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CONSULTING CORP.  
Environment & Land Management

# REMEDIATION TECHNOLOGY SYMPOSIUM – 2010

## MULTI-PHASED ASSESSMENT AND REMEDIATION OF FORMER CAR DEALERSHIP TO RISK BASED STANDARDS UNDER THE BC CONTAMINATED SITES REGULATION CSAP PROCESS

Presented by:  
Cal Faminow, CTech  
EWD Consulting Corp.



# REMEDIATION TECHNOLOGY SYMPOSIUM – 2010

## » Outline

- A. Introduction
- B. Regulatory Framework
- C. Strategy
- D. Site Assessment
- E. Remediation
- F. Soil Vapour Assessment
- G. Screening Level Risk Assessment
- H. Detailed Risk Assessment
- I. Regulatory Complications
- J. Acknowledgements





## » Who is EWD?

- EWD is a Joint Venture between EBA Engineering and Focus Corp. and operating out of our Fort St. John, BC office and servicing Northeastern BC

## » Fort Motors Ltd. – Ford Dealership with 50 year history in Fort St. John

- Corporate Citizen and Leader in Community
- Moved to new location and committed to manage environmental responsibilities



# REGULATORY FRAMEWORK

- » Environmental Management Act, *Contaminated Sites Regulation* (CSR), B.C. Reg. 375/96, deposited 1996/12/16, O.C. 1480/96, effective 1997/04/01 [including amendments up to B.C. Reg. 112/2010, May 1, 2010].
- » Environmental Management Act, *Hazardous Waste Regulation* (HWR), B.C. Reg. 63/88, deposited 1988/02/18, O.C. 268/88, effective 1988/04/01 [including amendments up to B.C. Reg. 63/2009].



# REGULATORY FRAMEWORK

- » Technical Guidance on Contaminated Sites Document 1 – Site Characterization and Confirmation Testing
- » Technical Guidance on Contaminated Sites Document 3 – Environmental Quality Standards
- » Technical Guidance on Contaminated Sites Document 4 – Vapour Investigation and Remediation (Drafts)
- » Technical Guidance on Contaminated Sites Document 4 – Vapour Investigation and Remediation
- » Technical Guidance on Contaminated Sites Document 6 – Applying Water Quality Standards to Groundwater and Surface Water
- » Technical Guidance on Contaminated Sites Document 7 – Supplemental Guidance for Risk Assessments
- » Technical Guidance on Contaminated Sites Document 8 – Groundwater Investigation and Characterization
- » Technical Guidance on Contaminated Sites Document 10 – Checklist for Reviewing a Preliminary Site Investigation (PSI)
- » Technical Guidance on Contaminated Sites Document 11 – Checklist for Reviewing a Detailed Site Investigation (DSI)
- » Technical Guidance on Contaminated Sites Document 12 – Statistics for Contaminated Sites
- » Technical Guidance on Contaminated Sites Document 18 – Standards for Substances in Schedule 10 in the Contaminated Sites Regulation.
- » Interim Guidance for Contaminated Sites – Soil Vapour Assessments
- » Protocol 6 – Eligibility of Applications for Review by Approved Professionals
- » Protocol 7 – Regulation of Petroleum Hydrocarbons in Water under the Contaminated Sites and Special Waste Regulations
- » Protocol 11 – Upper Cap Concentrations of Substances
- » Protocol 12 – Site Risk Classification, Reclassification and Reporting
- » Protocol 13 – Screening Level Risk Assessment
- » Protocol 16 – Determining the Presence and Mobility of Nonaqueous Phase Liquids and Odorous Substances.
- » Protocol 17 – Requirements for Notifications of Independent Remediation and Offsite Migration



# FORT MOTORS STRATEGY

## » 16 City Lots

4 different activities/parcels

- Parcel A - Sales/Admin Building, former USTs/fuelling facility
- Parcel B - Used Car Lot
- Parcel C - Service and Parts Building
- Parcel D - Storage Compound



# FORT MOTORS STRATEGY

## » Strategy - Split dealership into 4 separate parcels based on regulatory complexity

A: Complex – known off-site issues

B: Somewhat Simple

C: Somewhat Complex

D: Simple





# FORT MOTORS STRATEGY



# SITE INVESTIGATIONS

## Parcel B – Stage 1 and 2 PSI

- » APECs – Former Drum Storage Area (decommissioned in 1990s), Fill from unknown source, surface contamination from parked vehicles and off-site Waste Oil AST on Parcel C;
- » Nine boreholes drilled;
- » Groundwater and soil impacts were not identified from on-site APECs.

