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CREATING AND DELIVERING BETTER SOLUTIONS

Managing and Mitigating Extensive Subsurface Fuel Product Beneath Two Inner-City Heritage Buildings

Ken Friedrich, P.Eng., The City of Edmonton
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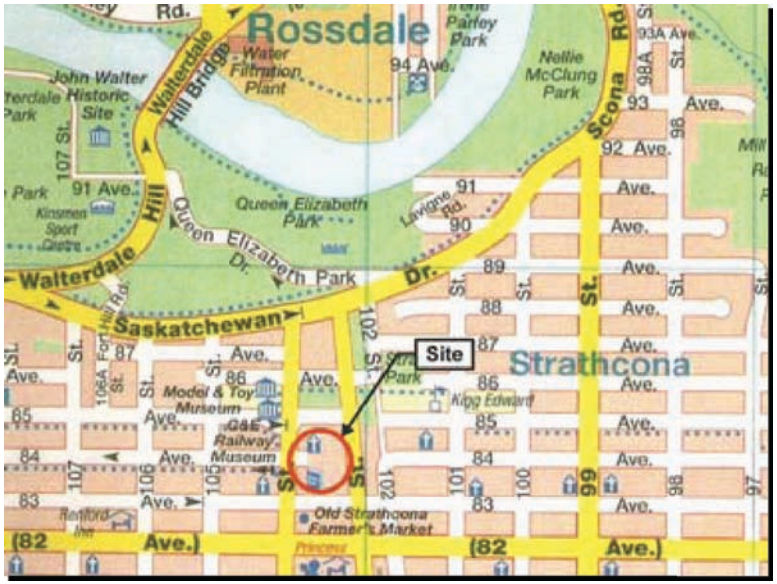
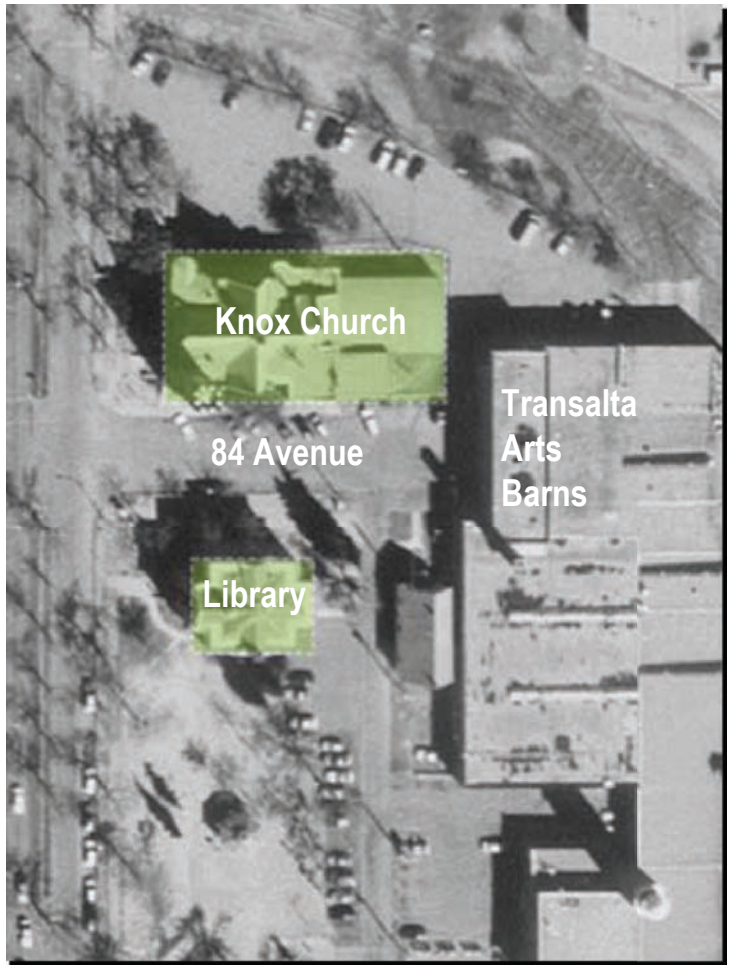
Presentation Outline

- Part I, Description and Planning – location, buildings, stakeholders, integration with other activity.
- Part II, Scope and Risk – hydrocarbon impacts, remediation ranking, remediation modes, field trial.
- Part III, Design - remediation components.
- Part IV, Implementation - HDD and well construction, difficulties and problems, commissioning, remediation progress to-date, community benefits.

