

LEAK DETECTION USING PFT TRACER TECHNOLOGY

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ICC Fall Meeting – Fountain Hills, AZ
Subcommittee C: Cable Systems
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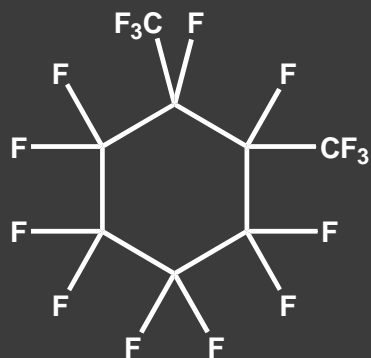


WASSON ECE
INSTRUMENTATION

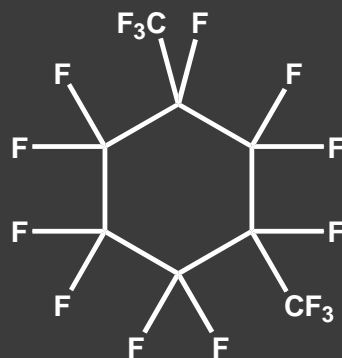
Agenda

- ⦿ What are PFTs?
- ⦿ Why use PFTs for leak detection?
- ⦿ How do we detect leaks using PFTs?
- ⦿ Tracer Concentrator
 - Hardware and features
 - Software and data analysis
 - Detecting leaks in the field
- ⦿ Questions

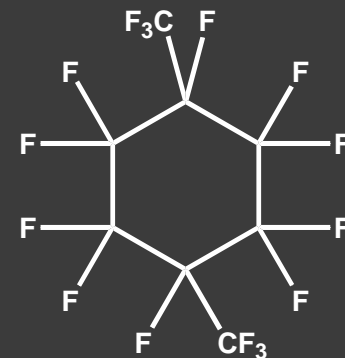
What are Perfluorocarbon Tracers (PFTs)?



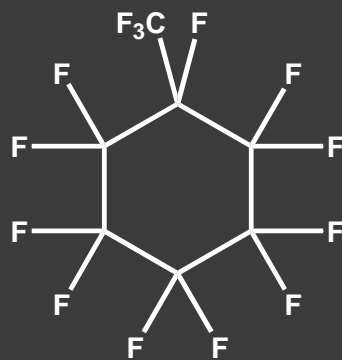
1,2-PDMCH



1,3-PDMCH



1,4-PDMCH



PMCH

Properties of PFTs

- ⦿ Non-Toxic
- ⦿ Non-Flammable
- ⦿ Insoluble in Water
- ⦿ Highly volatile
- ⦿ High chemical stability
 - Doesn't contribute to photochemical air pollution or stratospheric ozone depletion
- ⦿ Low background concentration
 - 1 – 10 fL/L, parts in 10^{15} (ppq)

Fun Parts Per Quadrillion Comparisons

- One postage stamp on a letter the size of California and Oregon combined
- One mile on a journey of 170 light years
- One human hair out of all of the hairs on all the heads of all the people in the world

PFT Uses

- ⦿ Location of dielectric fluid filled cable leaks
- ⦿ Subsurface barrier integrity
- ⦿ Atmospheric dispersion
- ⦿ Oil and gas well tracing

Why Use PFTs for Leak Detection?

- ⦿ Freezing and pressure testing is expensive and time consuming
 - Pipe must be de-energized
 - Large areas need to be excavated
 - Leak detection can take weeks
- ⦿ PFT method reduces impact and increases cost savings
 - No de-energization required
 - Can pinpoint leaks to within a few feet
 - Leaks have been found within hours

How do we detect leaks using PFTs?

- Tracers are added to oil which is fed into cable systems
- When a leak occurs, oil leaks into the environment
- PFTs permeate into the atmosphere
- Analytical equipment is used to detect PFTs and pinpoint leaks

How do we detect PFTs?

