

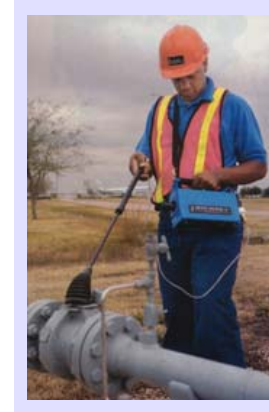
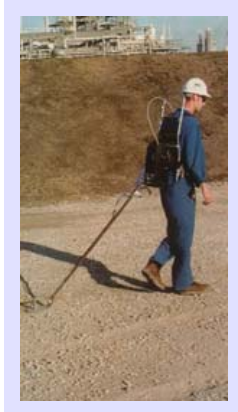
Airborne Lidar Pipeline Inspection Service (ALPIS™)



Overview

- Statement of the problem
- Technology
- Benefits
- Field results
- Discussion

Conventional Inspection Methods



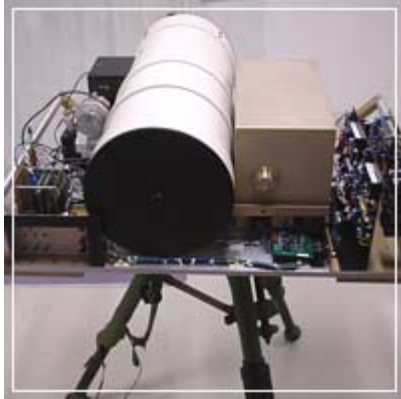
- **Hand-held or truck mounted "sniffers":**
 - Allow maximum coverage of only 8-10 miles a day
 - Scan the swath of one bumper width at best
 - Are ineffective over rough terrain and unwelcome over private land
- **Aerial patrols only look for secondary signs of leaks and right-of-way encroachments**

What is ALPIS



ALPIS (Airborne Lidar Pipeline Inspection Service) is a revolutionary new way to find leaks in natural gas transmission and gathering lines