Part I, Description and Planning - Location





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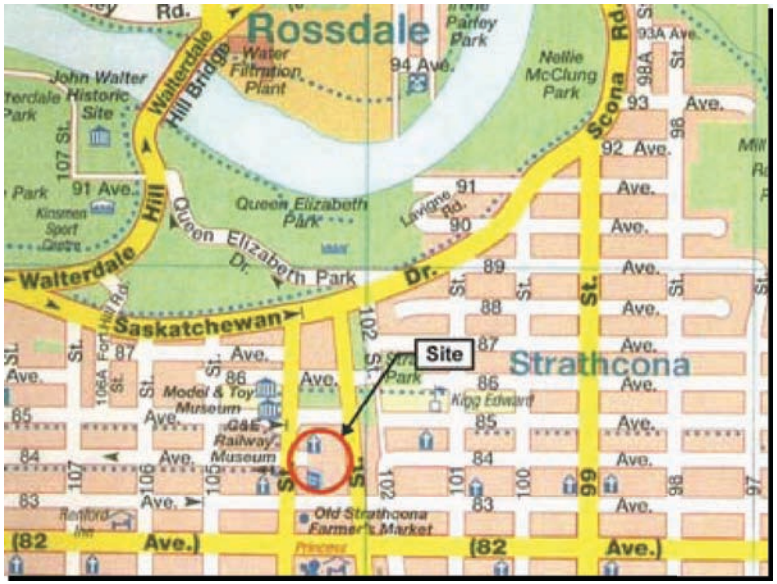