Tracer Analyzer System

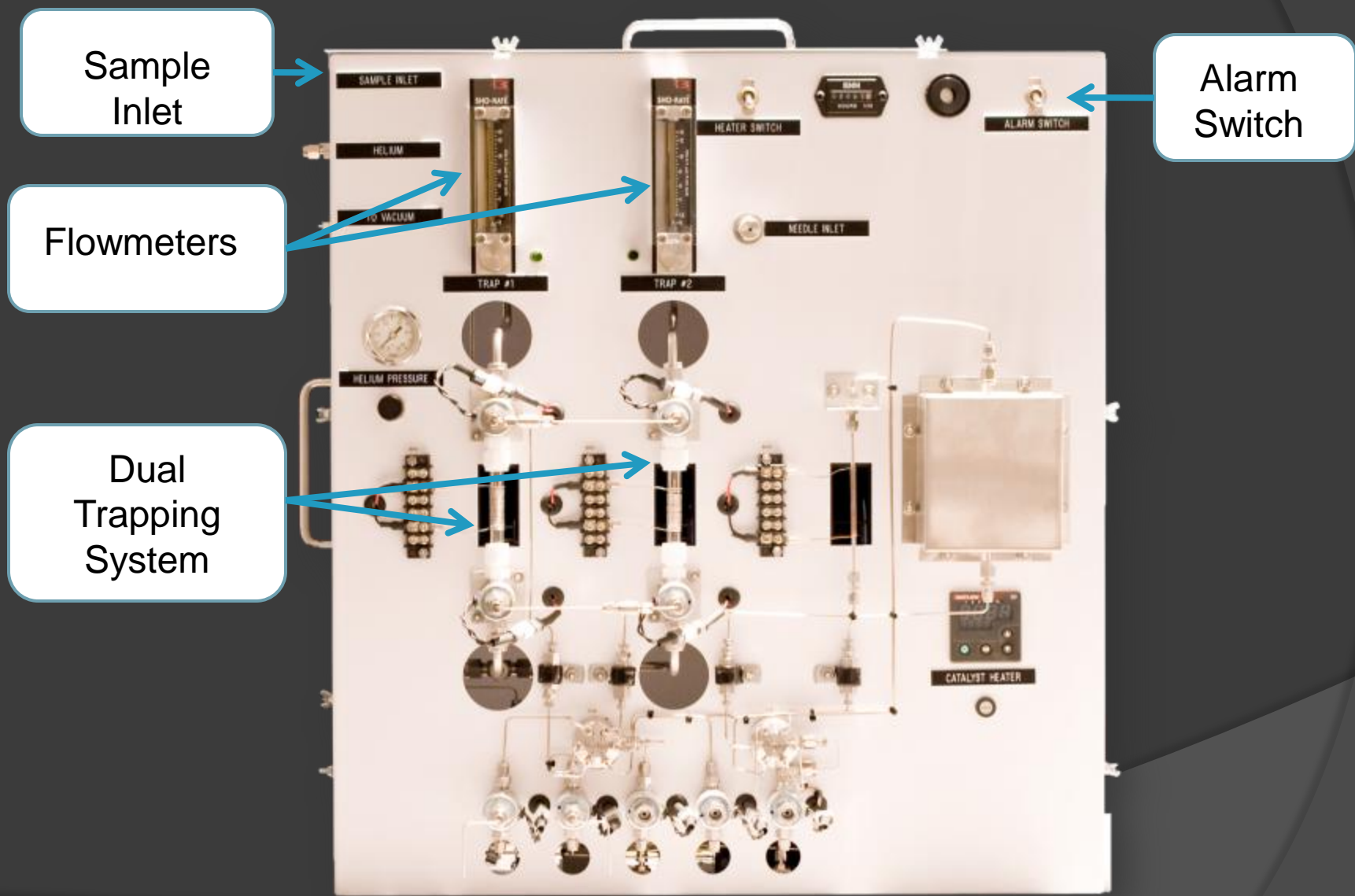


Tracer Analyzer



Gas Chromatograph

Tracer Analyzer



Tracer Analyzer Features

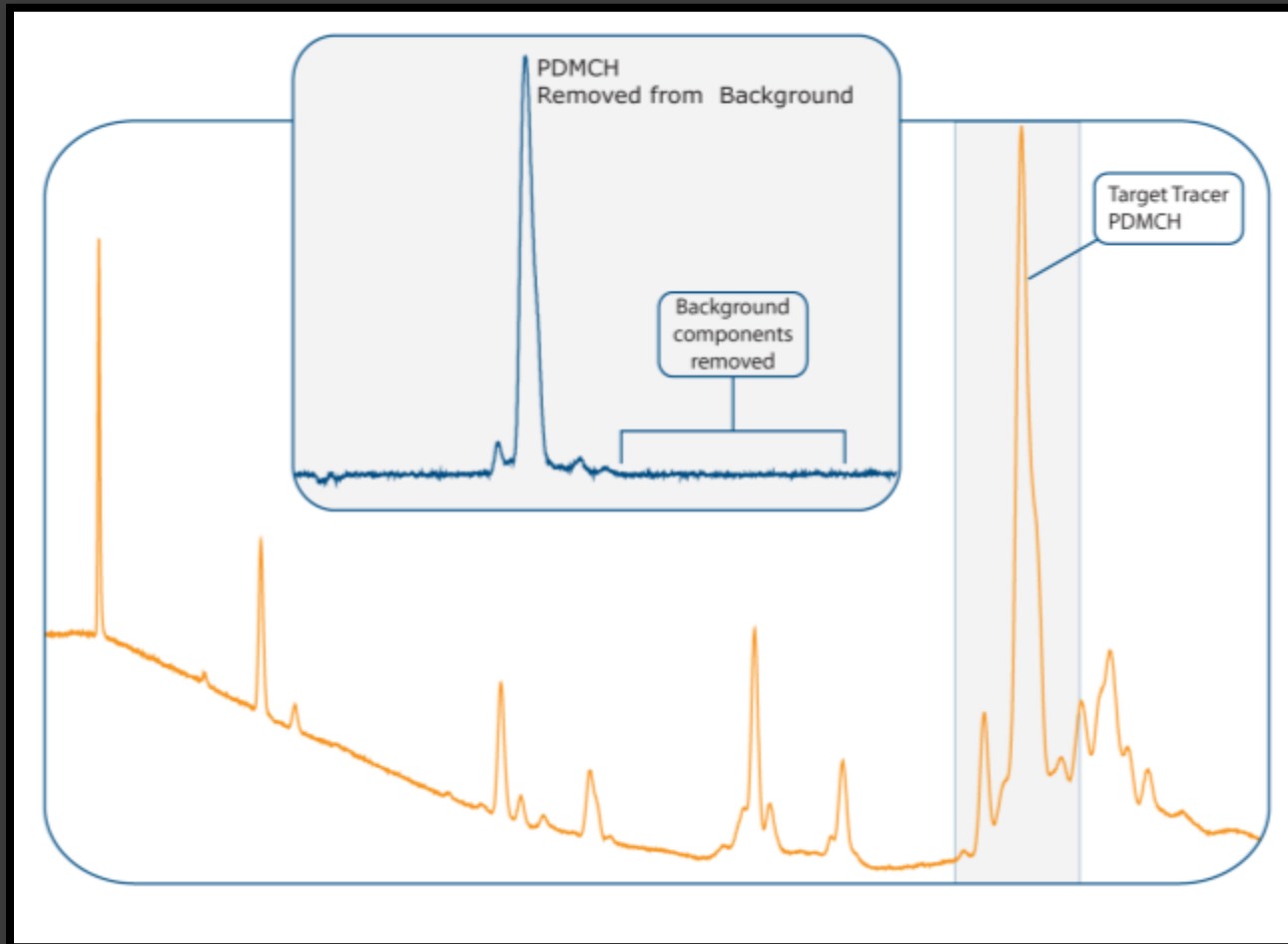
- Detects ambient tracer concentrations (fL/L)
- Designed for a mobile environment
- Automatically alarms when a leak is detected
- Near real-time analysis
- GPS tracking of leak status
- Gas chromatograph allows direct injection of oil and bag samples

How the Tracer Analyzer works

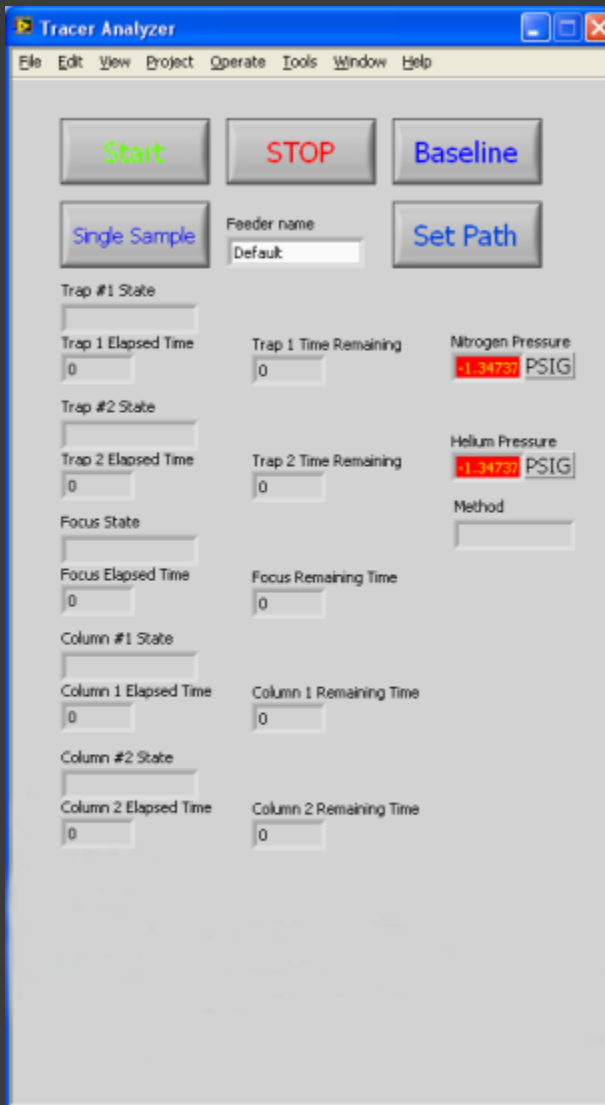
- Vacuum pump samples ambient air
- PFTs are trapped, concentrated, and desorbed to a gas chromatograph for analysis
- The ECD detector is sensitive to halogens and detects very low tracer concentrations
- Analyzer software graphs the data
- GPS system tracks leak status