ALPIS Evolution



1998

2000

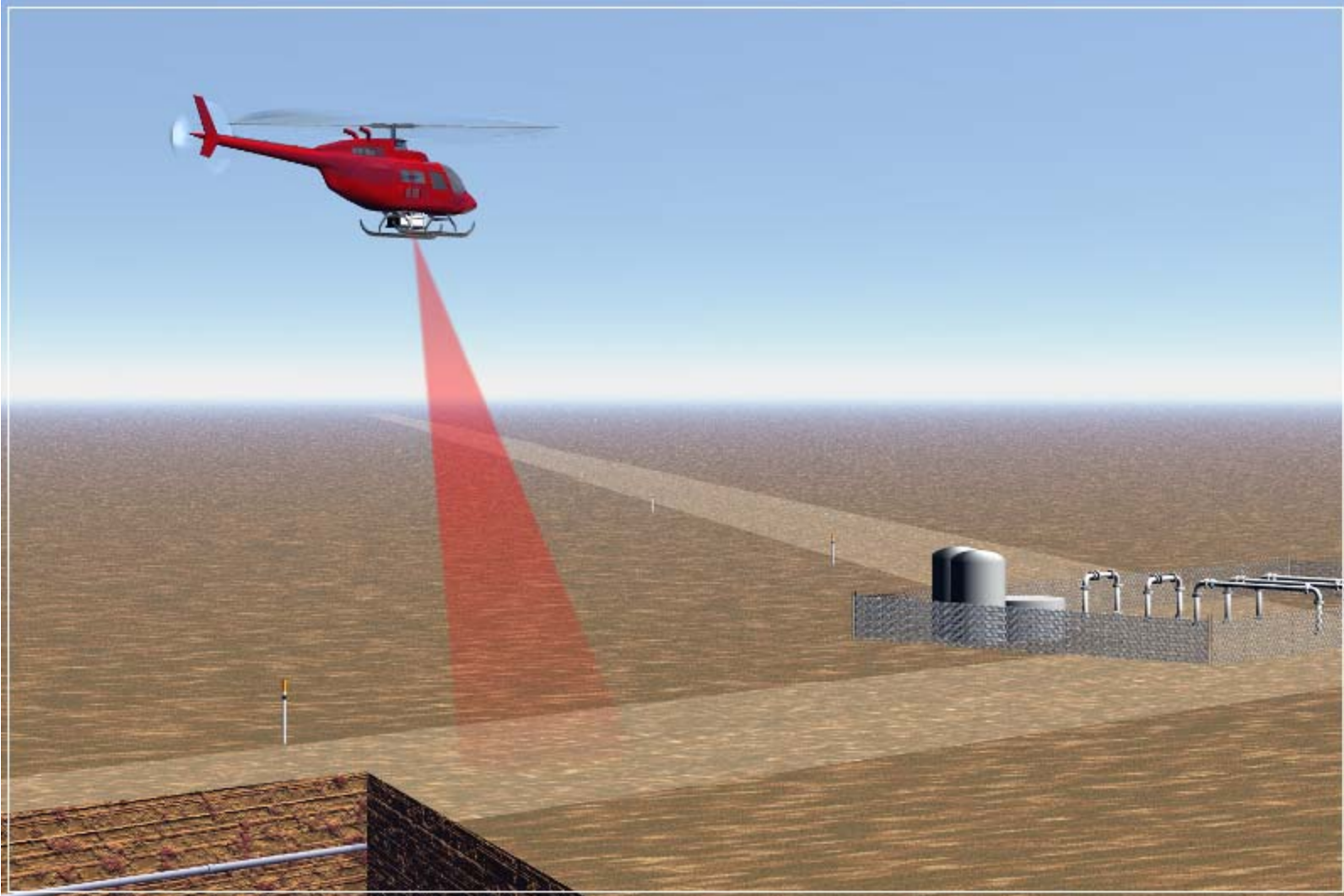
2002

2004

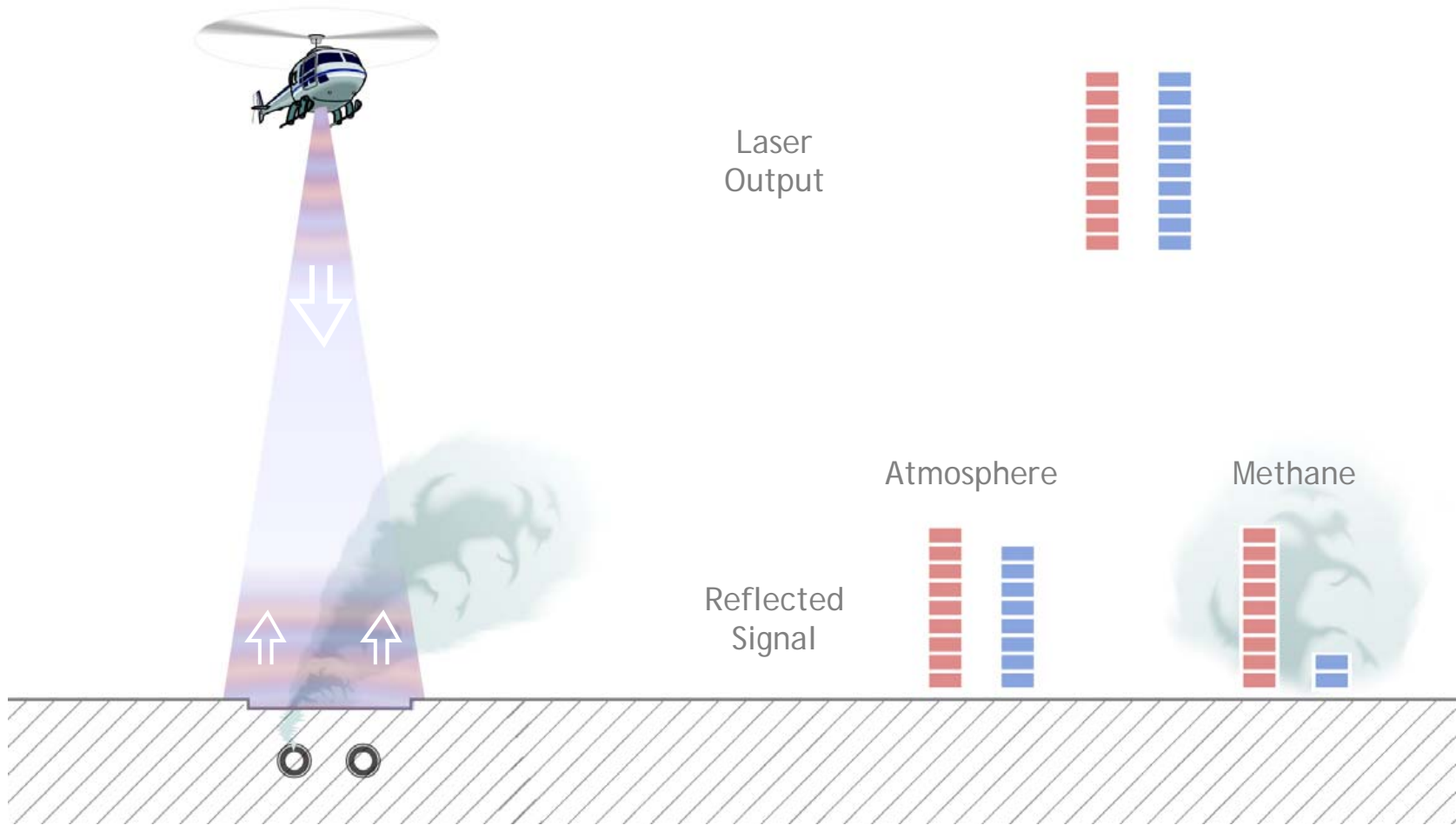
2006



How ALPIS Works



How Technology Works



How It Looks



Package weight: 250 lbs.

ALPIS at Work



ALPIS Benefits to Customers

- Over ten times faster than ground surveys
- **Highest sensitivity in remote gas detection**
- Easy access to rough terrain
- Non-disruptive to private landowners
- GPS accuracy of results
- **Full coverage of the right-of-way**
- Digital photography of the entire survey route
- **Full reports delivered within 24 hours of inspection**
- 1-hour emergency response available
- Multimedia and Internet based reporting and archiving

Survey Results

Printed reports



- ▶ Conventional, easy to use format
- ▶ Convenient for field follow ups