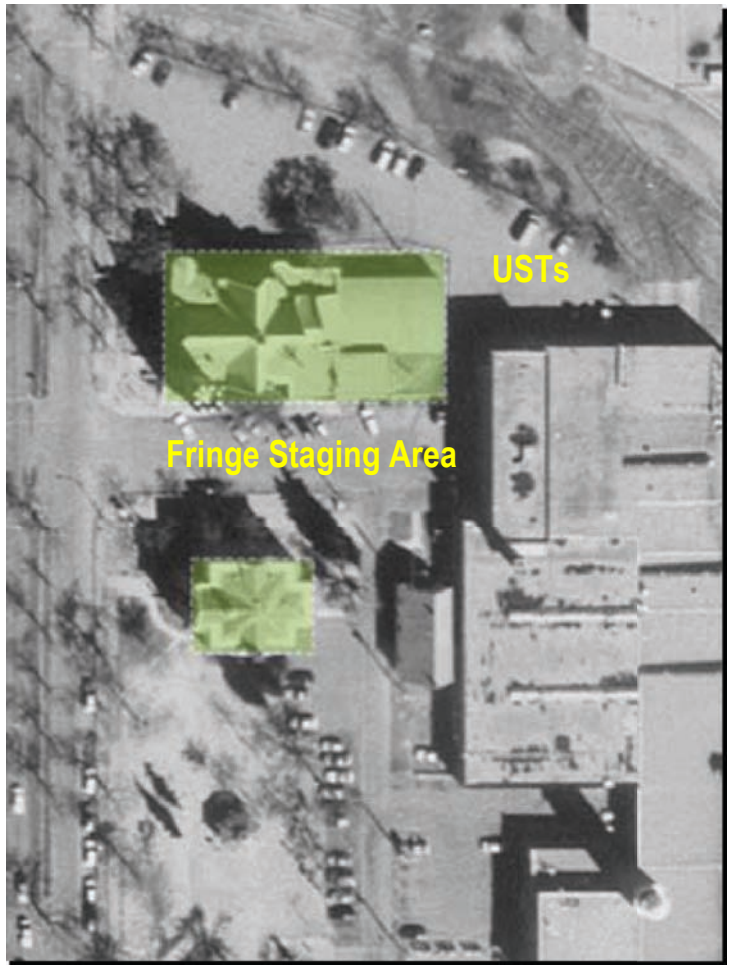

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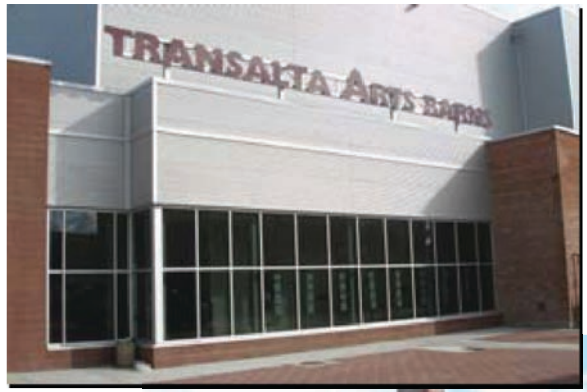
Part I, Description and Planning - Buildings

Knox Church



Transalta Arts Barns
(Fringe Theatre Building)

Strathcona Library

Part I, Description and Planning - Stakeholders

- Knox Church
- The City of Edmonton:
  - Community Services, Drainage Services, Library Board, Planning and Development, Property Management, Transportation and Streets
- Edmonton Radial Railway Society (leasing rail ROW)
- Edmonton International Fringe Theatre Festival
- Heritage Resources Management Branch
- Old Strathcona Foundation
- Regulatory (Alberta Environment)

Part I, Description and Planning – Integration

Library Restoration and Expansion

Part I, Description and Planning – Integration

Library Restorat

Edmonton Fringe Festival (August)

Part I, Description and Planning – Integration

Library Restorat

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84 Avenue Upgrading

Part I, Description and Planning – Integration

Library Restorat

Edmonton Fringe Festival (August)

84 Aven

High Level Streetcar Requirements

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Part II, Scope and Risk - Hydrocarbon Impacts

Diesel Fuel Product in Monitoring Wells (Red)

Dissolved Hydrocarbons in Monitoring Wells (Orange)

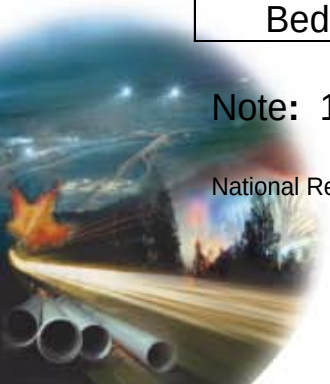
Part II, Scope and Risk - Remediation Ranking

Ranking for Groundwater Remediation Difficulty

Host Media	Mobile Dissolved (Degrades/ Volatilizes)	Mobile Dissolved	Strongly Sorbed, Dissolved (Degrades/ Volatilizes)	Strongly Sorbed, Dissolved	Separate Phase LNAPL	Separate Phase DNAPL
• Homogeneous Single Layer	1	1 - 2	2	2 – 3	2 - 3	3
• Homogeneous Multiple Layers	1	1 - 2	2	2 – 3	2 - 3	3
• Heterogeneous Single Layer	2	2	3	3	3	4
• Heterogeneous Multiple Layers	2	2	3	3	3	4
• Fractured Bedrock	3	3	3	3	4	4

Note**:** 1 = least difficult, 4 = most difficult

National Research Council



Part II, Scope and Risk - Remediation Ranking

- Vertical and inclined wells
  - proven for liquid and vapour phases
    e.g., BV, IAS, SVE, MPE, P & T
  - MPE copes well with WT fluctuation
- Horizontal wells
  - proven for vapour phase
    e.g., BV, SVE
  - proven for fully submerged liquid phase
    e.g., P & T, possibly IAS
  - MPE copes poorly/stops with WT fluctuation

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Part II, Scope and Risk - Remediation Modes

Vertical Wells Versus Horizontal Wells (for MPE)

Criteria	Vertical and Inclined Wells	Horizontal (HDD) Wells
• Accessibility under buildings, etc.	Lowest angle is about 45º to 30º (from horizontal)	Wells fully horizontal after reaching design elevation
• Contractor specialization	Moderate only	Highly specialized
• Distance/radius of influence	Typically 2 m to 10 m radius (ROI), depending on soil type	Typically distance (DOI) is 3x to 5x vertical well ROI, for same soil type
• Screen design	Standard PVC slot sizes	Specialized slot sizing to ensure end-of-pipe residual effect
• Site disruption (trenching)	Trenching to connect all wellheads	No trenching, well is its own connection
• Tolerance to WT fluctuation	Screen 'straddles' a large range of potential WT movement	Risk of screen dewatering or excessive submergence relative to WT. Contingency needed to avoid submergence ('dead heading')
• Winterization	Need to insulate and possibly heat-trace all surface 'headers'	Well components below frost line are already winterized