How the Tracer Analyzer works

Multidimensional Chromatography



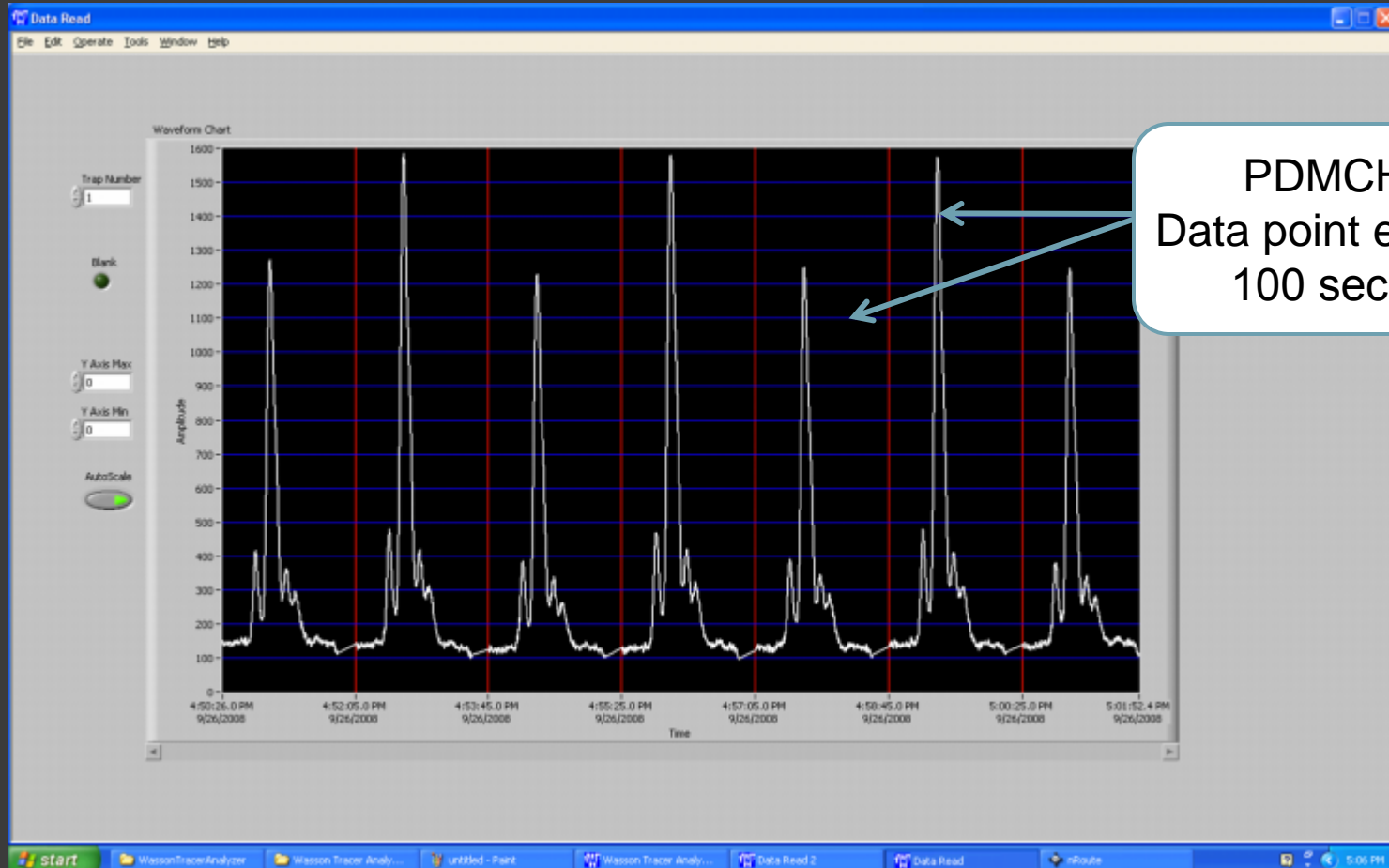
Tracer Software



- User friendly software
- Carrier gas pressure alarms
- Monitor trap states
- Set baseline
- Choose continuous or single sampling