- ▶ Available within an hour after survey



Interactive DVDs



- ▶ Combine maps and high-resolution digital imaging in one easy to use software package
- ▶ Allow to replay the entire inspection for visual verification



Secure online GIS - database



- ▶ Aids in maintenance and repair planning
- ▶ Improves long-distance collaboration
- ▶ Enhances field feedback



Printed Report

Natural Gas Pipeline Leak Detection Inspection Report

Submitted to:
ACME Industries
John Doe
123 Main St
Any Town, TX 00000

Contract No.
2006-011

Report No.
05114


Date(s)
Jan 11, 2006

Inspection Summary

Customer:	ACME Industries
Inspection Period:	January 11, 2006
Inspection Area:	Customer specified segments of pipeline system
Leak Detection Equipment:	LaSen's Airborne Lidar Pipeline Inspection System (ALPIS-III)
Equipment Calibration:	Prior to every inspection
Miles Inspected:	56.65

Inspection Results

Marker	Latitude (WGS-84)	Longitude (WGS-84)	Indication size	Wind	Visual	Map
A-13089	32 04 14.3	-107 30 14.6	Large	N at 5 mph.	Tank Battery	Map 1
A-133916	32 02 0.7	-107 27 49.1	Medium	N at 5 mph.		Map 1
A-193215	32 00 39.5	-107 27 16.0	Medium	N at 5 mph.		Map 1
A-212629	32 00 47.5	-107 25 9.9	Large	N at 5 mph.		Map 1



Inspection overview

Inspection results in a tabular format

Inspection results overlaid on a map

Complete Results on DVD

Map of the inspected area

Digital imaging

The screenshot displays the LASER software interface. At the top left is the LASER logo with the tagline 'ADVANCED LASER SENSORS'. The interface is divided into several sections:

- Map of the inspected area:** A central map showing a flight path in blue lines. A red pin marks a specific location labeled 'A-133916'. A wind indicator shows '5mph. N'. Navigation controls include 'Pan', 'Zoom', 'Zoom Out', 'Zoom In', and 'To Area'. A scale bar at the bottom of the map indicates '0' to '2 mi.' and 'Zoom level: 8000'.
- Digital imaging:** A large window on the right shows a high-resolution aerial photograph of a dirt road and surrounding vegetation. Below the image are sliders for 'Auto', 'Brightness', and 'Contrast', each with a value of '0' and '><' buttons.
- Current Position:** A panel with input fields for:
 - Latitude: 32.02.0.9
 - Longitude: -107.27.48.1
 - System: WGS-84
 - Format: DD MM SS
 - Speed: 21 mph
 - Altitude: 145 ft
 - Time: 13:08:03
 - Date: Wed, 01/11/2006
- Methane Indications:** A table with columns: Latitude, Longitude, Marker, Intensity, Flight, and Comments.

Latitude	Longitude	Marker	Intensity	Flight	Comments
32.07064567	-107.5040588	A-13089	Large	A	Tank Battery
32.03353746	-107.4633593	A-133916	Medium	A	
32.01069188	-107.4546798	A-193215	Medium	A	
32.01318727	-107.4191462	A-212629	Large	A	

At the bottom of the interface is a playback control bar with a 'Play' button and navigation arrows.

Detailed inspection information

Secure On-line Database

LaSen Database

File Edit View History Bookmarks Tools Help

http://www.laseninc.com/

Inspection: [DEMO-08-06](#)

Dates: 4-24-2006 — 4-27-2006

Miles surveyed: 85.50

Indications found: 14

[Back to the database list](#)

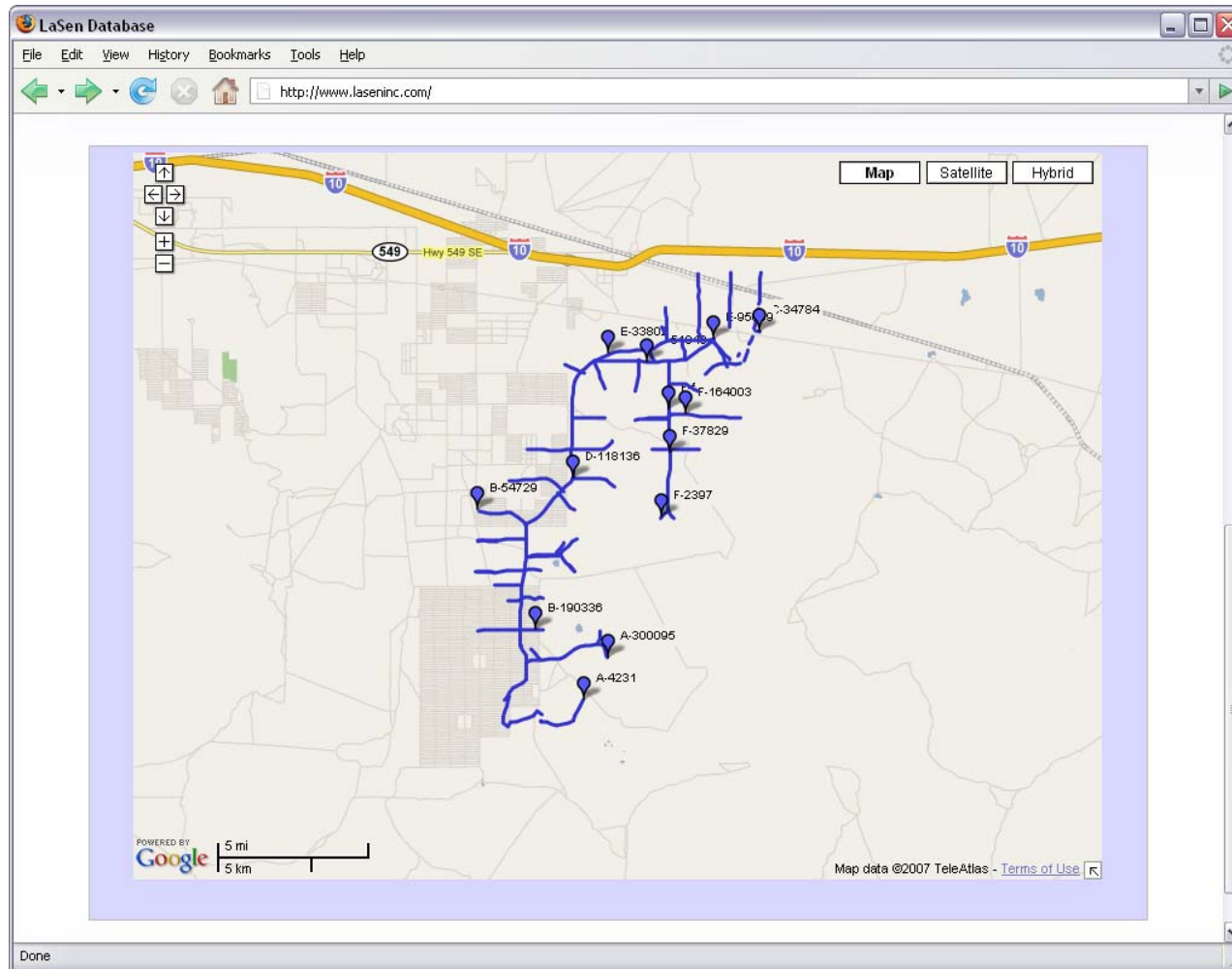
[Download table in TXT format](#)

