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Environmental Services Ltd.

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Low Temperature Ex-Situ Bioremediation of Hydrocarbon Contaminated Soils

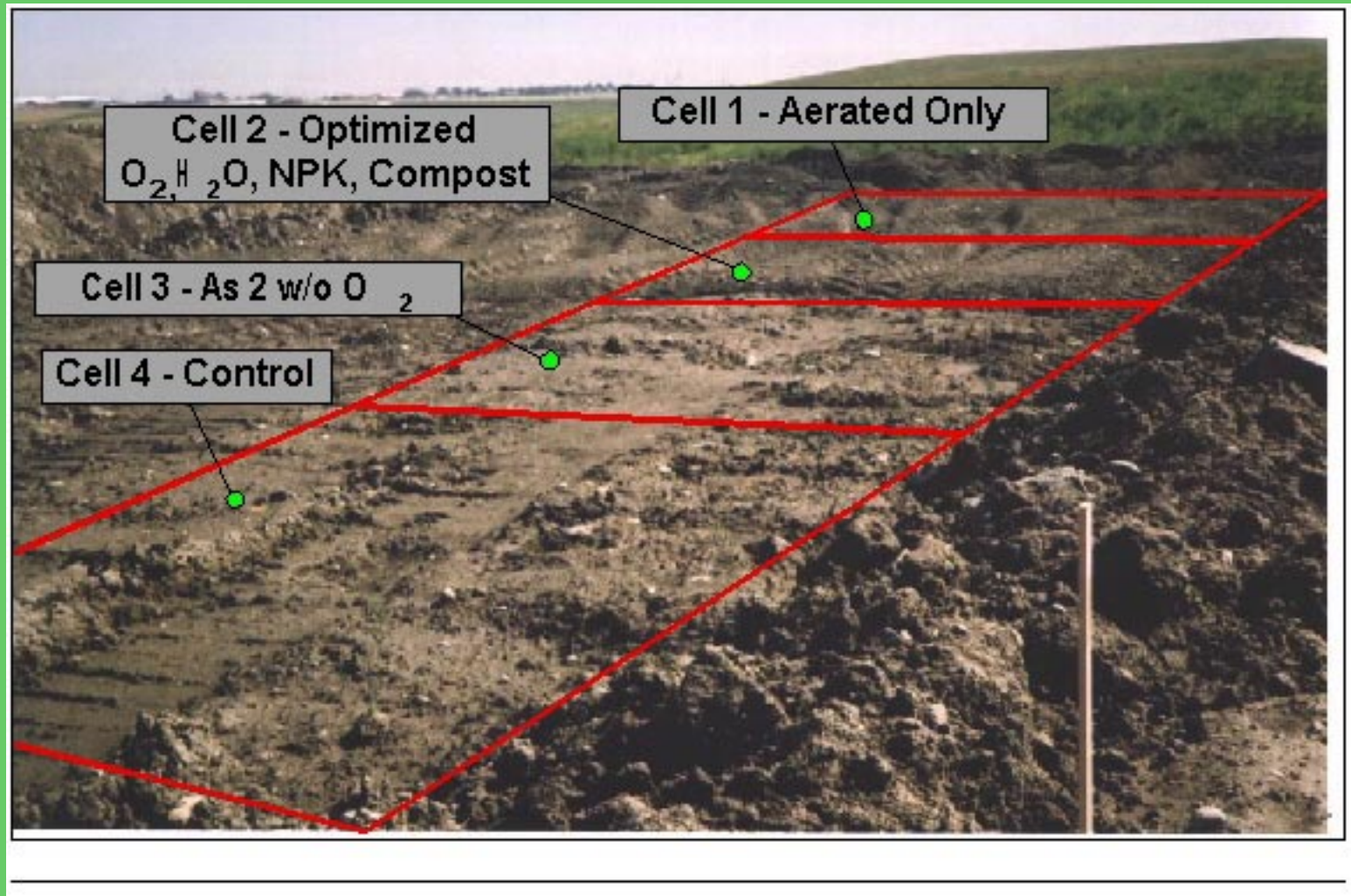
October 17, 2002



