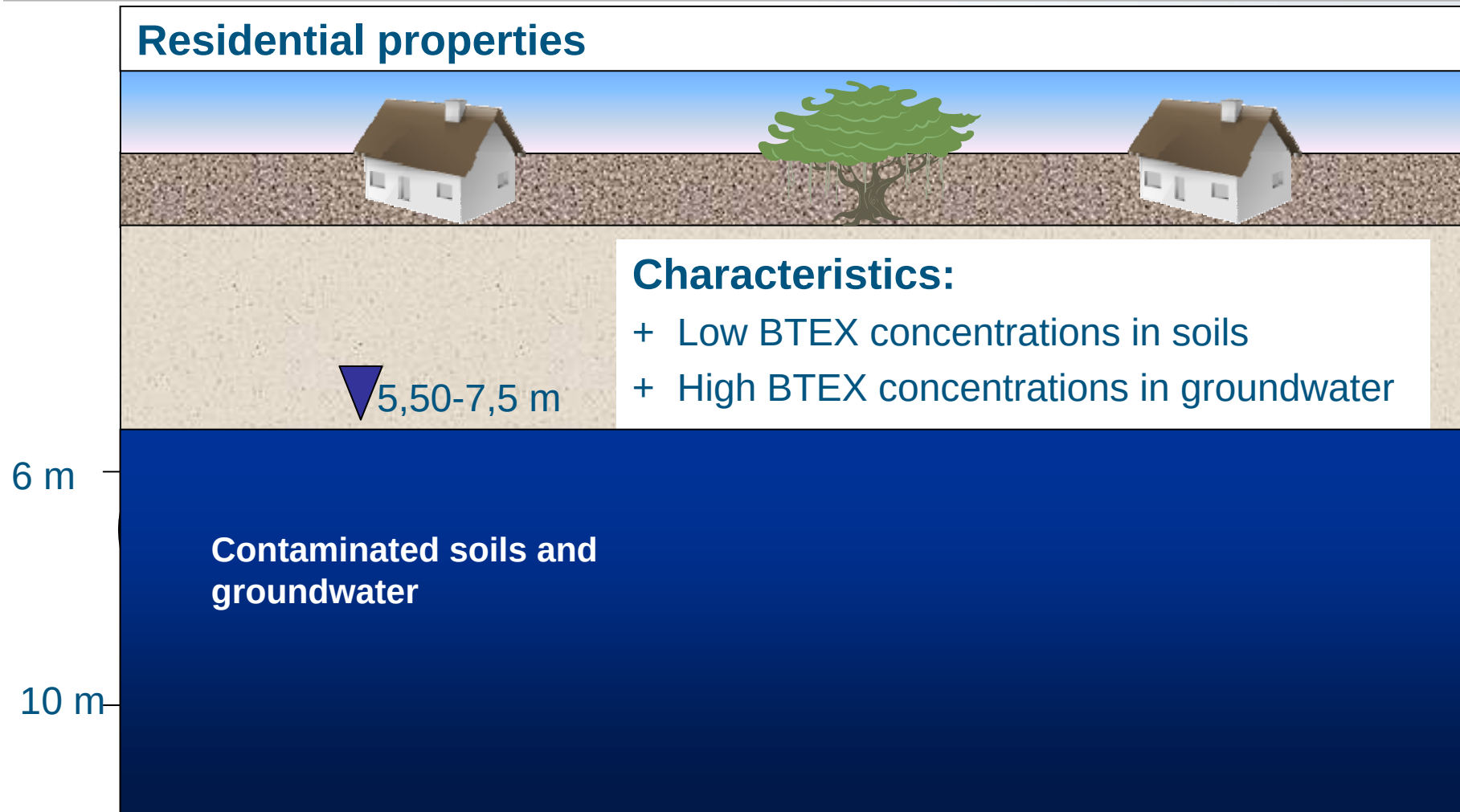
+ Site Environmental Background



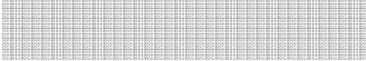
+ Site Environmental Background



+ Site Environmental Background





-  + Site Description
-  + Applicable Legislation
-  + Site Environmental Background
-  + **Challenges**
-  + Remediation Technologies
-  + Results
-  + Conclusions
-  + Questions

+ Challenges

- + 10 contaminated sites
- + Presence of commercial activities
- + Buildings, private houses, landscaping
- + Many stakeholders including: residents, business owners, municipality
- + Sites located on busy streets
- + Environmental problematic differed from one site to another