## Parcel D – Stage 1 and 2 PSI

- » APEC – Fill from unknown source and potential surface contamination from parked vehicles;
- » Four boreholes drilled;
- » Groundwater and soil impacts were not identified.

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# SITE INVESTIGATIONS

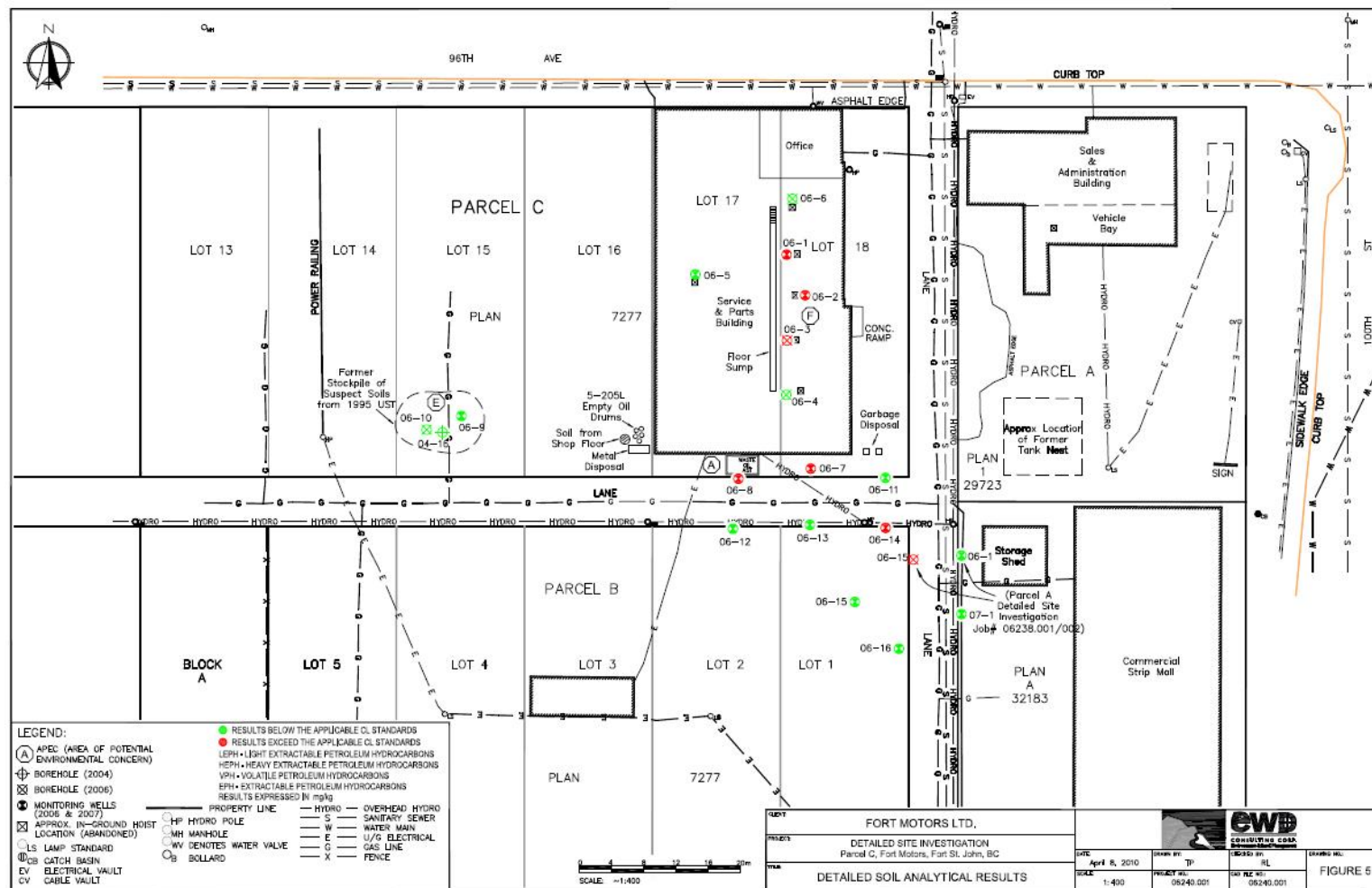
## Parcel C – Stage 1 and 2 PSI, DSI

- » APECs – Waste Oil AST, Parcel A USTs, Parts Cleaning, Fill from Unknown Source, In-ground Vehicle Hoists, Former Soil Stockpile (Parcel A tank pull), Former Waste Oil Drum Storage;
- » Seventeen boreholes drilled;
- » Hydrocarbon soil and groundwater impacts identified from waste oil AST and in-ground hoists;
- » Soil contamination found to extend off site onto City laneway and Parcel B.