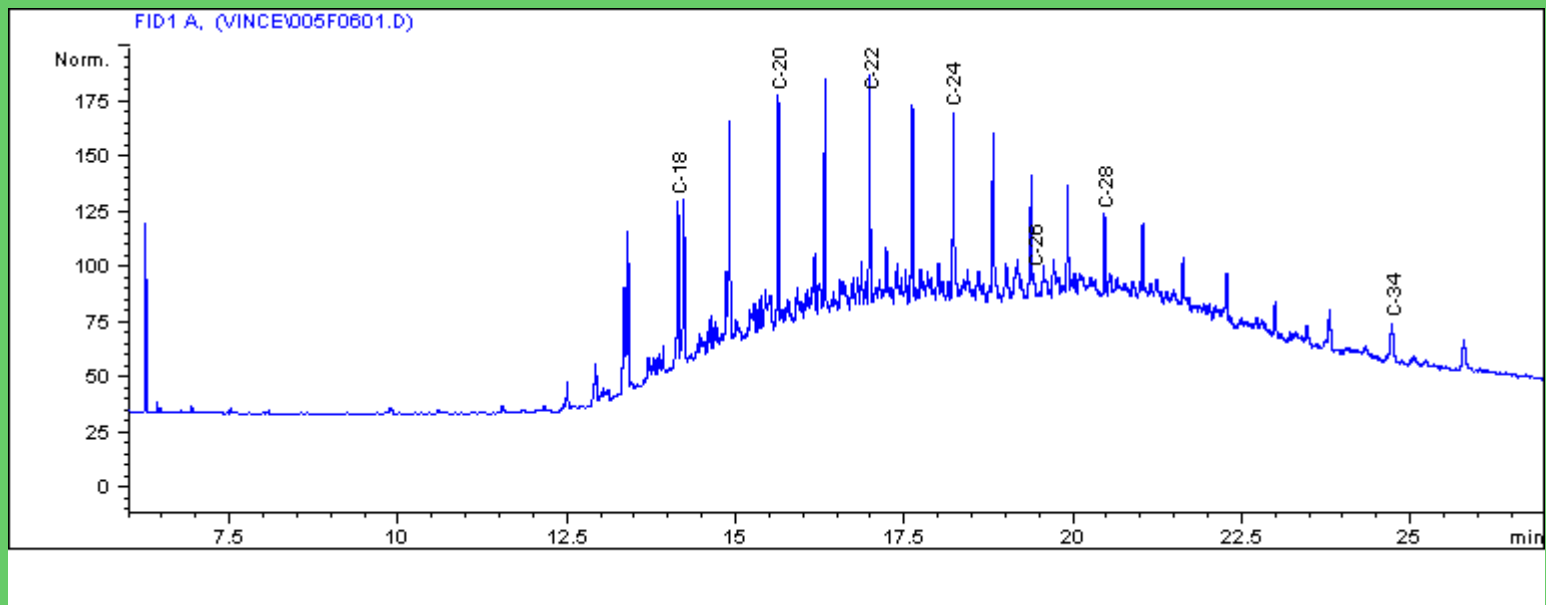
Introduction

- **Bioremediation Season – how long is it?**
- **Traditionally assumed to be 5-6 months**
- **Lab research proves soil bacteria can efficiently degrade HC as low as 48 C**
- **Can these lab results be carried to the field?**