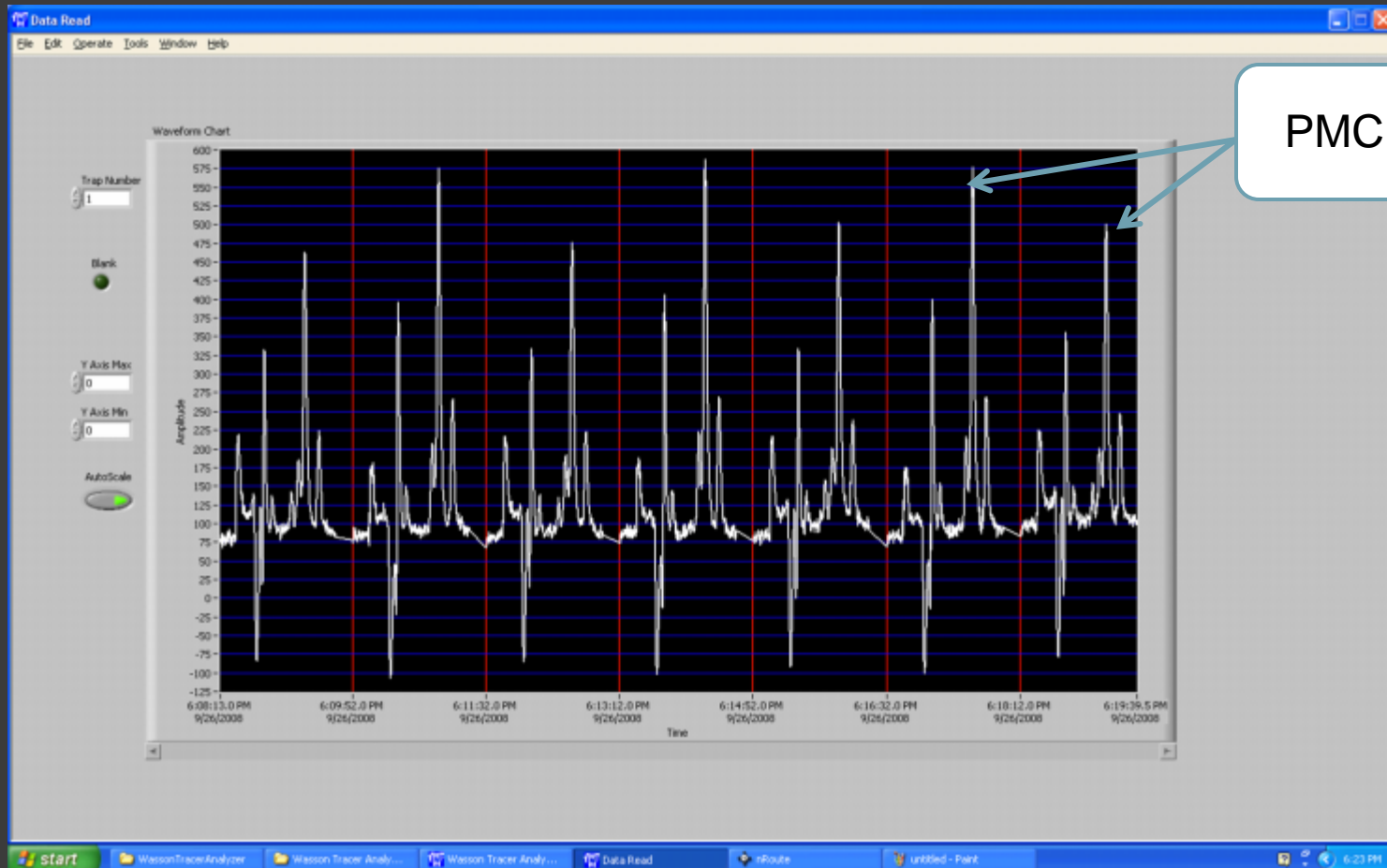
Tracer Software

Near Real Time Analysis



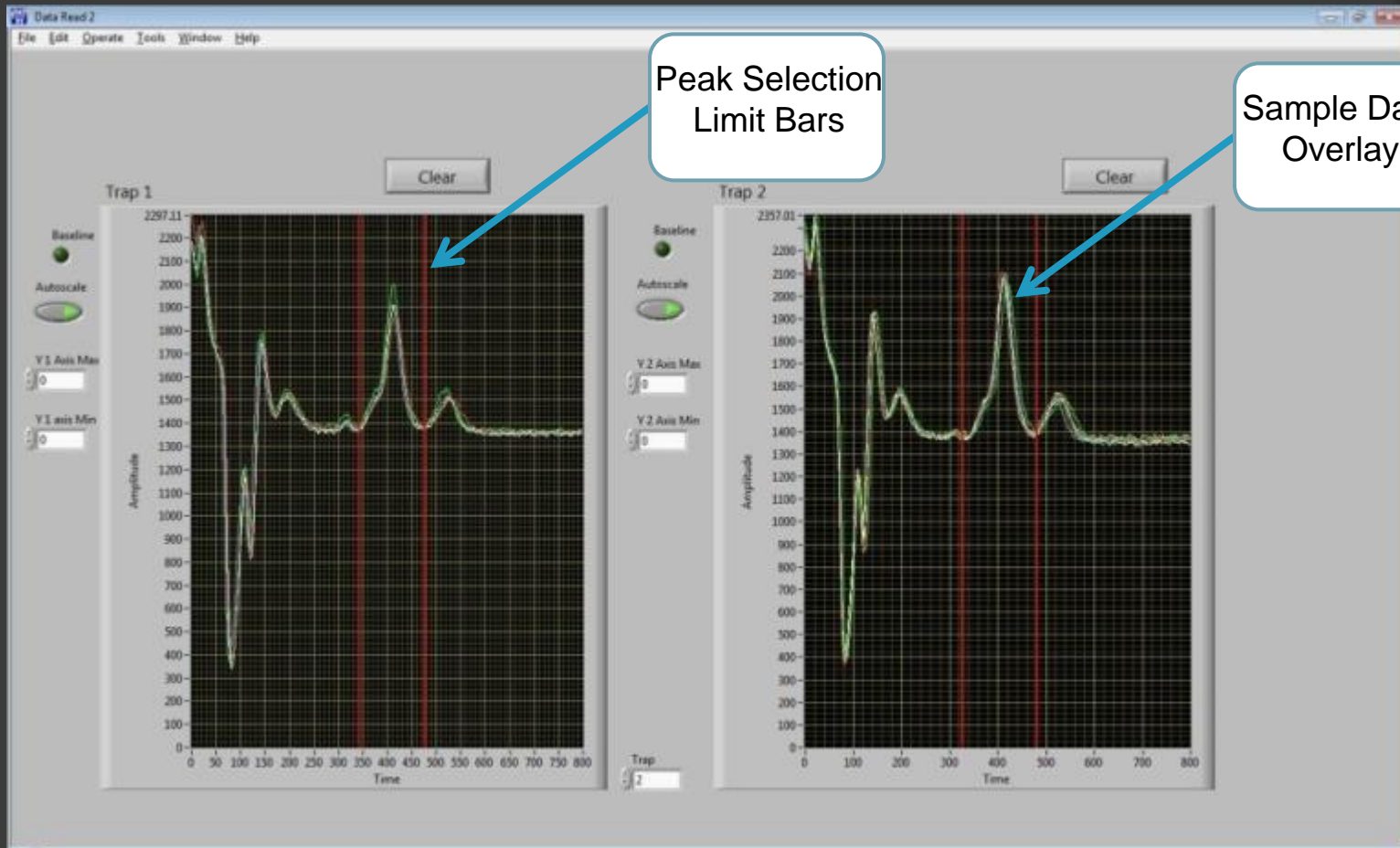
Tracer Software

Advance Selectivity



Tracer Software

Data Analysis



Tracer Software

Leak Detection



Tracer Software

GPS Integrated Data Analysis

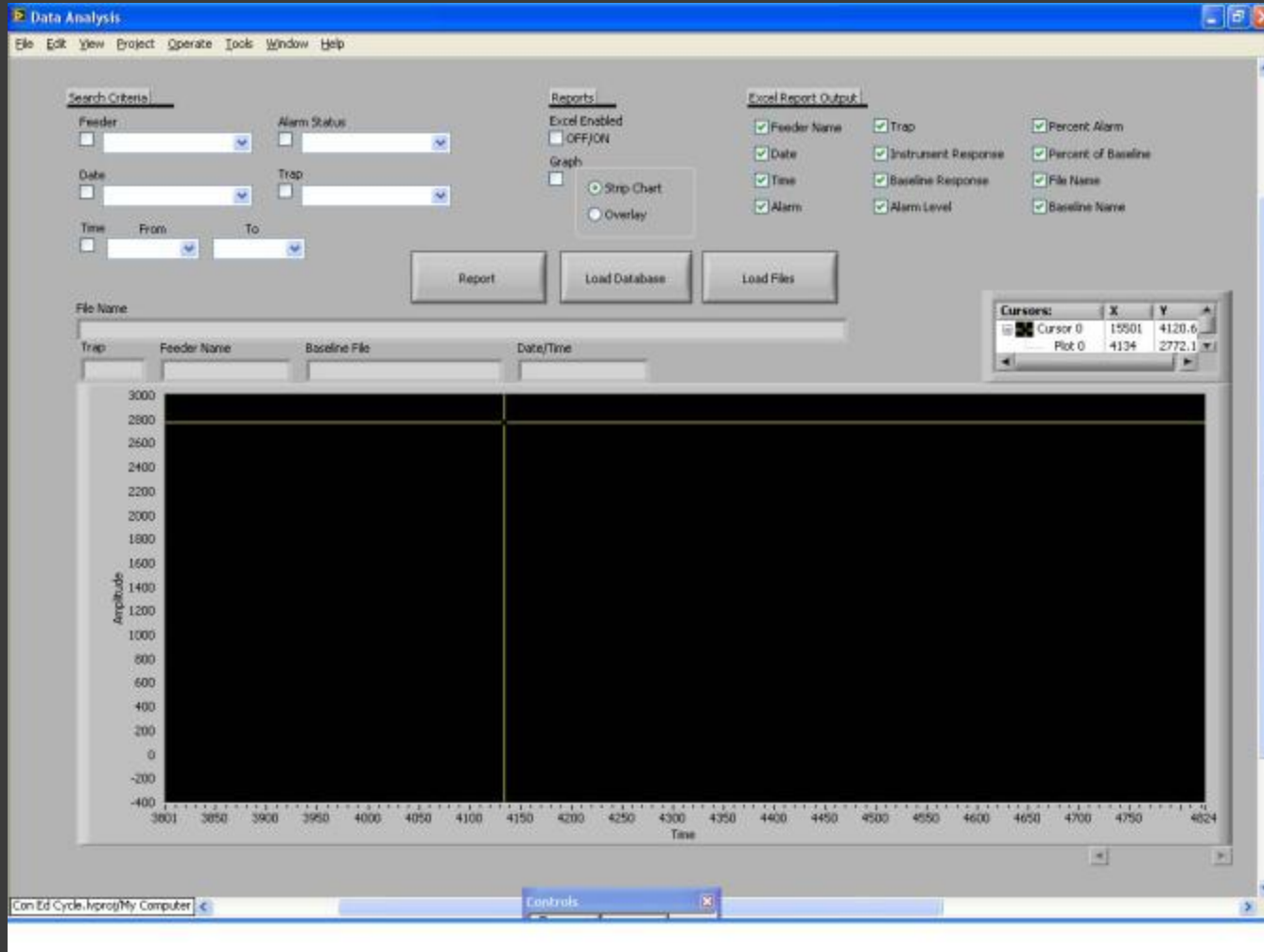
The screenshot displays the nRoute software interface. At the top, the title bar reads "nRoute". Below it is a menu bar with "File", "Edit", "View", "Find", "Route", "Tools", "Utilities", and "Help". A toolbar contains various icons for navigation and settings. The main map area shows a street grid with a red route line. A status bar at the top right of the map area displays "Driving South", "Heading 195°", and "Speed (mph) 111.8". Two callout boxes are present: one pointing to a red dot on Centre St labeled "Sample Status: Red (Leak Detected)", and another pointing to a green dot on Centre St labeled "Sample Status: Green (No Leak Detected)". At the bottom, a waypoints table is visible.