# SITE INVESTIGATIONS

## Parcel C

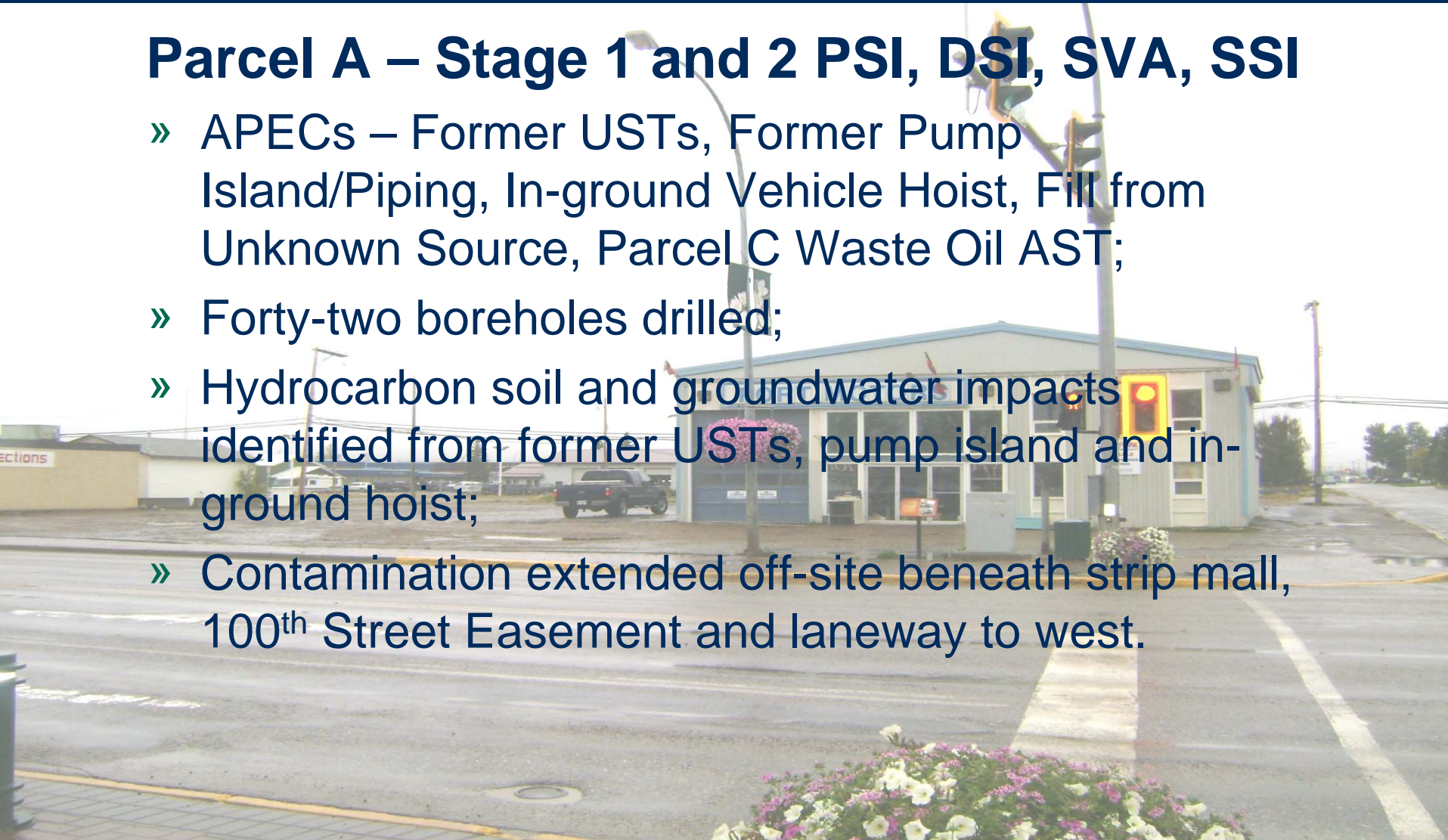




# SITE INVESTIGATIONS

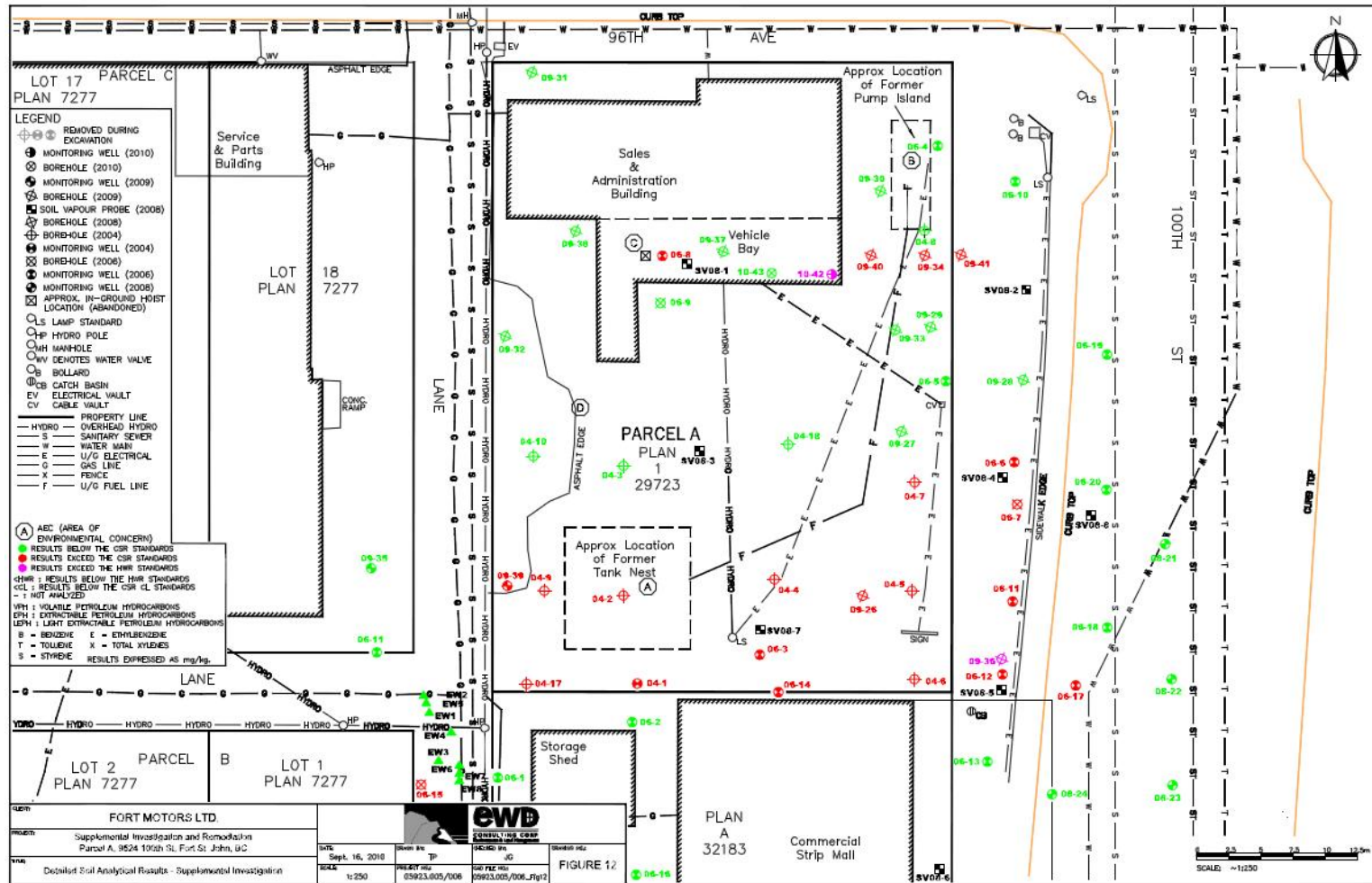
## Parcel A – Stage 1 and 2 PSI, DSI, SVA, SSI

- » APECs – Former USTs, Former Pump Island/Piping, In-ground Vehicle Hoist, Fill from Unknown Source, Parcel C Waste Oil AST;
- » Forty-two boreholes drilled;
- » Hydrocarbon soil and groundwater impacts identified from former USTs, pump island and in-ground hoist;
- » Contamination extended off-site beneath strip mall, 100<sup>th</sup> Street Easement and laneway to west.



# SITE INVESTIGATIONS

## Parcel A



# TROUBLE SHOOTING

## » Over Temperature Samples Due to Shipping Delays

- 84.4% reduction applied (worst case scenario) to BTEX/VPH/LEPH/HEPH;
- Derived from study by Alan D. Hewitt that investigated the effects that high temperature (i.e. 22 °C) had on degradation of benzene and toluene concentrations in soil samples;
- Resulted in very conservative numbers.

## » Metal Anomaly

- Extremely high antimony, lead and tin results in duplicate fill sample;
- Resulted in 20 m spacing analysis of shallow fill to investigate potential metal contamination and further assessment work in vicinity of metal hit;
- Normal distribution and outliers tested. Anomalous result determined to be an outlier. Value is also well outside of the 95% confidence interval;
- A second population was not identified during assessment. The result was attributed to laboratory error or more likely a piece of metal present in the duplicate, which is not representative of soil concentrations.





