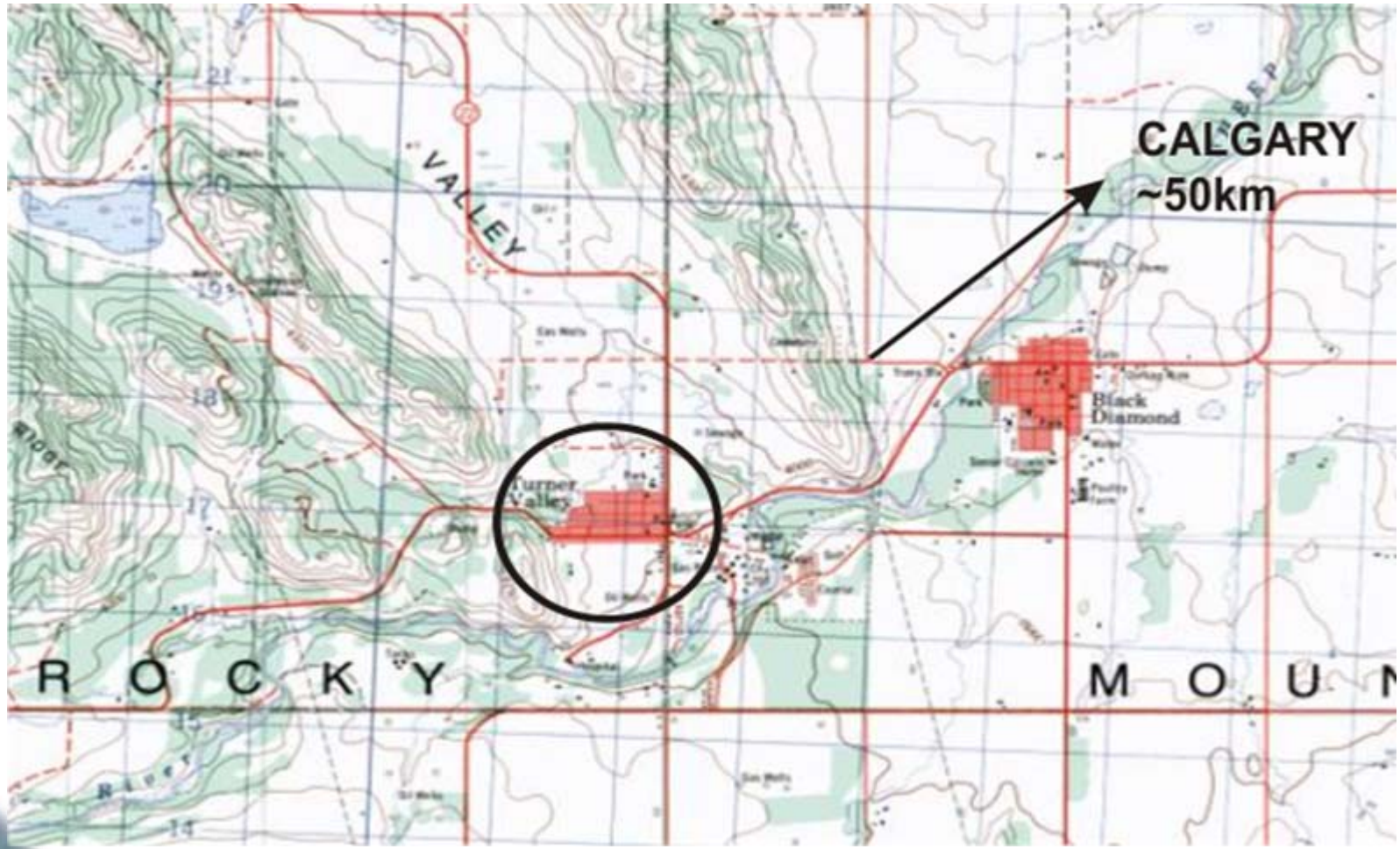
Remediation of Odour Impacted Soil Former Landfill, Turner Valley, AB

Bart Kenneway, Frans Hettinga
EBA Engineering Consultants Ltd.