Treatment Pad



Chromatograph of Raw Material



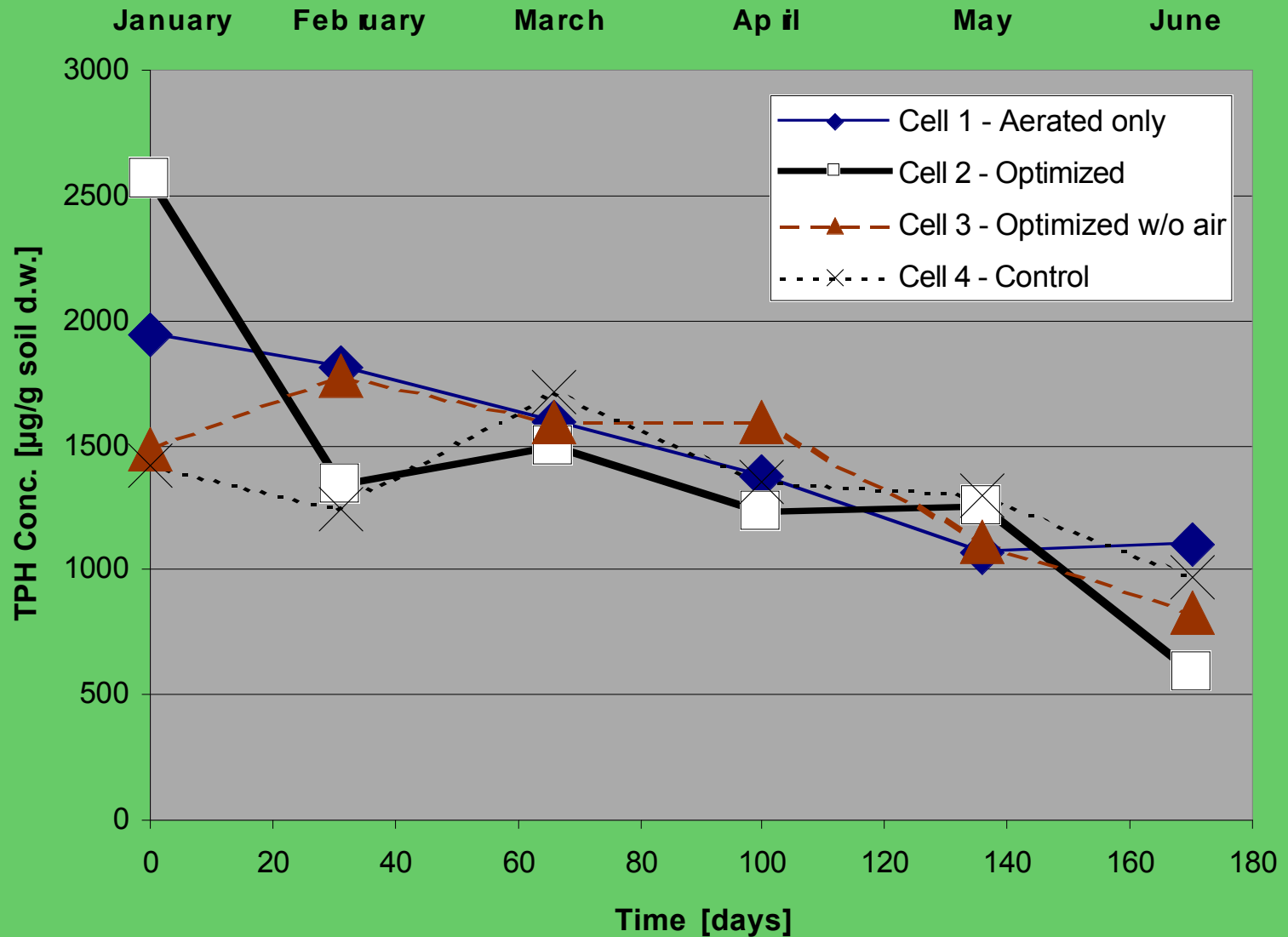