# REMEDIATION

## 4 Excavation Phases to Date

- » Laneway south and east of Parcel C and Portion of Parcel B;
- » Parcel A – UST basin, offsite in 100 St. RoW and south onto strip mall property;
- » Parcel C inside service area to manage contamination associated with in-ground hoists;
- » Parcel A – Pump Island/distribution line;
- » Approximately 3,400 tonnes of soil was excavated and disposed of at a secure landfill;
- » **5th excavation** scheduled for Oct 2010 to remove HW identified beneath vehicle wash bay in Sales Building.





# REMEDIATION



# SOIL VAPOUR ASSESSMENT

- » **Completed for Parcel A only**
- » February 2008 – Moe Issues the Interim Air Concentration Criteria (ACC).
  - Soil vapour becomes a regulated media.
  - Draft Interim Guidance and early draft of Technical Guidance Document 4.
    - Model breathing zone (indoor and outdoor) with attenuation factors.
    - Semi-volatile and volatile compounds.
    - No detectable concentration required for trigger (later amended).
- » Completed First Sampling Event in September 2008.
- » January 1, 2009 – MoE Introduces Sixth Amendment to the CSR
  - Schedule 11 introduced that provides the Generic Numerical Vapour Standards.
  - Supersedes the interim ACC brought out in February 2008.
  - Protective of human health only.
  - Revised draft Technical Guidance Document 4 introduced.
    - Attenuation factor can now be applied to very shallow soil vapour probes.
- » Second sampling event in April 2009.
  - Technical Guidance Document 4 finalized in September 2010
  - Attenuation factors provide greater relief for shallow soil vapour probes.



# SOIL VAPOUR ASSESSMENT

## Conceptual Site Model (CSM)

### Fort Motors Sales and Administration Building

- » Slab-on-grade - soil vapour migration through cracks in the floor slab located in the vehicle bay.
- » Plumbing and utilities sealed with concrete or enters the building from the outside, above the floor slab.

### Strip Mall

- » Earth crawl space.
- » Soil vapour migration into the building would occur from the crawl space and enter the breathing zone of the main floor through any cracks or openings in the wood subfloor.

### Seasonal Variations and Preferential Pathways

- » Unclear if there would be a significant difference for indoor vapour intrusion during winter and summer months due to heating or air conditioning.
- » Significant amount of frost in the surficial soils surrounding the buildings may inhibit soil vapour intrusion into outdoor air.
- » Based on DSI results the utility backfill appears to be native clayey soils.

Detail	Fort Motors	Strip Mall
Tenants	Vacant	Audio Connections, Computer Factory, Canadian Water Services
Area	366 m <sup>2</sup> (0.037 hectares)	828 m <sup>2</sup> (0.083 hectares)
Building Construction	Wood and steel frame construction clad with aluminum siding	Brick walls and wood frame construction
Number of Floors (exc. Basement)	One	One
Foundation	Slab-on-grade	Wood subfloor with earth crawl space beneath
Sumps	Floor sump in vehicle hoist bay	Drainage sump in northwest portion of building
Floor Drains	None visible	None
Floor Cracks	Significant pitting and several large cracks in the vehicle bay	N/A
Heating	HVAC	HVAC
Heat Distribution	Forced air	Forced air
Air Conditioning	HVAC	HVAC
Water Supply	Municipal water	Municipal water
Septage	Municipal sewer	Municipal Sewer
Fill Material	Unknown/Fine grained soils	Sand and Gravel
Ground Cover	Asphalt and gravel fill	Asphalt and grass
Chemical Storage	General household cleaners	General household cleaners
Flooring	Vinyl floor tile and unfinished concrete	Carpet



# SOIL VAPOUR ASSESSMENT

## January 2009

- » CSAP Society releases draft PCOC list for different sites (i.e., waste oil, gasoline);
- » Non-detect VOC's in Parcel C;
- » Gasoline PCOC list targeted;
- » Draft screening PCOC list was not used (already numerous problems due to regulatory changes).

## Soil Vapour PCOC List (gasoline)

- » Benzene
- » 1,3,5 trimethylbenzene
- » Toluene
- » Isopropylbenzene
- » Ethylbenzene
- » Methyl tert-butyl ether (MTBE)
- » Xylene
- » 1,3 butadiene
- » n-hexane
- » Methcyclohexane
- » n-decane
- » 1,2 dibromethane (EDB)
- » 1,2,3 trimethylbenzene
- » Naphthalene
- » 1,2dichloroethane (DCA)
- » VPHv





# SOIL VAPOUR ASSESSMENT

## First Sampling Event – September 2008

### » Eight Shallow Soil Vapour Probes Installed

- Seven sampled, one discarded due to groundwater intrusion;
- SUMMA canisters and XAD sorbent tubes;
- Under draft ACC no standard for VPH and LEPH. Surrogate approach with n-hexane/toluene (VPH) and n-decane/naphthalene (LEPH);
- SUMMA can pick up hydrocarbons greater than C16 but no PAHs;
- Definition of VPH later extended to include C13, no LEPH. All PAHs except naphthalene later removed.