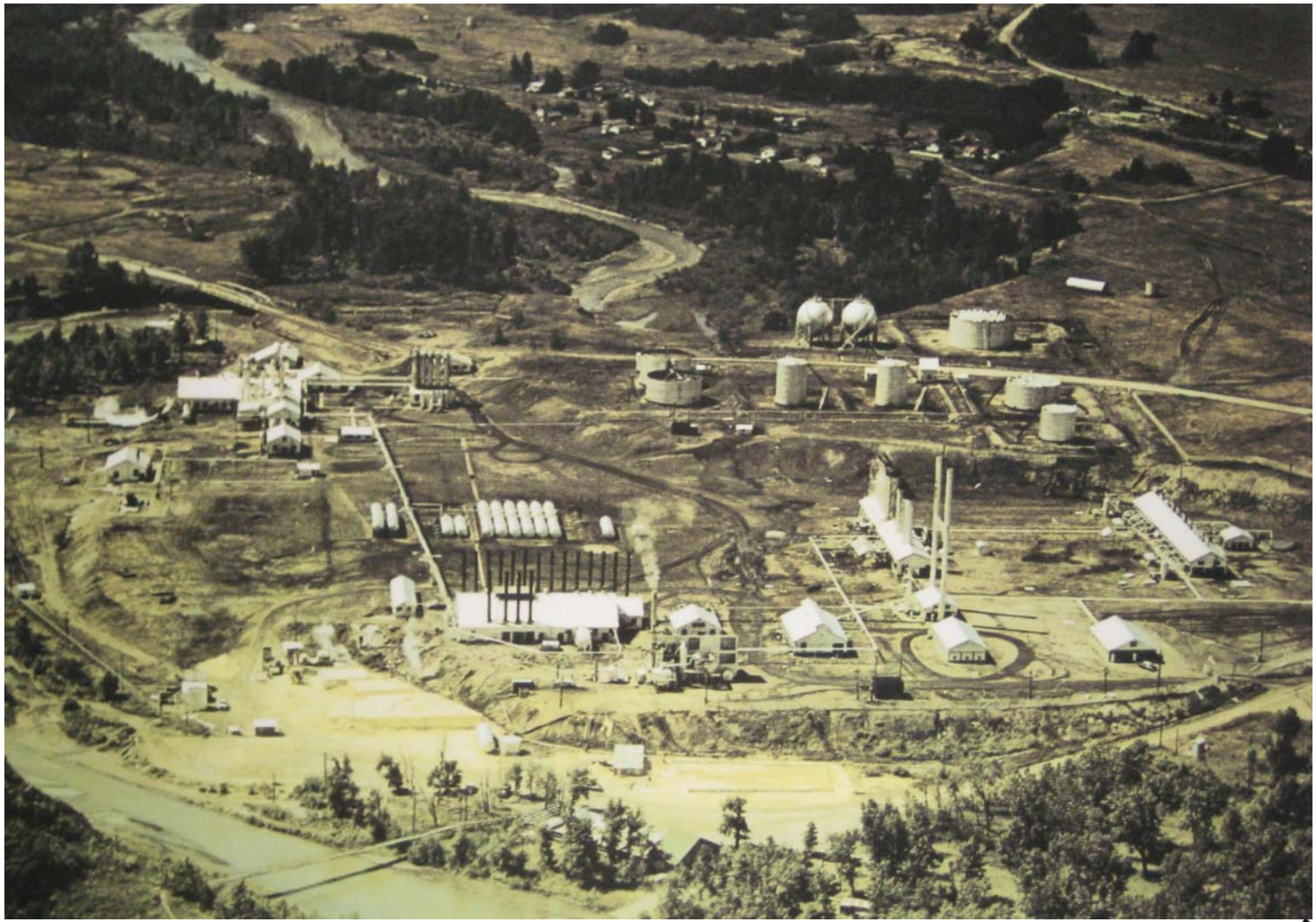
Project Background

- Former landfill in Turner Valley
- Used for waste disposal from municipal, domestic and industrial sources including gas plant wastes
- Waste was disposed of for approximately 50 years
- Site clean up became a priority due to potential and existing residential developments nearby

Turner Valley



Historic Turner Valley



Site Characteristics

- Site dimensions: approximately 200 m x 250 m
- Site is located on a terrace near the Sheep River
- Gravels underlain by shale bedrock
- Numerous pipelines

Assessment

- Extensive testpitting program to assess and characterize soil and groundwater conditions and waste types
- Each testpit was v-trenched using hydrovac for safety
- Soils consisted of gravels with large cobbles and boulders, with bedrock at 3 mbgs
- Groundwater typically found at 2.5 mbgs
- Assessment identified waste debris overlying hydrocarbon impacts