Name	Symbol	Comment	Position	Altitude	Depth	Proximity	Temperature	Display	Date Modified
116CentreSt	Green	116 Centre St	N40 42.986 W74 00.070					Symbol & ...	10/28/2008 1...
145CentreSt	Red	145 Centre St	N40 43.047 W74 00.023					Symbol & ...	10/28/2008 1...
98CentreSt	Green	98 Centre St	N40 42.953 W74 00.093					Symbol & ...	10/28/2008 1...
CanalSt	Red	Canal St	N40 43.082 W73 59.997					Symbol & ...	10/28/2008 1...
CentreSt	Green	Centre St	N40 43.015 W74 00.049					Symbol & ...	10/28/2008 1...

0 Items Selected Lat/Lon hdddmm.mmm(WGS 84)

start | 4 Firefox | Microsoft Excel - dht... | Local Disk (C:) | Installation.doc - Mic... | nRoute | 10:49 AM

Tracer Software Data Analysis



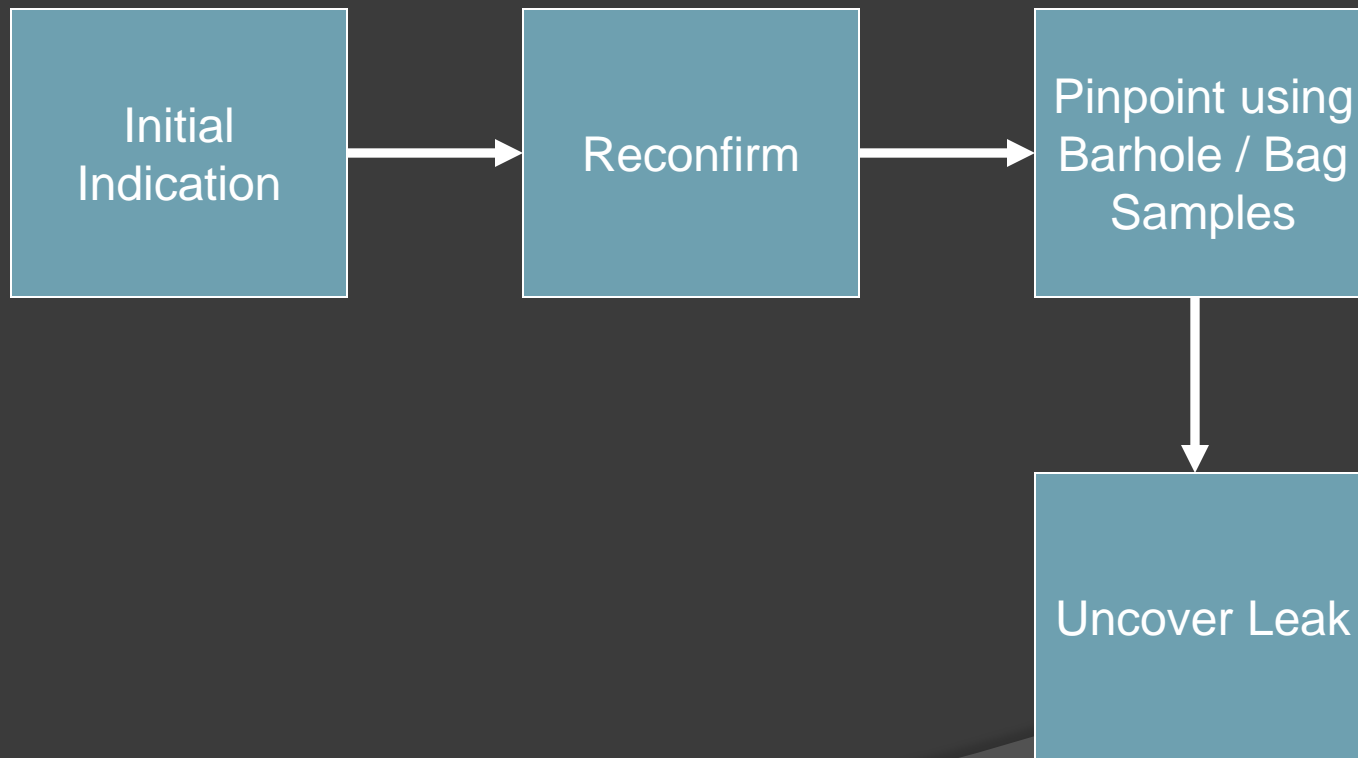
Detecting Leaks in the Field

- High pressure feeder leak detected based on pressure changes
- 4 Tracer Analyzer units ready to be deployed
- Feeder route is followed until leak is detected