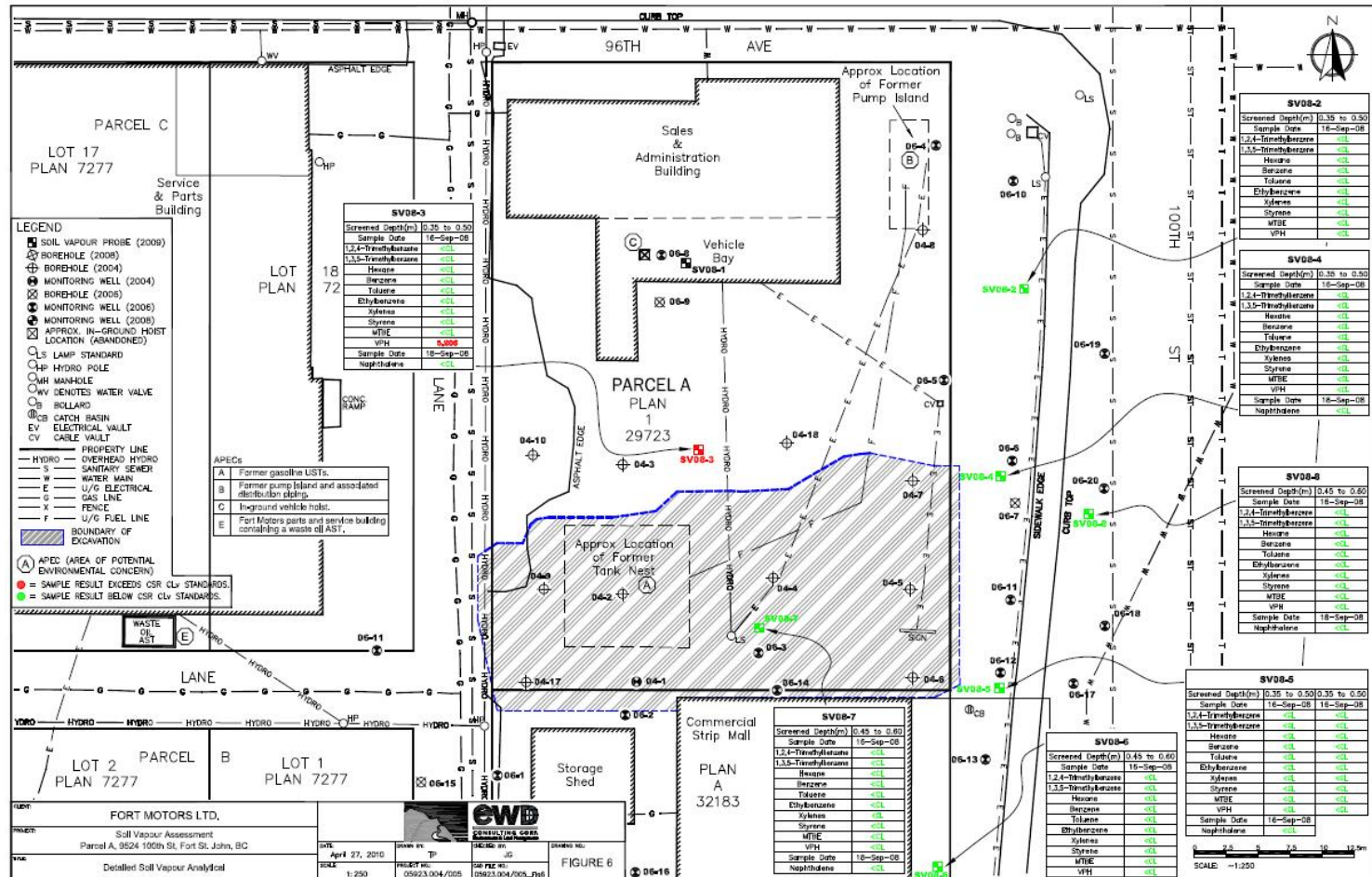
### » Two Indoor Air Samples And Two Outdoor Air Samples Collected

- Soil vapour concentrations beneath buildings not assessed due to shallow water table or presence of crawl space. Therefore, two air samples collected per building (minimum recommended frequency as per SAB report);
- Combination of SUMMA canisters, XAD sorbent tubes, charcoal sorbent tubes and thermal desorption tubes.