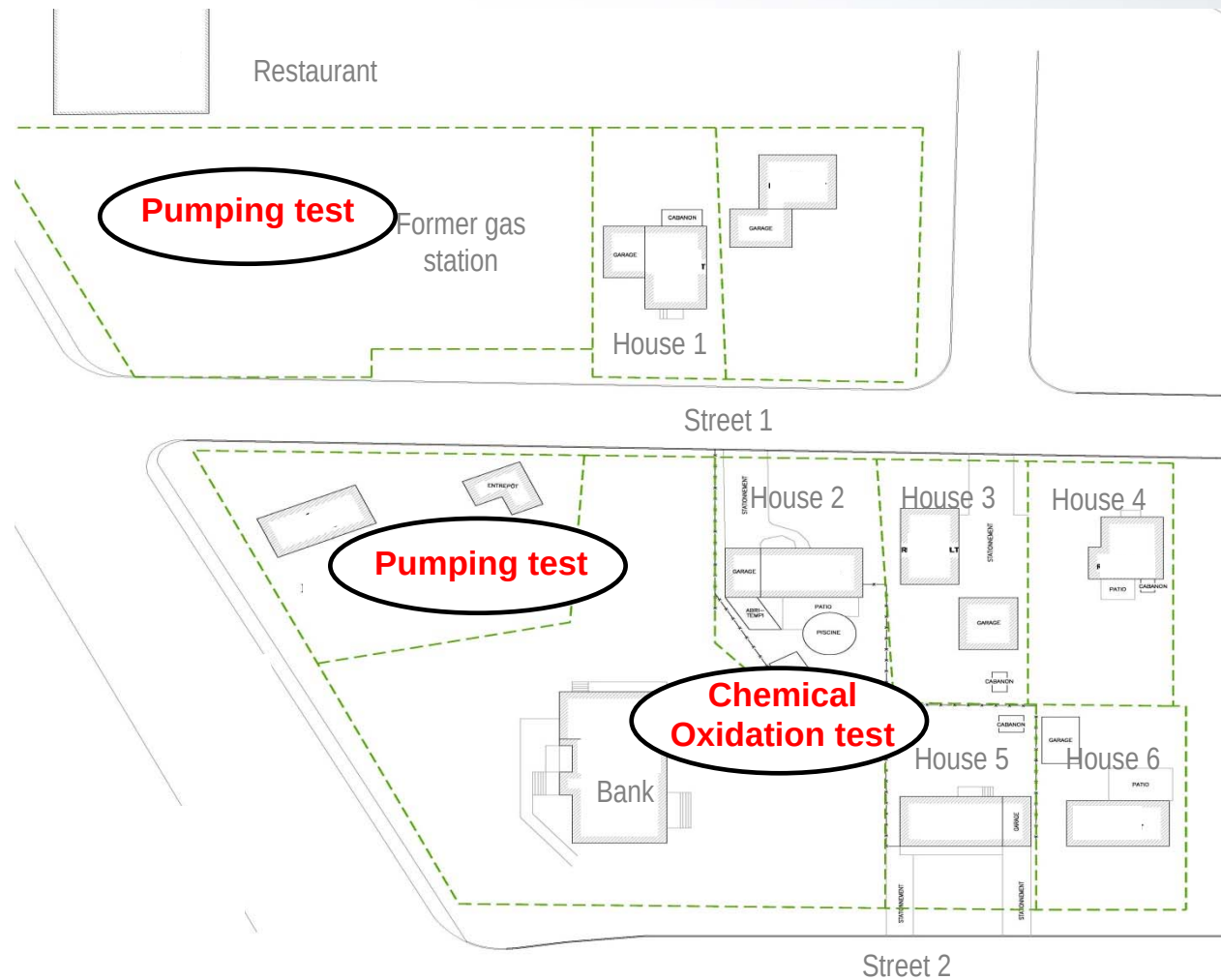
+ Challenges





-  Site Description
-  Applicable Legislation
-  Site Environmental Background
-  Challenges
-  **Remediation Technologies**
-  Results
-  Conclusions
-  Questions

+ Remediation Technologies



+ Remediation Technologies

Pumping test:

- + Realized on two sites at different season
- + Pumping of groundwater and air from the geological formation from a given observation well and monitoring the influence to determine:
 - Radius of influence
 - Viability of the technology under field conditions
 - Type and size of equipments
 - Quantity of the extraction and the injection wells
 - Quantity of the pumping wells if necessary

+ Remediation Technologies

Pumping test (Suite):

+ Results:

- Large influence of radius
- Easy to lower the groundwater
- Coherent test results (both tests)

+ Excellent field conditions for applying technologies:

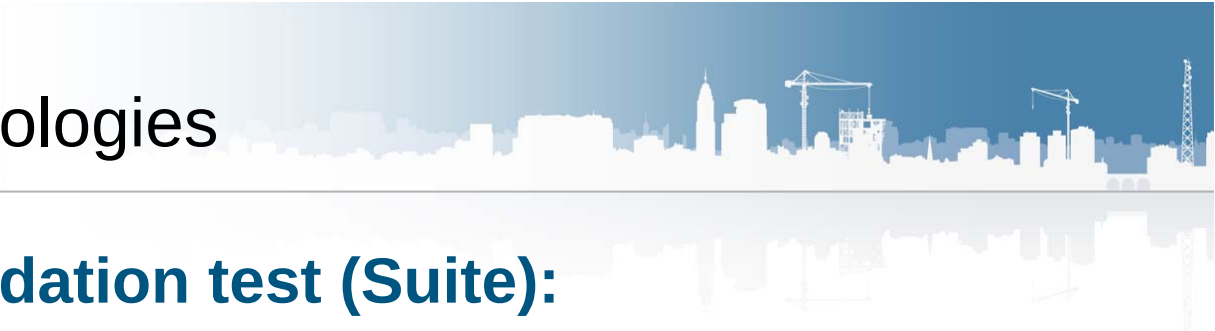
- Multi-Phase Extraction
- Pump and treat
- Sparging

+ Remediation Technologies

Chemical Oxidation test:

- + Proposed technology to be used for residential sites:
 - Contaminated soils located in the saturated zone
 - Possibility to remediate the soils and the water in the same time
 - Good field conditions for technology
- + Injection of an oxidant (sodium persulfate) and a catalyst (chelated iron or caustic soda) in the soil to determine:
 - Natural oxydant demand (NOD)
 - Radius of influence
 - Viability of technology under field conditions
 - Quantity of the injection points

Remediation Technologies



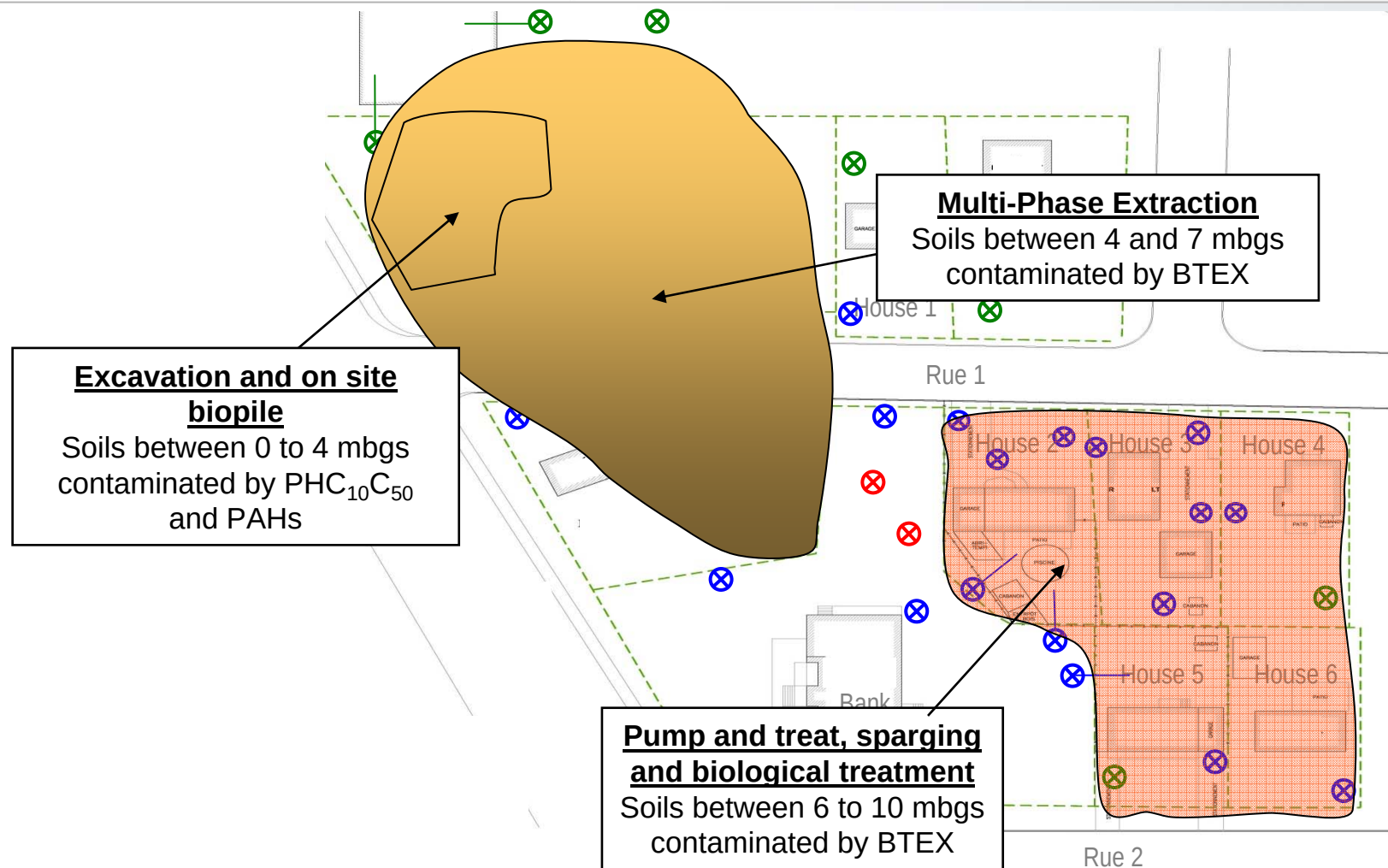
Chemical Oxidation test (Suite):