Remediation Stage 1

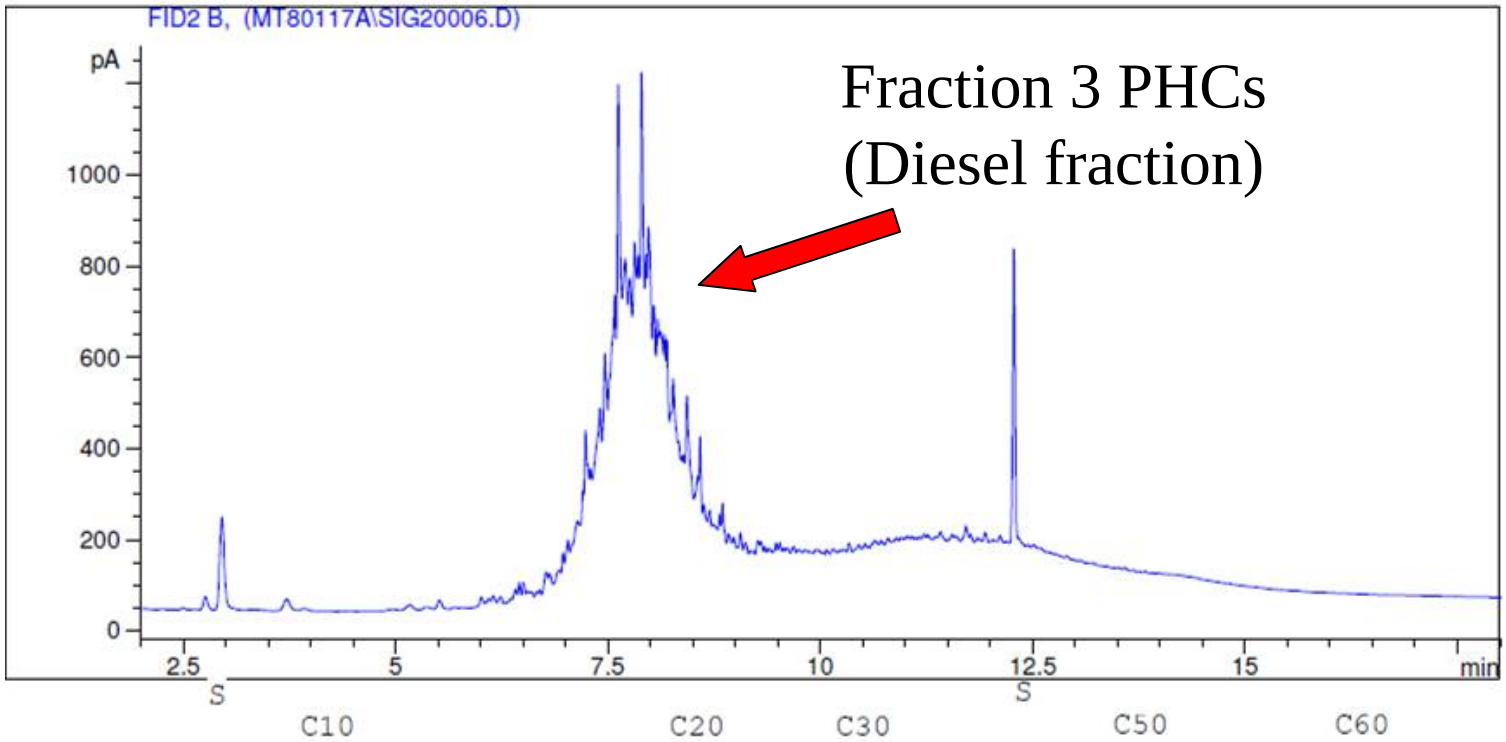
- Asbestos identified throughout solid wastes required removal, abatement and disposal
- Segregation of the asbestos was not possible
- Total volume landfilled: 5,700 Tonnes
- Odour impacted material identified during final Stage 1 excavation in central portion of site

Remediation Stage 1

Remediation Stage 1

Key Component: Hydrocarbon Impacts

Sample ID: L594807-3 V20
Injection Date: 1/18/2008 2:08:38 PM
Injection Time: 1/18/2008 2:08:38 PM
Instrument ID: Instrument 1
Operator: calgary



Second Component – Odourous Compounds

CLIENT SAMPLE ID: CENTRAL 10M SOUTH @ 2.5M

COMPOUND:	REPORTING LIMIT	UNITS	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (ug/m^3)
Hydrogen Sulfide	10	ppb	<10	<14
Carbonyl Sulfide	1	ppb	190	470
Methanethiol	1	ppb	350	680
Ethanethiol	1	ppb	1600	4200
Dimethyl Sulfide	1	ppb	<1	<2.5
Carbon Disulfide	1	ppb	60	190
iso-Propyl Mercaptan	1	ppb	310	950
t-Butyl Mercaptan	1	ppb	<1	<3.7
Propanethiol	1	ppb	19	60
Ethylmethyl Sulfide	1	ppb	650	2000
s-Butyl Mercaptan	1	ppb	68	250
Diethyl Sulfide	1	ppb	<1	<3.7
n-Butyl Mercaptan	1	ppb	<1	<3.7
Dimethyl Disulfide	1	ppb	1600	6200
Diethyl Disulfide	1	ppb	15000	73000

Understanding The Source

- Compounds identified had offensive odours
- Combination of natural compounds (e.g. sulphides also present in wine, cheese, cabbage) and industrial compounds (e.g. mercaptans)
- Olfactory detection at <10 ppb – onsite source material had values of 15,000 ppb