# SOIL VAPOUR ASSESSMENT

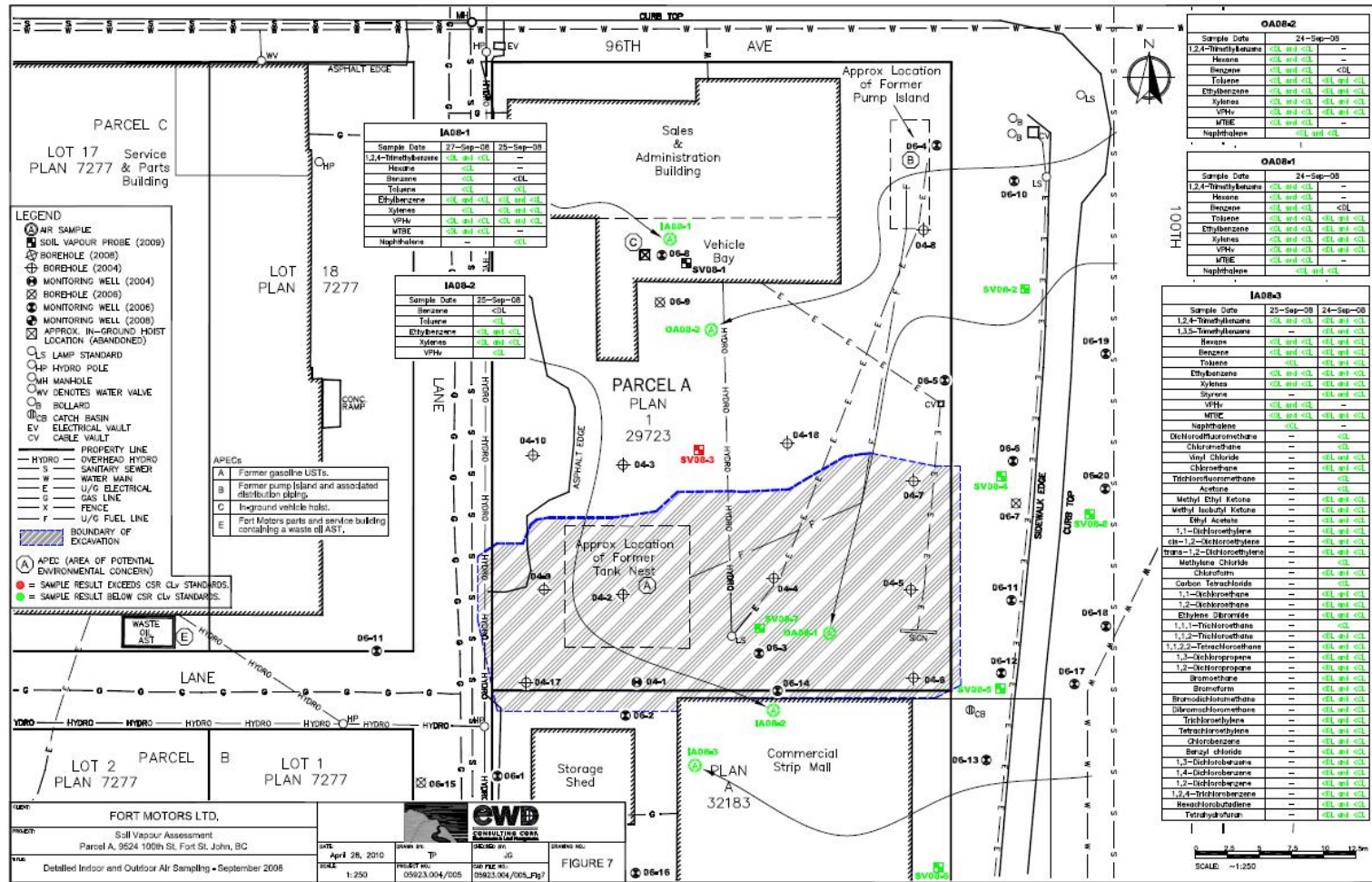
## SVP Sampling Event – September 2008





# SOIL VAPOUR ASSESSMENT

## Air Sampling Event – September 2008



# SOIL VAPOUR ASSESSMENT

## Second Sampling Event – April 2009

### » Eight Indoor Air Samples Collected

- Four samples per building determined sufficient to characterize one floor (two minimum recommended in the SAB report).

### » Eleven Outdoor Air Samples Collected

- Shallow attenuation factor not released until July 2009. Early soil vapour results without attenuation applied exceeded ACC or there were detection limit problems;
- First round of indoor and outdoor soil vapour sampling showed promising results;
- Target 20 m spacing across the Property and off-site areas.