+ Results:

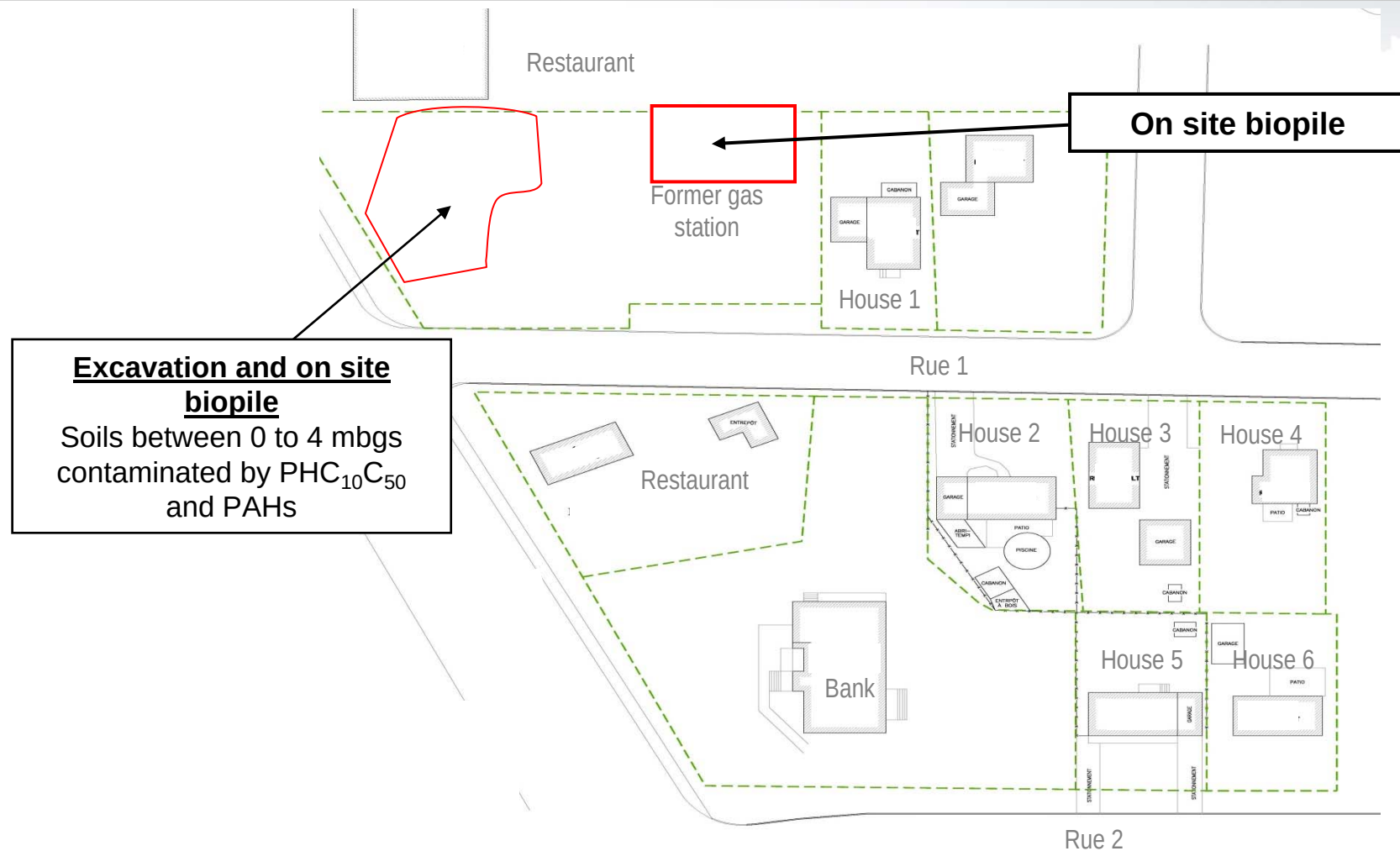
- Good influence of radius
- Good product repartition
- Easy to inject the product (low pressure injection)

