Sullivan Fatalities Incident: Technical Investigations and Findings Part 1 & 2

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Vancouver, BC

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Fatalities Incident

May 15 – 17, 2006

- Doug Erickson
- Bob Newcombe
- Kim Weitzel
- Shawn Currier

http://www.mediaroom.gov.bc.ca/sullivan_mine/sullivan_mine.htm
Technical Panel

- Technical Panel formed to investigate the incident and general lessons for industry

- Ricci Berdusco
- Bruce Dawson
- Daryl Hockley
- Al Hoffman
- Walter Kuit
- Dr. John Meech

- Mike O’Kane
- Phil Pascuzzi
- Clem Pelletier
- Mark Phillip
- Andy Robertson
- Dr. Ward Wilson
Presentation Outline

• Site Layout & Post Incident Hypothesis

• Overview of Phase 1 Monitoring System, Data and Analysis

• Overview of Phase 2 Monitoring System, Data and Analysis

• Geophysical Survey Results
Ditch Converted to Drain
Post Incident Hypothesis

- Pore-gas indicative of in situ WD1 conditions exited the dump through the 400 mm pipe, and into the shed as a result of:
  - decreasing atmospheric pressure conditions prior to, during, and following the time of the four fatalities; and
  - the 400 mm pipe, which terminates in the shed, likely being the primary hydraulic connection between the atmosphere and the dump.
Overview of Monitoring System

- Phase 1 Monitoring Focuses on:
  - Monitoring Station
  - Atmospheric Conditions
  - In Situ Till Cover Material Moisture and Temperature
Overview of Monitoring System

Three Diviner 2000 Transects

Slope In Situ Monitoring

Met Station and Bench In Situ Monitoring

Heated Instrumentation Shed

Monitoring Station
Overview of Monitoring System

- **Monitoring Station**
  - August 16\textsuperscript{th} to 21\textsuperscript{st}, 2006
  - At three locations in MS
    - 2 in pipe: entrance and 8 ft in
    - 1 in MS structure
      - Temperature
      - Barometric pressure
      - Gas sampling points
  - Air velocity in pipe
  - Sonic ranger (water level)
  - (ISCO water sampler)
Monitoring Data

Barometric Pressure

Air Temperature
Monitoring Data

Upper Soil Station Volumetric Water Content

Volumetric Water Content


15 cm

5 cm
Monitoring Data
Weir Flow

Hourly Average Weir Flow (m$^3$)

Cumulative Weir Flow Volume (m$^3$)
Monitoring Data

Air Temperature

Hourly Average Air Temperature

Atmospheric

Pipe

8-Ft Station

1-Jan 16-Jan 31-Jan 15-Feb 2-Mar 17-Mar 1-Apr 16-Apr 1-May 16-May 31-May

Atmospheric Air Temperature (°C)

Pipe

8-Ft Station

Atmospheric Air Temperature (°C)
Monitoring Data

Airflow

- Air Velocity (m/s)
- Cumulative Airflow (1,000 m³)

Into pipe
Out of pipe

August 06 to November 07
Monitoring Data

Oxygen and CO2 Concentration vs. Airflow

Atmospheric

8-Ft
Data Analysis

Airflow and Barometric Pressure

Barometric Pressure

Air Velocity
Data Analysis

Airflow and Air Temperature

Air Velocity

Air Temperature

Air Velocity (m/s)

Air Temperature (°C)

Data Analysis

Airflow and Air Temperature

$R^2 = 0.923$
Incident Air Temperature

Historic Air Temperature (Cranbrook)

Air Temperature (°C)

Phase 2 Installation - Internal

- Locations altered based on initial gas results and discovery of bare spots
Phase 2 Location Selection
Phase 2 Instrumentation
**Phase 2 Instrumentation**

**BASIC INSTALLATION OF CONTINUOUS MULTICHANNEL TUBING**

- **GP**: Gas Sampling
- **P**: Pressure Sampling
- **T**: Automated Temperature Sampling

- **Mesh Screen Sample Port**
- **Bentonite Layer**
- **Sand Layer**

**Legend:**
- **Blue**: Mesh Screen Sample Port
- **Gray**: Bentonite Layer
- **Black**: Sand Layer

**To Depth**

**Till 1m Cover**

- 2m: GP
- 3.5m: GP
- 5m: GP
- 6.5m: GP
- 8m: GP
- 9.5m: GP
- 11m: GP

- 2m: T
- 4m: T
- 7m: T
- 9m: T
- 11m: T
Phase 2 Instrumentation

Push-in Piezometers
Phase 2 Temperature Data

BH-1A

Temperature (°C): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Phase 2 Temperature Data

BH-3A

Temperature (°C): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Depth below surface (ft)

Time (days from 2007-03-30)
August 1, 2007

Phase 2 Gas Data (negative velocity)

O₂, CO₂

1.3, 5.9
4.2, 4.4
1.3, 5.5
0.9, 5.5
1.1, 6
4.9, 4.3
1.5, 5.4
0.9, 5.7
0.5, 4.8
0.1, 7.9
0, 7.7
11, 1.8
5, 4.4
0.5, 4.8
1.3, 9.8
4.9, 4.3
0, 7
Phase 2 Gas Data (positive velocity)

7 November, 2007

O₂, CO₂

3.1, 4.3
1.8, 5.3
3.5, 4.3
7.8, 2.5
16, 1.3
11, 2.3
21, 0.1
21, 0.03
14, 1.6
21, 0.1
2.5, 7.4
6.4, 3.3
18, 0.6
Geophysical Survey