# Air Sampling Event – April 2009



# SCREENING LEVEL RISK ASSESSMENT

## Regulatory Process

- » First level of risk assessment in BC – Protocol 13 – mainly qualitative assessment;
- » Used to assess risk from concentrations above CSR Standards.
- » Must have a completed DSI to do SLRA;
- » Determines whether pathway linking source of contamination to receptor (human or ecological) is complete;
- » Can be used to obtain a risk-based Certificate of Compliance (CoC).
- » Can be reviewed by Risk or Standards CSAP;
- » Simpler, quicker, and less expensive than detailed risk assessment or remediation for most sites;
- » Likely to be successful for sites with deep contamination, limited groundwater impacts, and no vapour issues.



# SCREENING LEVEL RISK ASSESSMENT

## Methodology

- » Determine if precluding conditions exist such as high-risk site, NAPL, preferential pathways;
- » Complete a problem formulation (describe sources of contamination, exposure pathways and receptors);
- » If ecological exposure possible, RPBio needs to do bioinventory (supplemental to usual DSI work);
- » Complete a questionnaire with “yes” and “no” answers. “Yes” answer means unacceptable risk;
- » Provide a recommendation for a CoC (pass SLRA) or for further detailed risk assessment/remediation (fail SLRA) based on questionnaire.



# SCREENING LEVEL RISK ASSESSMENT

## Fort Motors Site

- » Risk assessment only viable option as contamination beneath buildings and under roads - soil conditions not conducive to in situ remediation technologies.
- » Feasibility for SLRA success determined by reviewing DSI before starting work based on:
  - No precluding conditions;
  - Soil contamination > 1m deep;
  - No groundwater use;
  - No vapour issues.
- » Detailed risk assessment in separate CoC being used to address off-site contamination, where there are precluding conditions (i.e. NAPL indicator standards) and SLRA can't be used.





# DETAILED RISK ASSESSMENT

- » Used to address issues remaining after SLRA;
- » Quantitative assessment looking at combined assessment of toxicity (effects) and exposure for human and ecological receptors;
- » Specific to a particular site - looks at specific receptor types, their activities on site, toxicity of chemicals for particular site conditions, considers effects of uncertainties;
- » More expensive than SLRA (\$20K minimum);
- » Best for sites where remediation is expensive and/or long-term or where contamination cannot be accessed;
- » Can be combined with a remedial approaches to reduce remediation costs – through development of risk based standards and knowing which specific issue is driving the need for clean-up.



# DETAILED RISK ASSESSMENT - BC

- » Can be used to obtain a risk-based CoC but requires review by a Risk Standards CSAP - only 12 Risk Standards CSAPs in BC;
- » Higher CSAP/MoE review fees than for Standards CSR Instruments;
- » Requires sign-off of third-party affected property owners;
- » Perception - May not be perceived as being as “clean” as a site assessed using a standards approach, despite same level of protection applied for ecological and human receptors.



# DRA – Fort Motors

- » On-site contamination: Meets all requirements for SLRA (requires permission from MoE without removal of Haz Waste);
- » Will need to assess all contaminants exceeding standards (hydrocarbons) using DRA for human health (no ecological issues);
- » Need to look at all potential receptors (public, commercial workers, construction workers), exposure times, what activities they do on site (digging, working, etc.) and exposure pathways (breathing dust, ingesting soil, breathing vapours, skin contact with contamination).





# DRA – Fort Motors (cont.)

- » Need to look at appropriate toxicity values for chemicals that follow BC MoE hierarchy – US EPA, Health Canada, CCME, etc;
- » Use standard equations to calculate risk separately for carcinogens and non-carcinogens;
- » Determine if risk exceeds provincial benchmarks for carcinogens and non-carcinogens;
- » Determine reliability of risk assessment – data gaps, deviation from standard approaches, etc;



# REGULATORY COMPLICATIONS

## Issues

- » Disconnect between HWR and CSR;
- » Leachable BETX identified below sales building and off site areas resulting in classification as Hazardous Waste;
- » Requirement to register on/off site HW as In Situ Historical Hazardous Waste facility;
- » Cannot use P6 without permission from MoE – increases timeline without certainty;



# REGULATORY COMPLICATIONS (cont.)

## Solution

- » Cut out floor slab and remove remaining on-site HW from Sales Building;
- » Apply SLRA to on-site issues, CSAP review and apply for CoC;
- » Register off site HW as Historical In Situ Hazardous Waste site;
- » Apply for an AiP for off site contamination in 100 St. and the strip mall;
- » Concurrently complete DRA, and have off-site issues reviewed by MoE for CoC.





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