+ Technology not selected for reasons of cost

+ Remediation Technologies



+ Remediation Technologies – On site Biopile

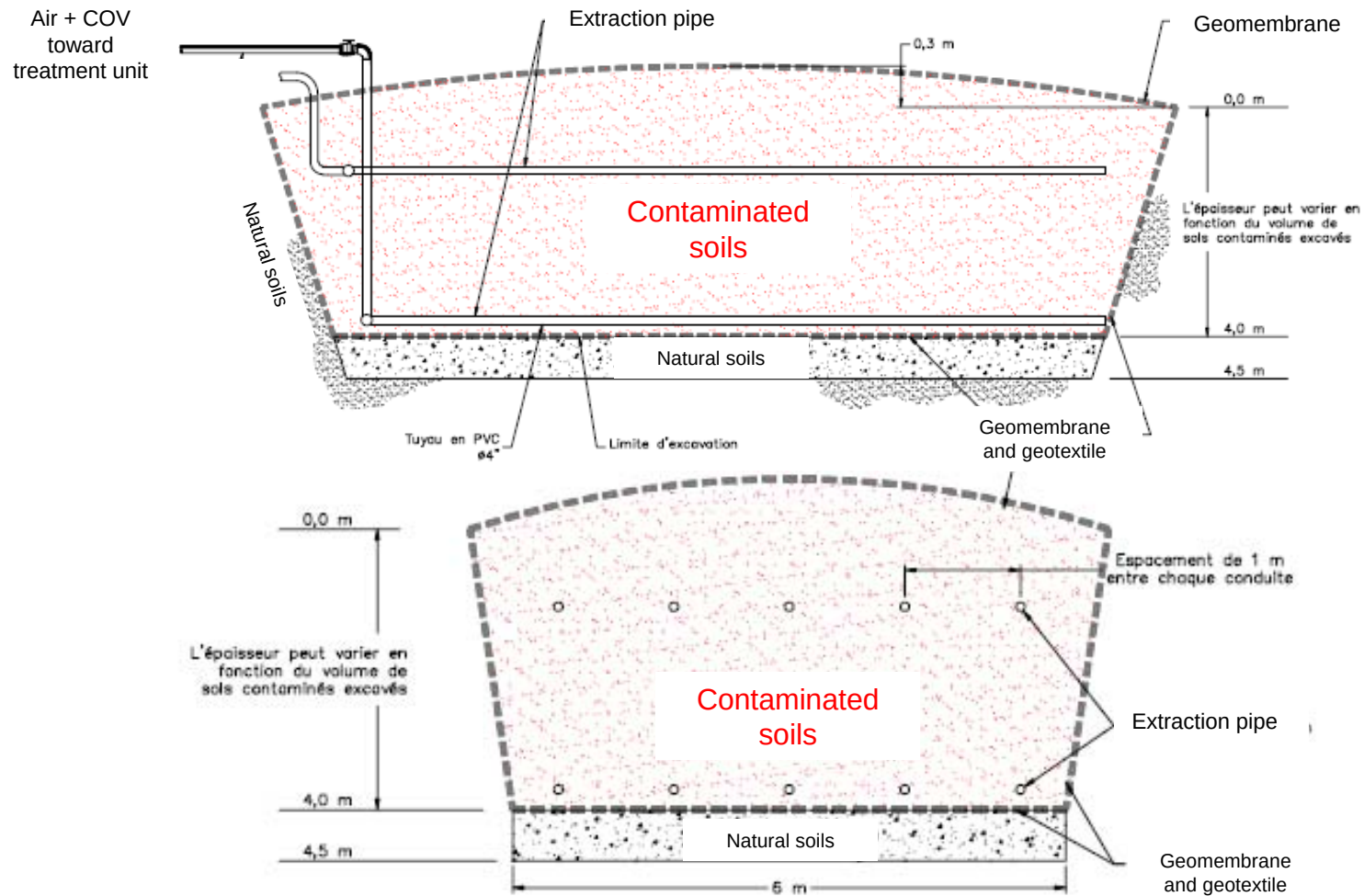




Remediation Technologies – On site Biopile

- + Located to the south and southwest of the former gas station
- + Soil between 0 and 4 mbgs
- + Advantages:
 - Presence of PAH contamination biologically treatable
 - Underground Biopile: reduce odours and visual impact for neighbours
 - Treatment parameters easy to control
 - Less expensive than dig and dump, even more in remote sites
- + Disadvantages:
 - Dust emission during implementation
 - Presence of machineries in a residential area
 - Requires demolition of existing structures

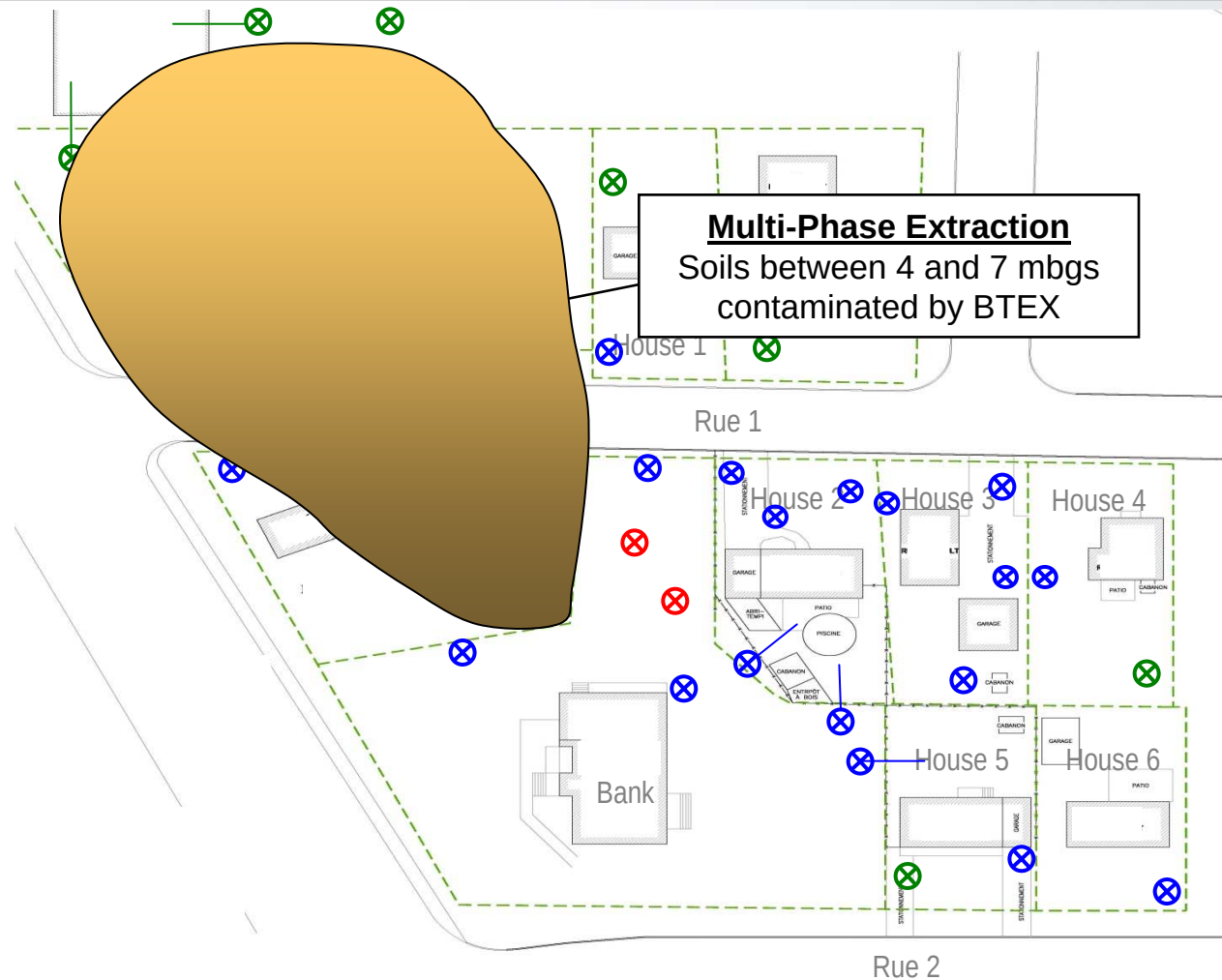
+ Remediation Technologies – On site Biopile