Hydrocarbon Conglomerate



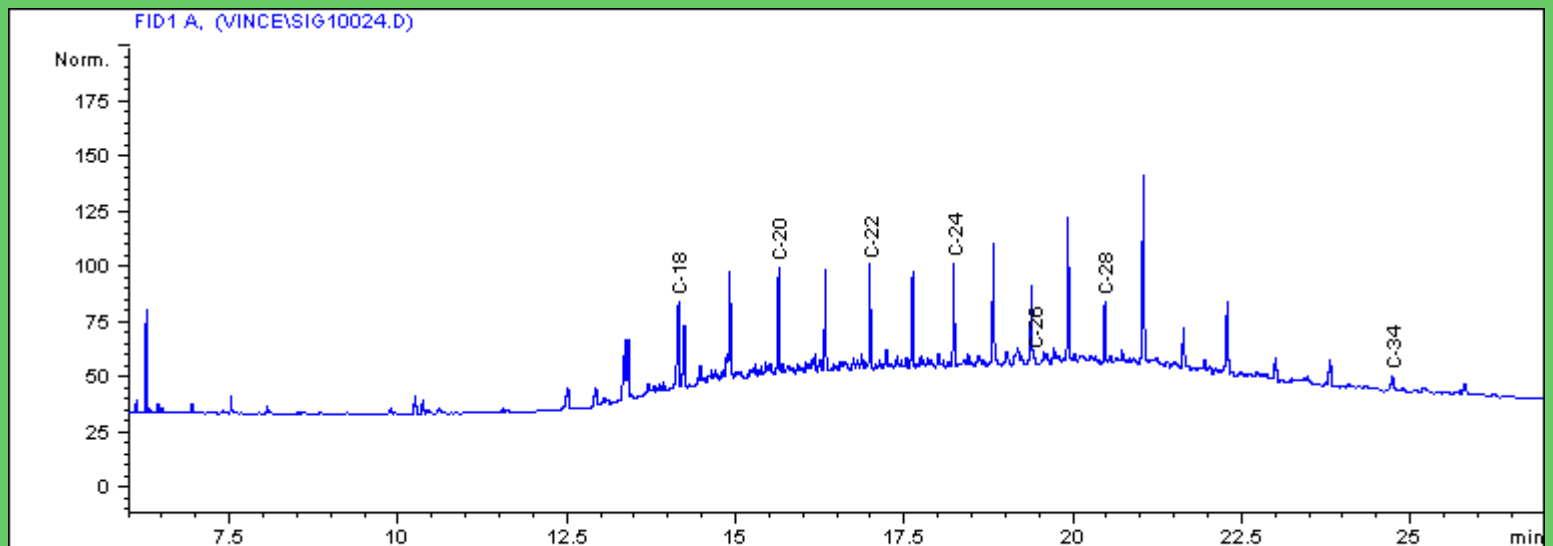
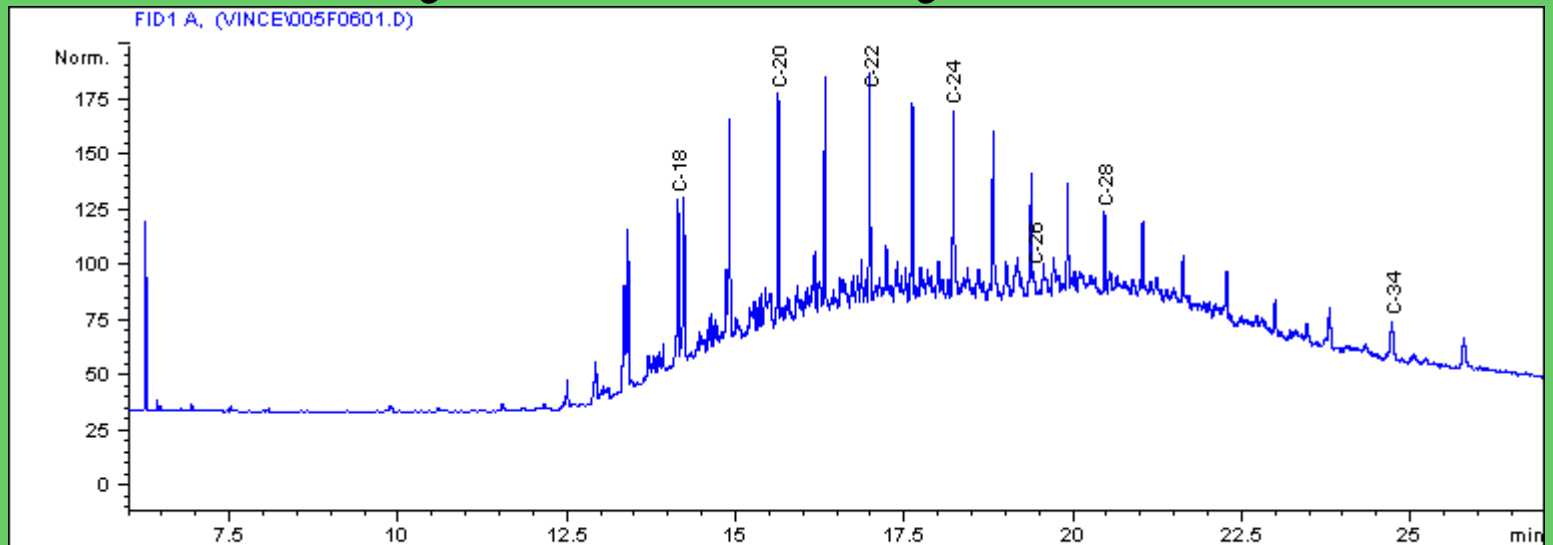
Gator