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Part II, Scope and Risk - Field Trial

Part III, Design - Remediation Components

- Extraction wells
  - 100 metre long HDD wells (3)
  - Custom slot size
  - End-of-well vacuum sensors
  - Pneumatic well flushing
- Liquids separation and collection
- Water treatment (solids, GAC, MCM)
- Off-gas catalytic oxidation (incineration)
- Sensor data acquisition and PLC system
- Satellite link for Web monitoring and control
- Secure and noise-reducing enclosure

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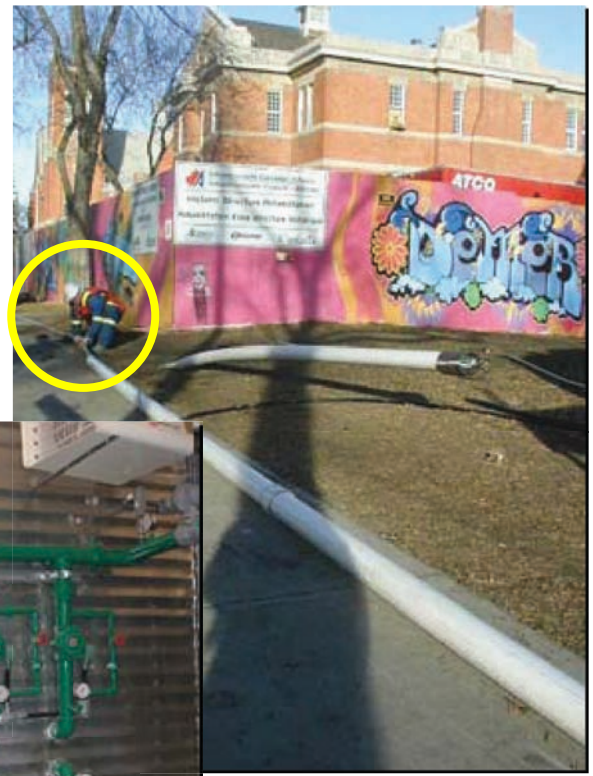

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Part IV, Implementation - HDD and Well Construction

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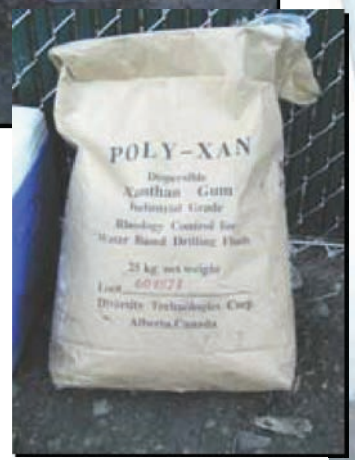
Part IV, Implementation - Difficulties and Problems



Part IV, Implementation - Commissioning

Treated Water Sampling (COE Sewer Bylaw)

Catalytic Oxidizer (Incinerator) for Off-gas Destruction

Part IV, Implementation – Remediation Progress

Well ID	In-well Product Thickness (cm)		
	April 2005	November 2005	May 2006
103	34	19	-
104	51	73	-
107	26	20	16
108	7	15	-
207	17	18	-
BH 4-3	5	10	63
BH 4-4	10	37	-

Part IV, Implementation – Remediation Progress

Extracted hydrocarbon mass (approx.):

- Separated phase (oil) 50 kg
- Sorbed phase (GAC) 160 kg
- Sorbed phase (MCM) 1,415 kg
- Vapour phase (oxidized) 8,600 kg

Total (March - September, 2006) ±10,225 kg

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(±12,500 litres, or ±2,750 igal.)

Part IV, Implementation - Community Benefits

Acknowledgments – Project Team

ALS

Ground Effects
Environmental Services Inc.

HAMILTON & OLSEN
SURVEYS LTD

Thank You

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