+ Remediation Technologies – On site Biopile



+ Remediation Technologies – Multi-Phase Extraction





+ Remediation Technologies – Multi-Phase Extraction

+ Commercial Area

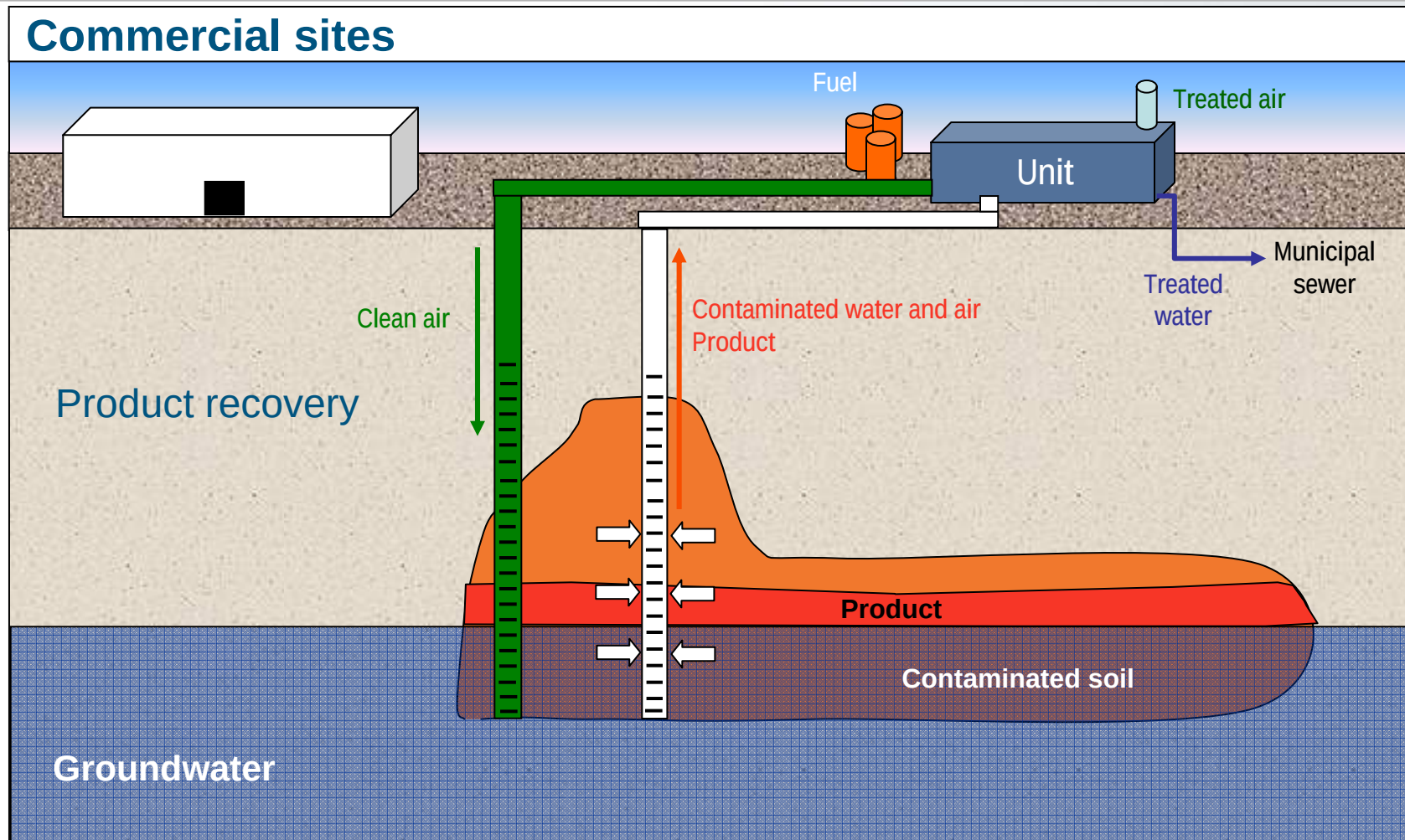
+ Advantages:

- Allow treatment of impacted soils at depth
- Provide possibility of lowering the water table
- Less impact on neighbours
- No structure support required
- Technology easily applicable to light hydrocarbon