Understanding The Source – Lean Oil

When the absorber plant was constructed in 1933, it contained three absorption towers. The plant was used in conjunction with the propane and gasoline plants to extract liquid petroleum products from the natural gas. Additional towers were added in 1934 and 1941. The absorption technology was used for 52 years, making it the longest-running facility in Canada.

had little choice but to flare the excess that Calgary and the surrounding areas could not use. The gas was flared in a gully near a rock cut along Sheep Creek. During peak flaring, street lighting in Calgary was not necessary because of the flare's pink glow on the horizon. The glow could also be seen from as far away as

the gas after the separators. In this new process, wet gas entered the vertical absorption towers at the bottom. Through a series of trays and bubble caps, the gas came in contact with a stream of lean oil flowing in the opposite direction. The oil was a special blend produced by Imperial Oil at their Calgary refinery. Through the

Remediation Stage 2

- Odour issues worse than expected
- Odour control during further excavation required
- Evaluate various options and technologies to find an appropriate solution

Evaluation Matrix

Evaluation of critical key factors

- **Site location and proximity to landowners**
- **Site features (soil, groundwater, relief, topography)**
- **Mechanism of impact (initial odour generation and how it arrived at this site)**
- **Disposal location and transport route**
- **>20 active pipelines and abandoned facilities at the site**
- **Duration of project**
- **Time of year (ambient temps, recreational users, road bans, etc.)**

Options Considered

In-situ

- Aeration (windmills and air pumps)
- Hydrogen Peroxide/Chemical Oxidation
- Phyto-remediation

In-situ/ex-situ combo

- In-situ carbon slurry
- Zeolites
- Grout injection with hardening polymer

Ex-situ

- Freezing and hauling
- Excavation and spraying with fire suppression foam
- Spray on chemical oxidation (ex-situ)
- Excavation inside structure with air treatment
- Enclosed soil washing

Key Factors for Final Decision

- Likelihood of odour release
- Safety (exposure for workers)
- Operating parameters for a system (noise levels, design)
- Time to completion
- Overall cost
- Security requirement during off hours

Stage 2 Remedial Solution

- Excavate in a covered trench system, maintaining negative pressure (suction) on the trench
- Air treatment for off-gas air
- Enclosed excavator bucket to reduce odours during truck loading
- Spray-on chemicals
- Enclosed transport
- Landfill disposal away from residential areas
- Full time dedicated onsite air monitoring

Pilot Testing for Air Treatment

- Discussions with client, remediation contractors
- Construct bench-scale equipment
- Obtain fresh soil
- Determine minimum air flow
- Test effectiveness of treatment chemicals
- Analyze for byproducts, off-gas quality (chlorine, chloroform, PHCs, S-compounds)
- Cost out full scale system

Obtain fresh soil

Pilot Testing for Air Treatment

Simulate trench and suction

Estimate airflow requirements

Pilot Testing for Air Treatment

Measure and optimize

Major System Components

- Flexible ducting for air movement
- 150 m of impermeable liner for trench covering
- Two blowers @ 3,000 cfm (high pressure)
- One 23 m^3 plastic tank with bubbling solution
- One 23 m^3 plastic knockout tank
- Two 2,000 lbs GAC containers
- 15 Kw Power Generator
- Mounted on flat-bed trailer for onsite mobility

Covered Trench Excavation

System in Operation

System in Operation

System in Operation

System in Operation

Diffuser in Treatment Tank

Remediation in Progress

Remediation Stage 2 Completion

- Approximately 2 months to complete Stage 2 excavation
- Communication was a key component in project success: client, contractors, multiple stakeholders and residents
- Onsite air monitoring provided real time data
- Significant manual labour requirement during Stage 2 due to added project complexity, potential for odour releases and system requirements

Cost Breakdown of Odour Related Work (%)

Evaluate options	**1%**
Bench scale testing	**3%**
Construct and rent equipment	**8%**
Remediation contractor	**47%**
Air quality monitoring and laboratory	**6%**
Landfill disposal (8,900 Tonnes)	**19%**
Project management, system design, sampling, safety, documentation, etc.	**11%**
Budget Remaining	**5%**

Lessons Learned

- No safety incidents (a total of 1,654 man hours for Stage 2 excavation alone)
- Total volume landfilled: 8,900 Tonnes
- Final project costs were approximately double the typical cost for excavation and disposal
- Final costs within 5% of projected budget
- Minimal odour complaints and disturbance to surrounding residents

Acknowledgments

ConocoPhillips Canada

Sequoia Environmental Remediation Inc.

HAZCO
A CCS Company

www.eba.ca

ENGINEERING | ENVIRONMENT | TRANSPORTATION | MINING | ENERGY | DEVELOPMENT | ARCTIC | WASTE MANAGEMENT | ABORIGINAL PEOPLES