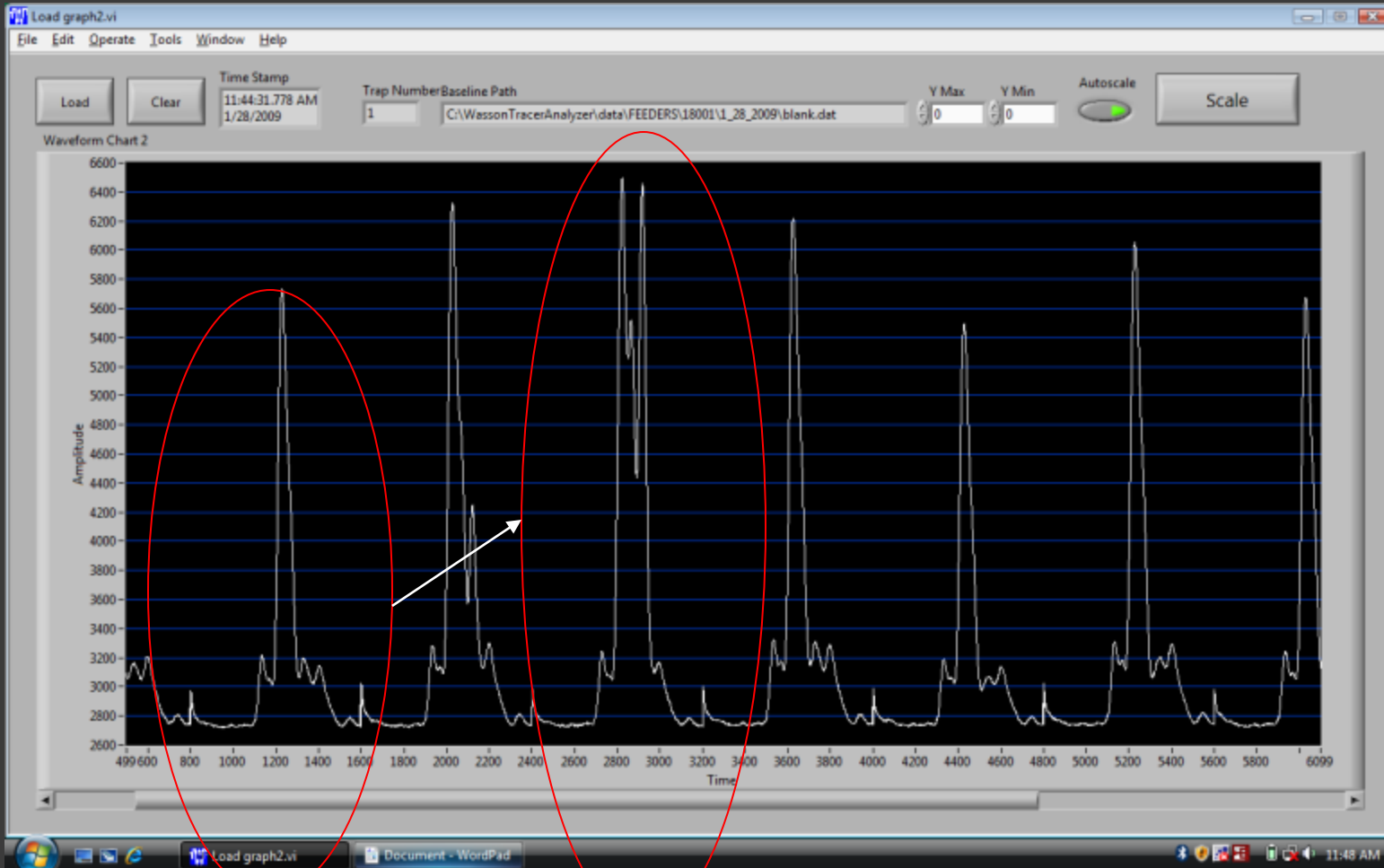
Detecting Leaks in the Field

Leak Finding Process



Detecting Leaks in the Field

PFT Analysis – Initial Leak Detection



Detecting Leaks in the Field

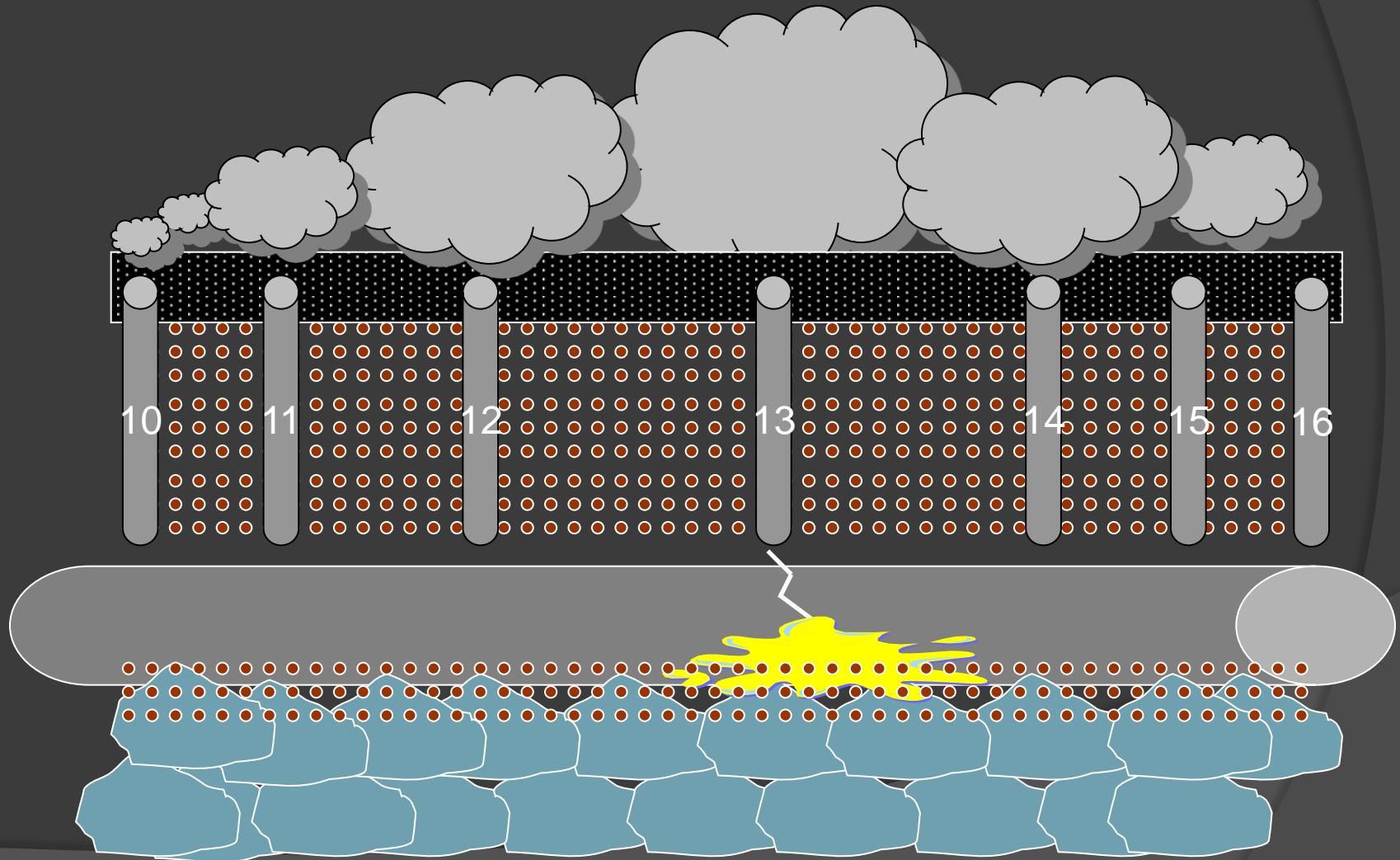
PFT Pinpointing/Bag Samples

- Once general area of leak is located, must barhole to pinpoint leak location
- Air is aspirated into sealable bags
- Bag samples analyzed directly on gas chromatograph