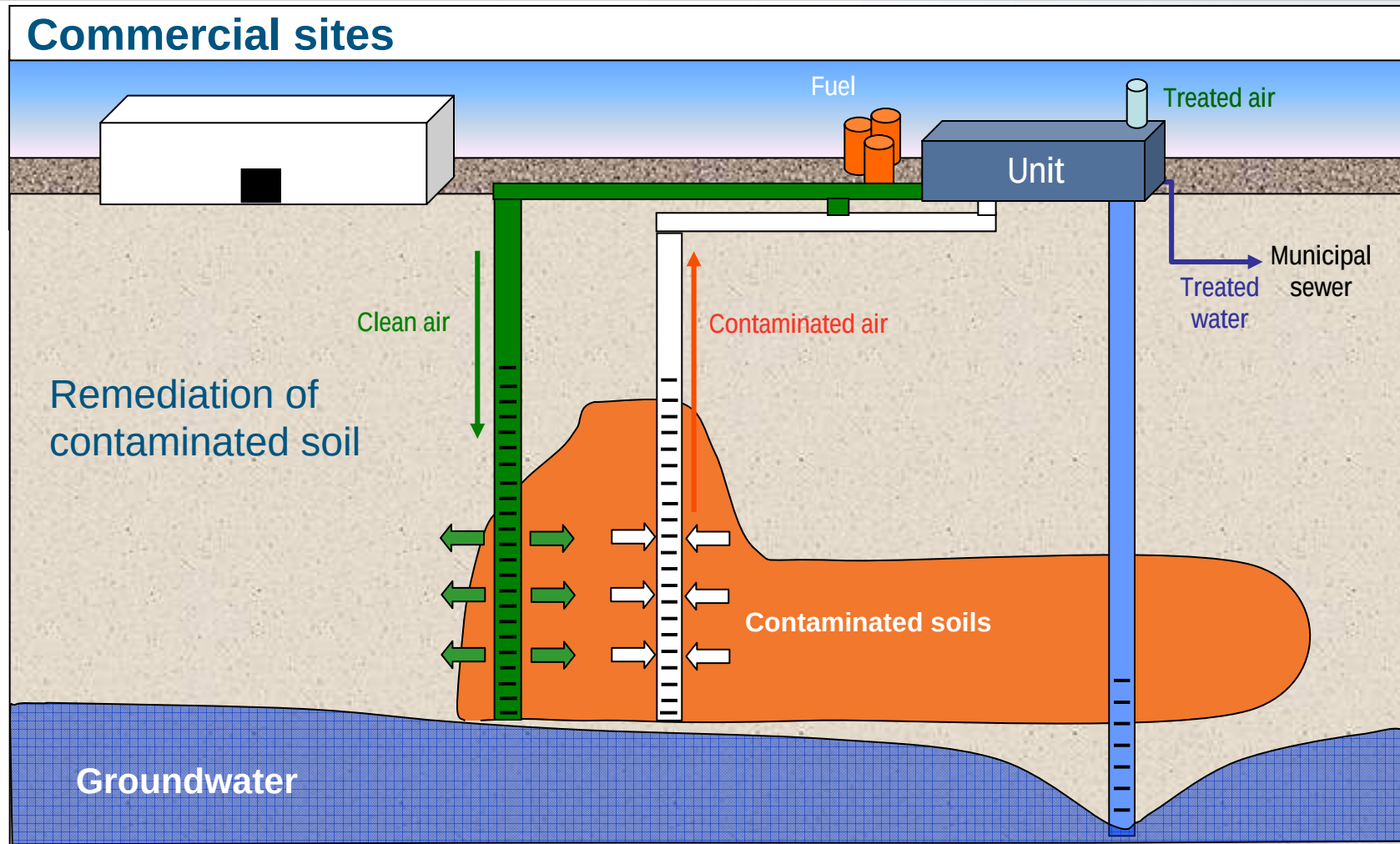
+ Disadvantages:

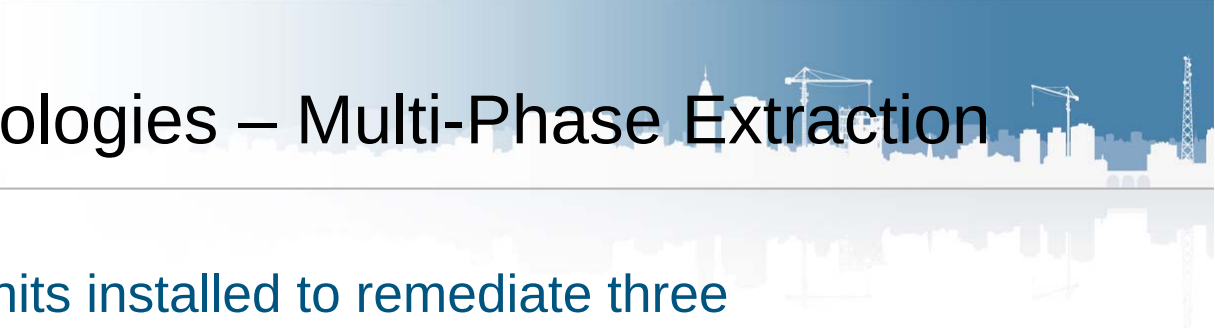
- Treatment parameters harder to control

+ Remediation Technologies – Multi-Phase Extraction



+ Remediation Technologies – Multi-Phase Extraction





Remediation Technologies – Multi-Phase Extraction

- + Two treatment units installed to remediate three commercial properties and one street
- + Treatment units connected to 68 extraction and 78 injection wells
- + Four pumping wells installed for lower the groundwater level