Hydrocarbon Degradation

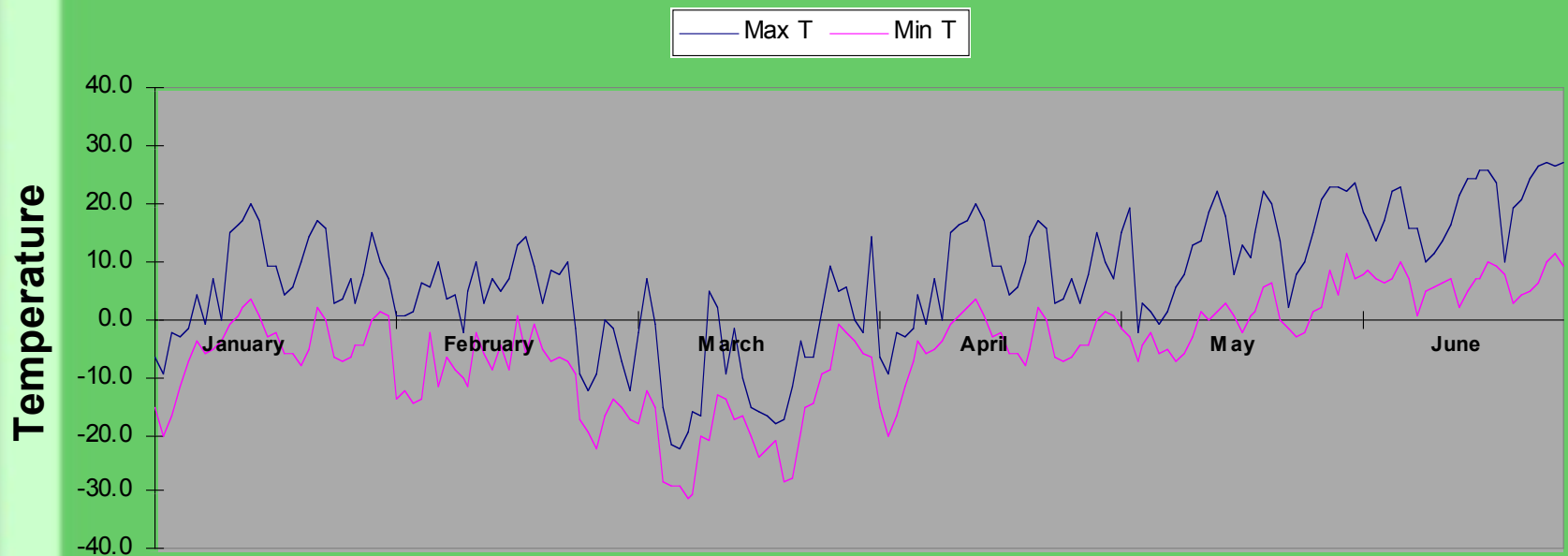


January 5 vs. May 21, 2002



Ambient Temperature Data

Temperature data Jan-June 25, 2002 Calgary Int'l



Results – TPH Reduction

- 77% Cell 2 - Optimized cell
- 57% Cell 1 - Aerated-only cell
- 44% Cell 3 - Optimized w/o aeration
- 17% Cell 4 - Control

Conclusions

- Substantial benefit to actively manage projects even when ambient temperature is near 0°C
- Optimized cell had at least an order of magnitude increase in microbial population relative to all others
- Microorganisms & nutrients already present in large #s at start of hot season
- This research shows that low temperature bioremediation is feasible and works best when nutrients, moisture, and oxygen are managed.



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