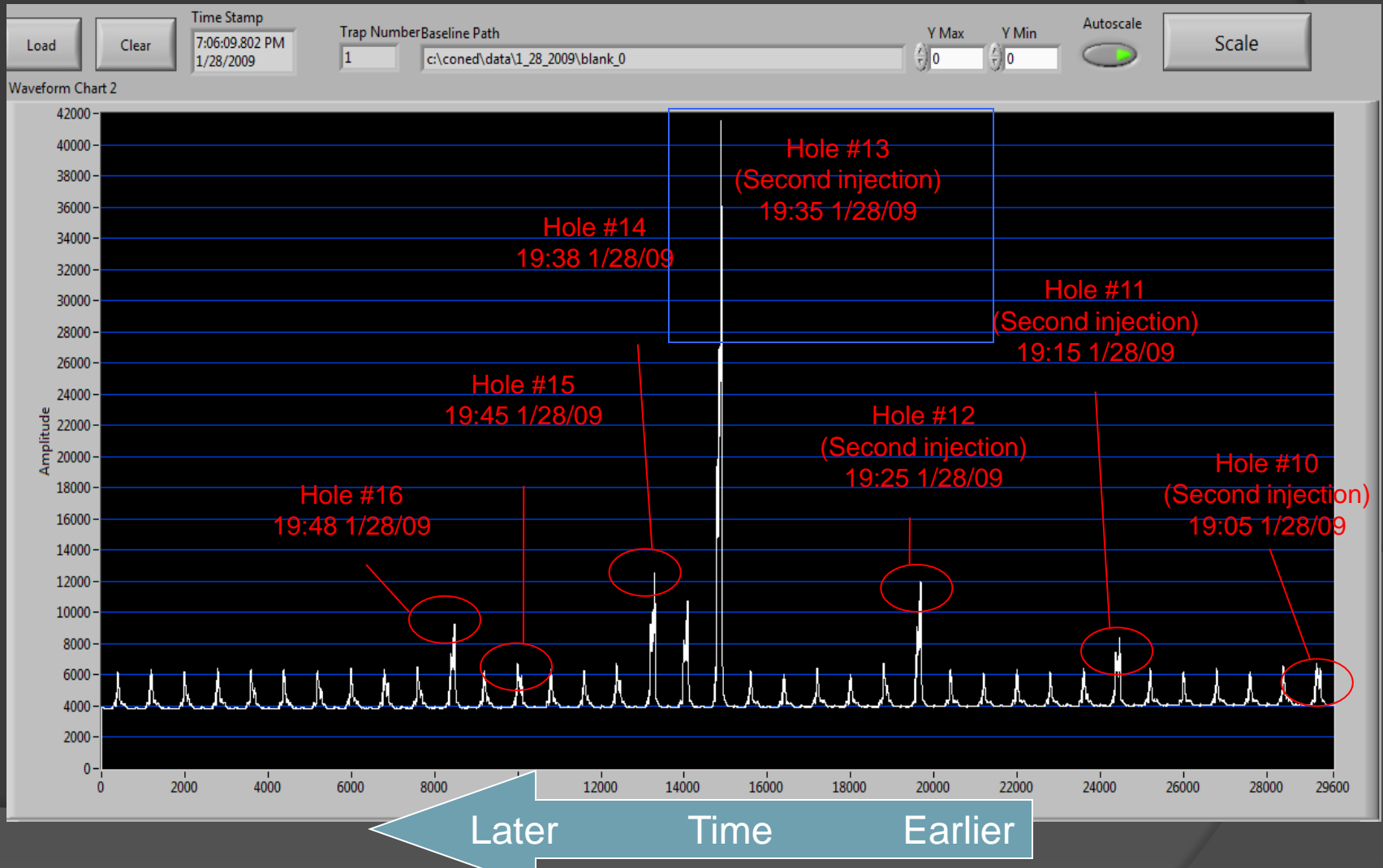
Detecting Leaks in the Field

PFT Bell Curve Theory



Detecting Leaks in the Field

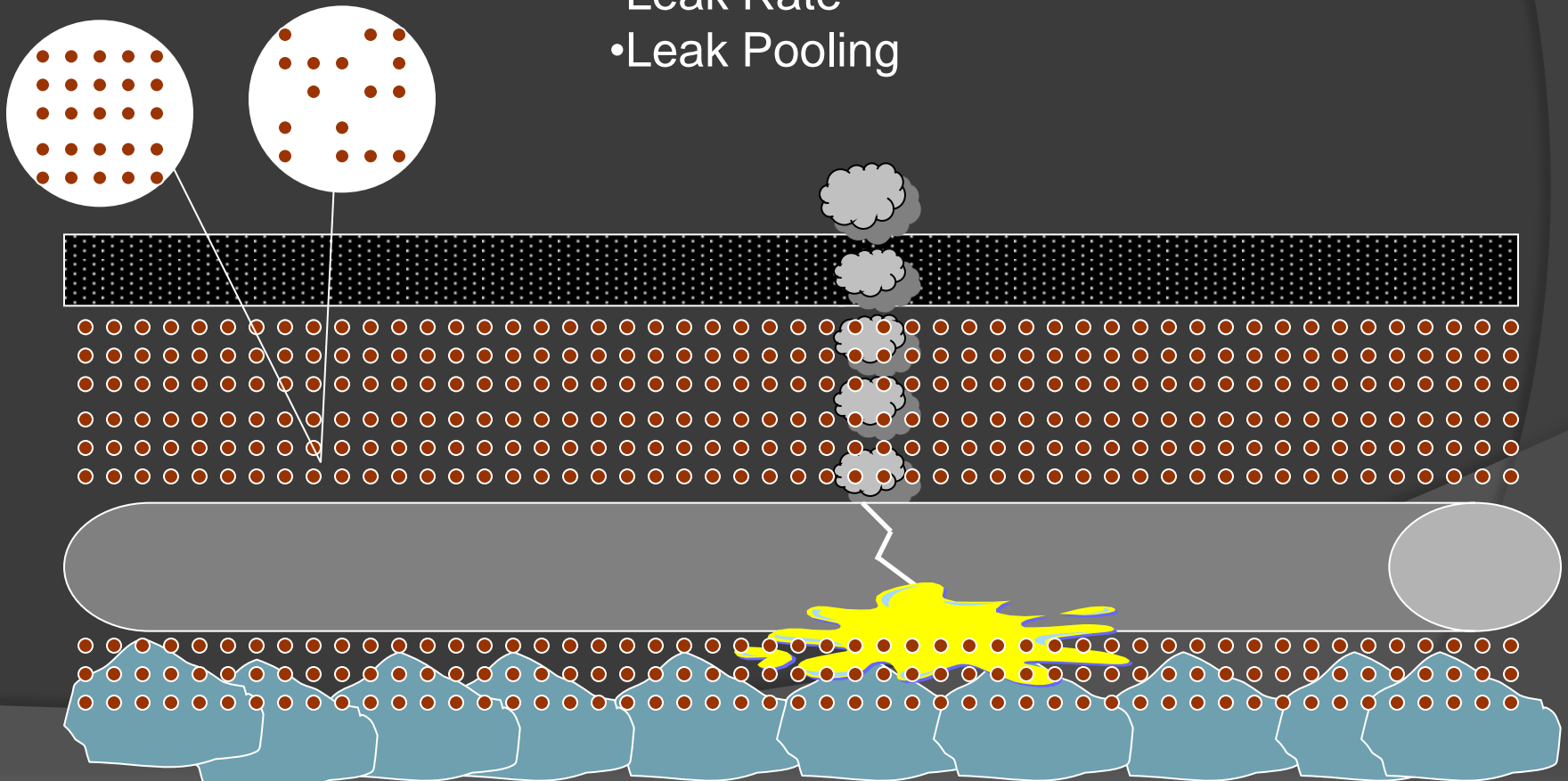
PFT Bag Samples – Bell Curve



Detecting Leaks in the Field

PFT Detection Problems – Low Signal

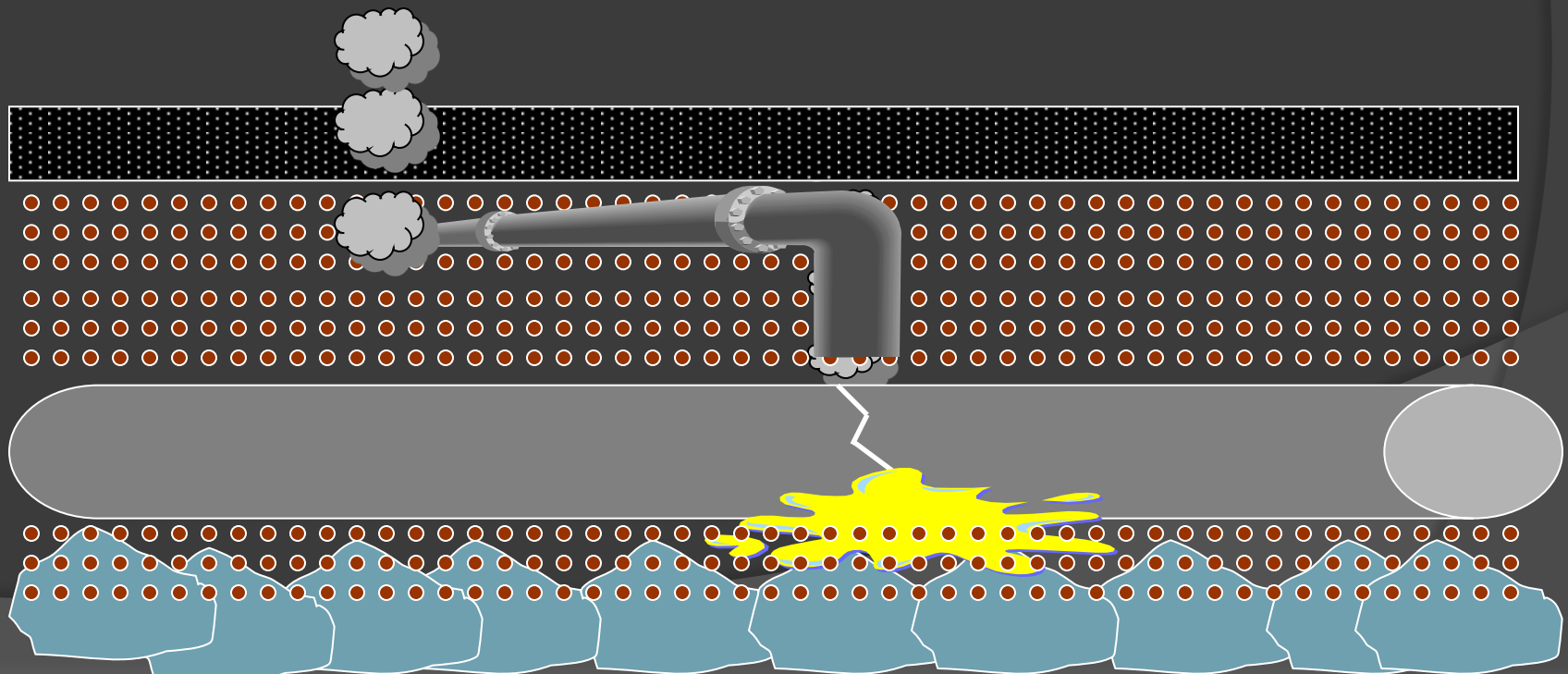
- Soil Density
- Frozen Ground
- Leak Rate
- Leak Pooling



Detecting Leaks in the Field

PFT Detection Problems Leak Not Found After Digging

- Duct work / piping
- Subway



Summary – PFT Benefits

- Reduces environmental impact
- Minimizes maintenance required
- Leak detection times are usually hours, not days or weeks
- Saves money

Thank You!

Questions?