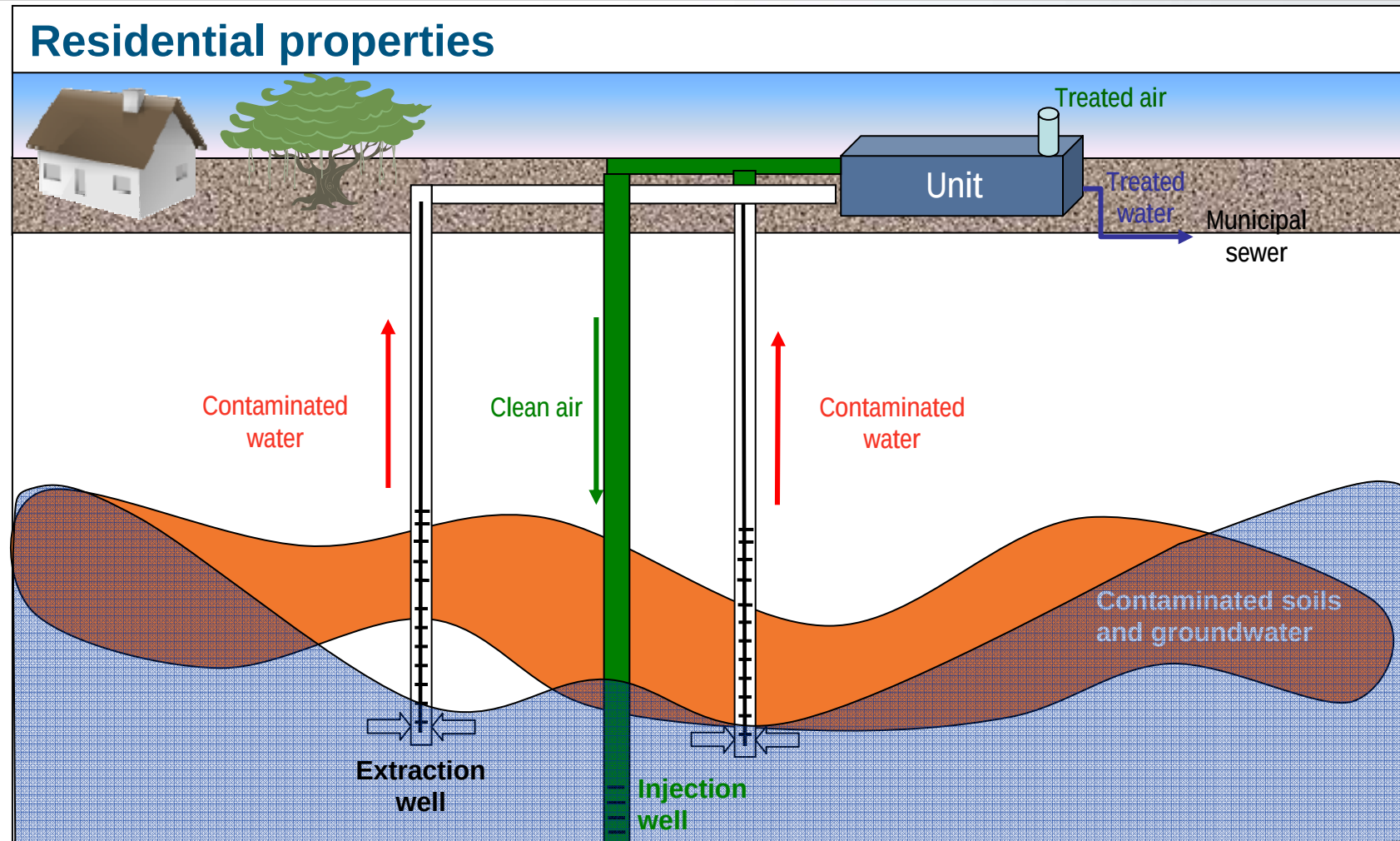
+ Remediation Technologies – Multi-Phase Extraction



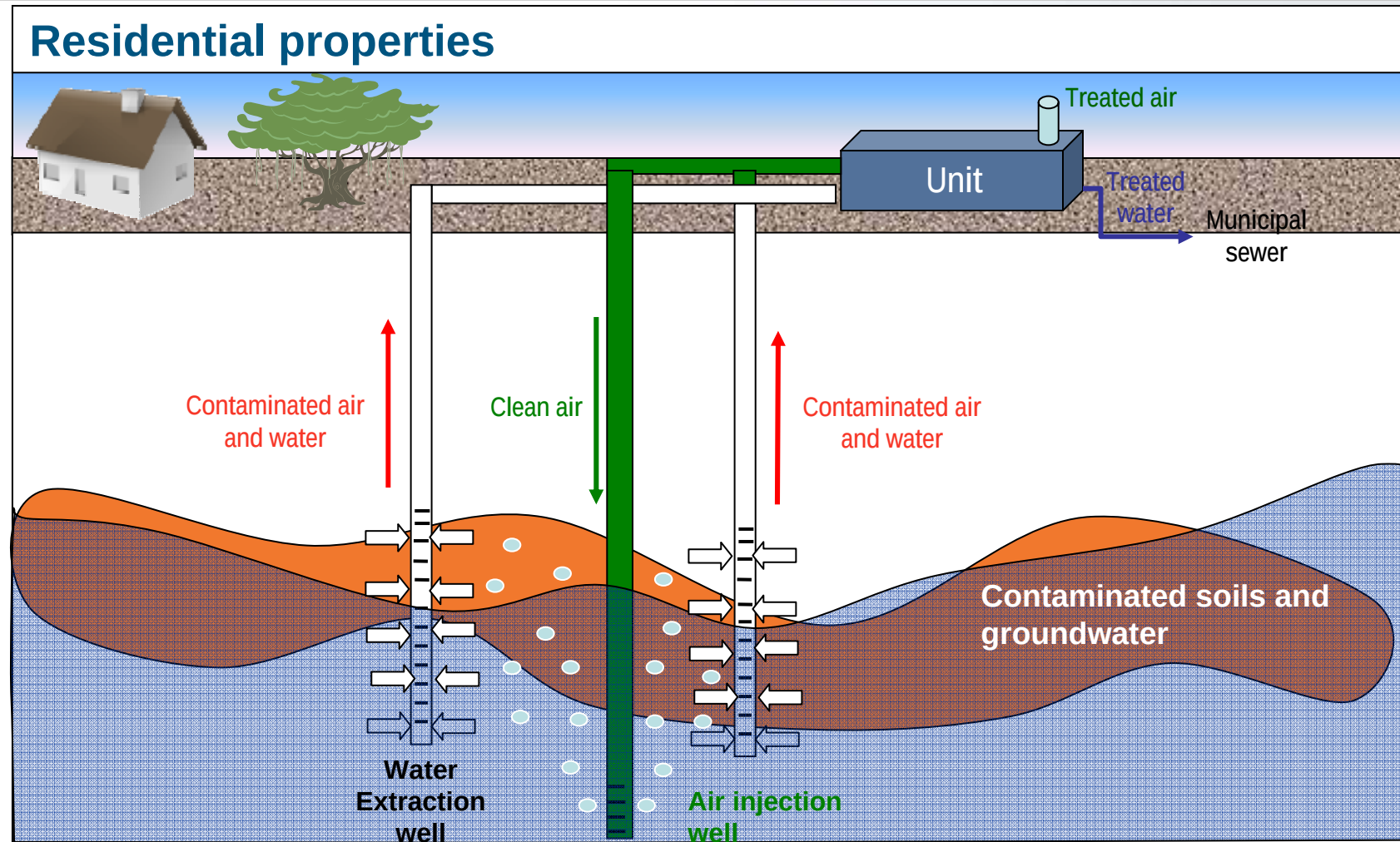
+ Remediation Technologies – Pump and Treat / Sparging

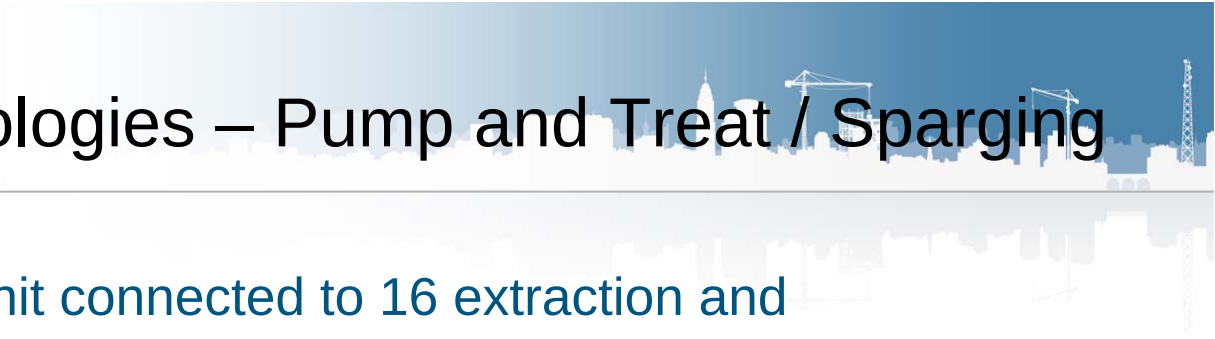
- + Residential properties
- + Three combined technologies:
 - Pump and treat
 - Sparging
 - Biologic treatment
- + Versatile technology allows :
 - To remediate in depth contaminated soils
 - To remediate contaminated soils in both vadose and saturated layers
 - To adjust the operation conditions of the system to the groundwater level

+ Remediation Technologies – Pump and Treat / Sparging



+ Remediation Technologies – Pump and Treat / Sparging





Remediation technologies – Pump and Treat / Sparging

- + One treatment unit connected to 16 extraction and 7 injection wells
- + Underground piping installed with a torpedo to minimize the impacts on the properties
- + Two pumping stations

+ Remediation Technologies – Pump and Treat / Sparging





-  + Site Description
-  + Applicable Legislation
-  + Site Environmental Background
-  + Challenges
-  + Remediation Technologies
-  + **Results**
-  + Conclusions
-  + Questions

+ Results

Commercial sites

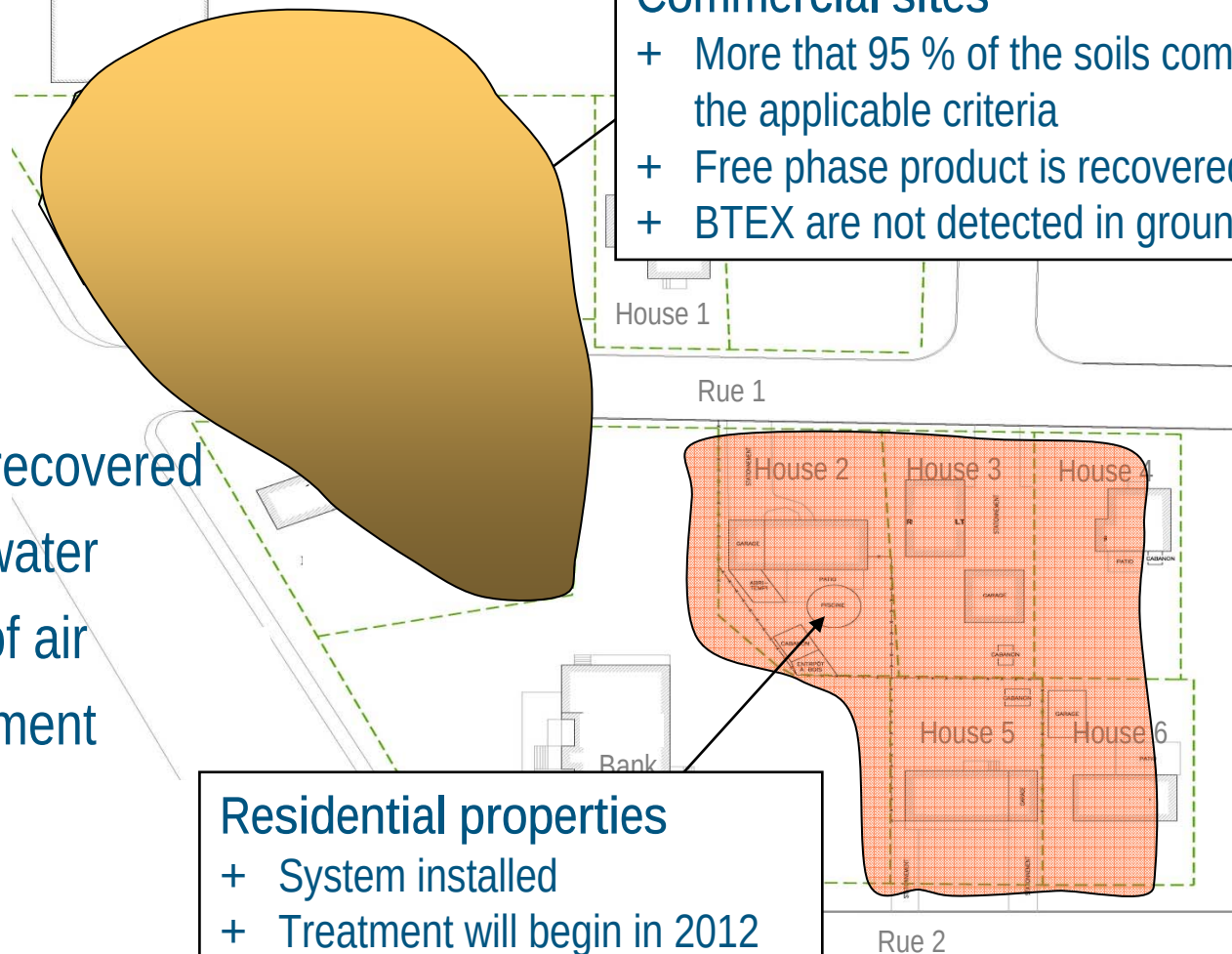
- + More that 95 % of the soils comply with the applicable criteria
- + Free phase product is recovered
- + BTEX are not detected in groundwater

So far:

- + 35 tons of gas recovered
- + 550 000 m³ of water
- + 18 millions m³ of air
- + 3 years of treatment

Residential properties

- + System installed
- + Treatment will begin in 2012





-  Site Description
-  Applicable Legislation
-  Site Environmental Background
-  Challenges
-  Remediation Technologies
-  Results
-  Conclusions
-  Questions

+ Conclusions

- + Monitoring wells installation
- + Communications with landowners

+ Questions



???



Thank you for your attention

www.lvm.ca