Disclaimer: All information featured herein is for demonstration purposes only. Pipeline coordinates and leak locations used in this sample database are fictitious and do not correspond to any real pipeline.

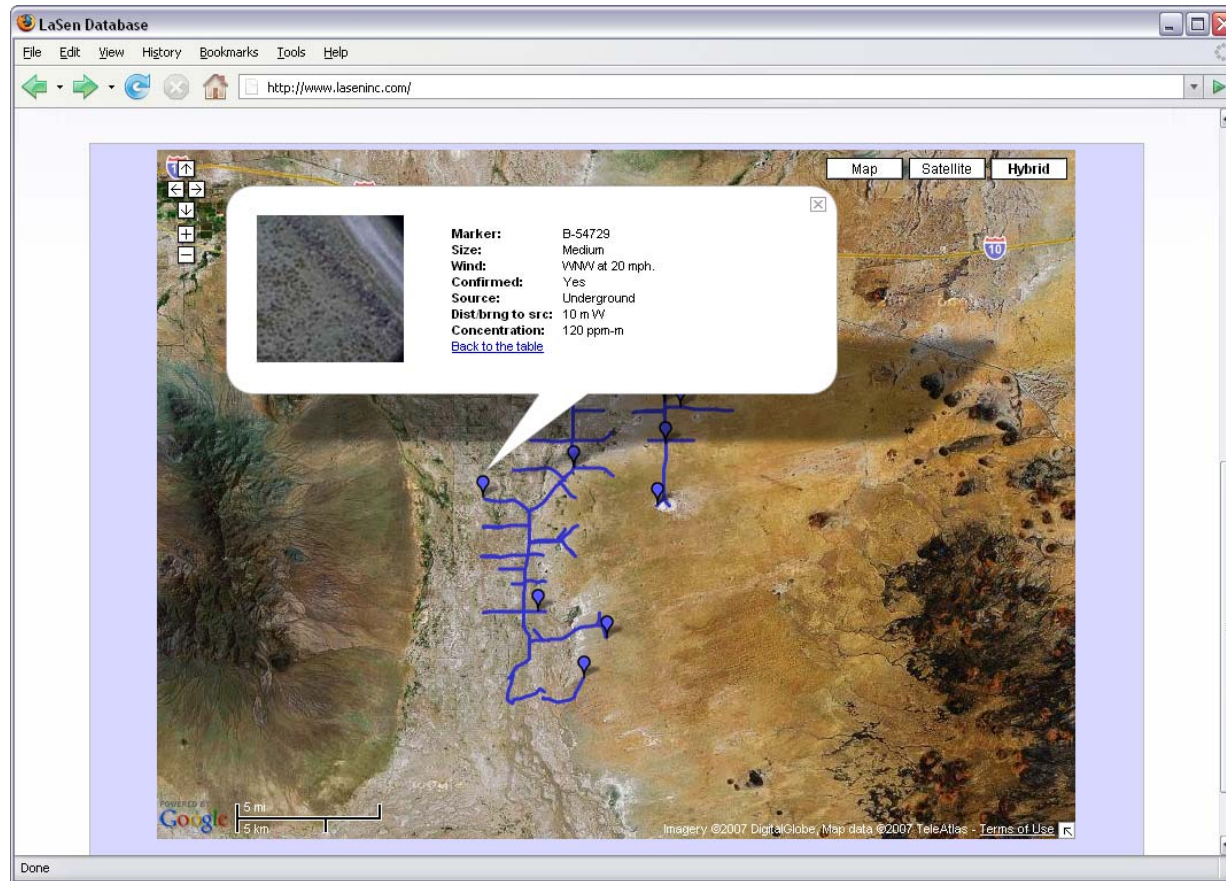
Marker	Latitude	Longitude	Size	Visual	Wind	Confirmed	Source	Dist brng to src	Concentr.	Leak rate	Notes
A-4231	32.027895	-107.409449	Small	Meter House	WNW at 20 mph.	Yes	Meter	7 m NW	40 ppm-m		
A-300095	32.048155	-107.395682	Large	Meter House	WNW at 20 mph.	Yes	Meter	exact	30000 ppm-m		
B-54729	32.119406	-107.469969	Medium		WNW at 20 mph.	Yes	Underground	10 m W	120 ppm-m		
B-190336	32.061470	-107.436534	Large		WNW at 20 mph.	Yes	Underground	exact	300 ppm-m		
C-34784	32.204434	-107.309439	Small		S at 8 mph.	Yes	Underground	exact	40 ppm-m		
D-51049	32.190007	-107.373686	Medium		S at 8 mph.	Yes	Underground	15 m S	150 ppm-m		
D-118136	32.134084	-107.415525	Medium		S at 8 mph.	Yes	Underground	exact	170 ppm-m		
E-33802	32.194302	-107.395707	Small		S at 8 mph.	Yes	Underground	exact	50 ppm-m		
E-95669	32.200954	-107.335968	Large	Valve Setting	S at 8 mph.	Yes	Leaking Valve Stem	exact	2000 ppm-m		
F-2397	32.115812	-107.365438	Small	Tank Battery	SSE at 19 mph.	Yes	Theif Hatch	70 m S	200 ppm-m		
F-37829	32.146423	-107.360608	Small		SSE at 19 mph.	Yes	Underground	exact	100 ppm-m		
F-54385	32.167627	-107.361060	Medium		SSE at 19 mph.	Yes	Underground	exact	140 ppm-m		
F-164003	32.165024	-107.351584	Large		SSE at 19 mph.	Yes	Underground	exact	300 ppm-m		

Done

Survey Results Overlay on Map



Survey Results Overlay on Satellite Imagery



High-resolution Image of Leak Location

The screenshot displays a web browser window titled "LaSen Database" with the URL "http://www.laseninc.com/". The main content area features a high-resolution aerial photograph of an industrial site. A central white rectangular area highlights a specific leak location. To the right of the image, a list of data points is provided:

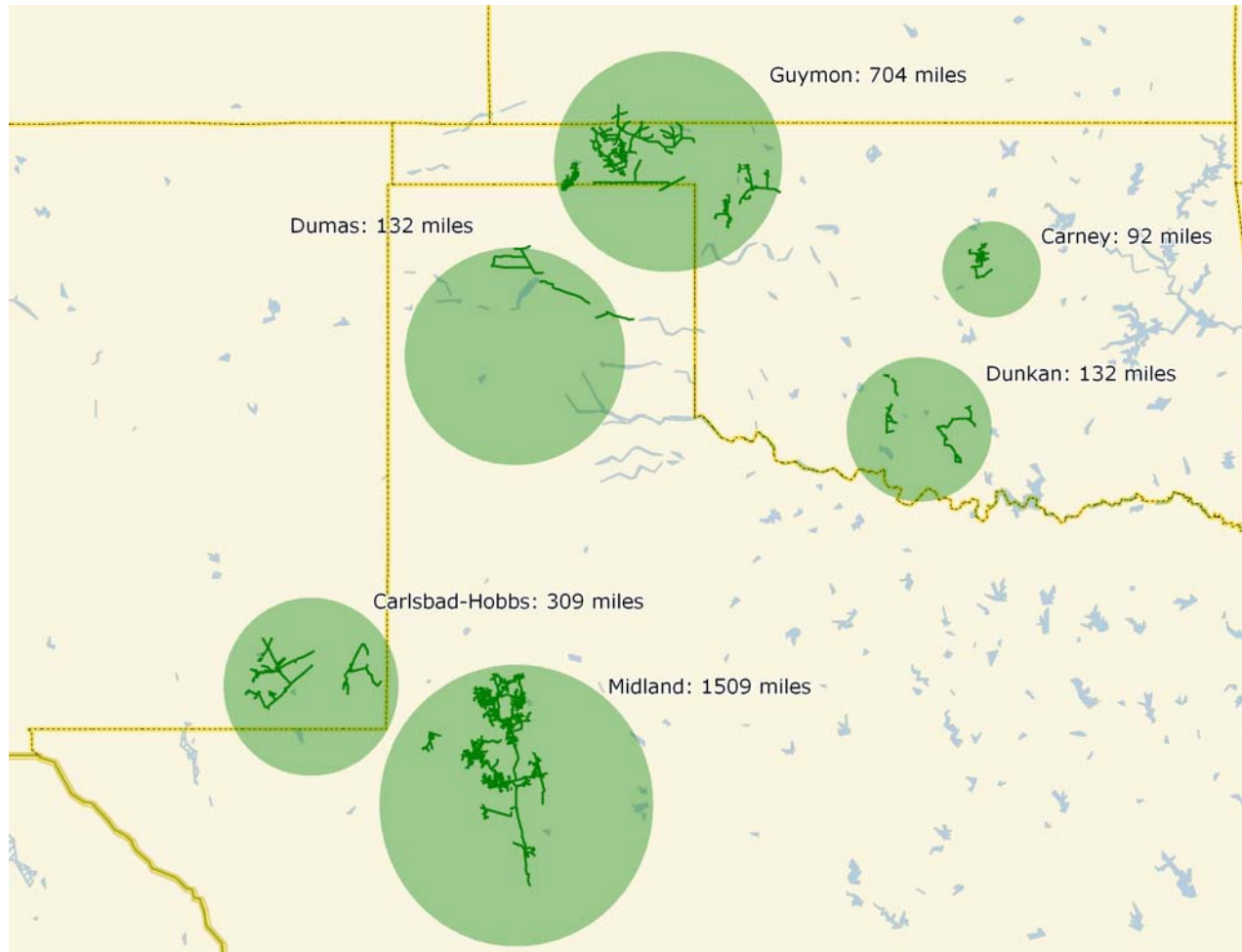
Marker:	F-2397
Latitude:	32.115812
Longitude:	-107.365438
Size:	Small
Visual:	Tank Battery
Wind:	SSE at 19 mph.
Confirmed:	Yes
Source:	Theif Hatch
Dist.brng to src:	70 m S
Concentration:	200 ppm-m
Date of inspection:	Monday, April 24, 2006 - Thursday, April 27, 2006

Below the image, there is a blue double-headed arrow and a small red "x" icon. The browser's status bar at the bottom left shows "Done".

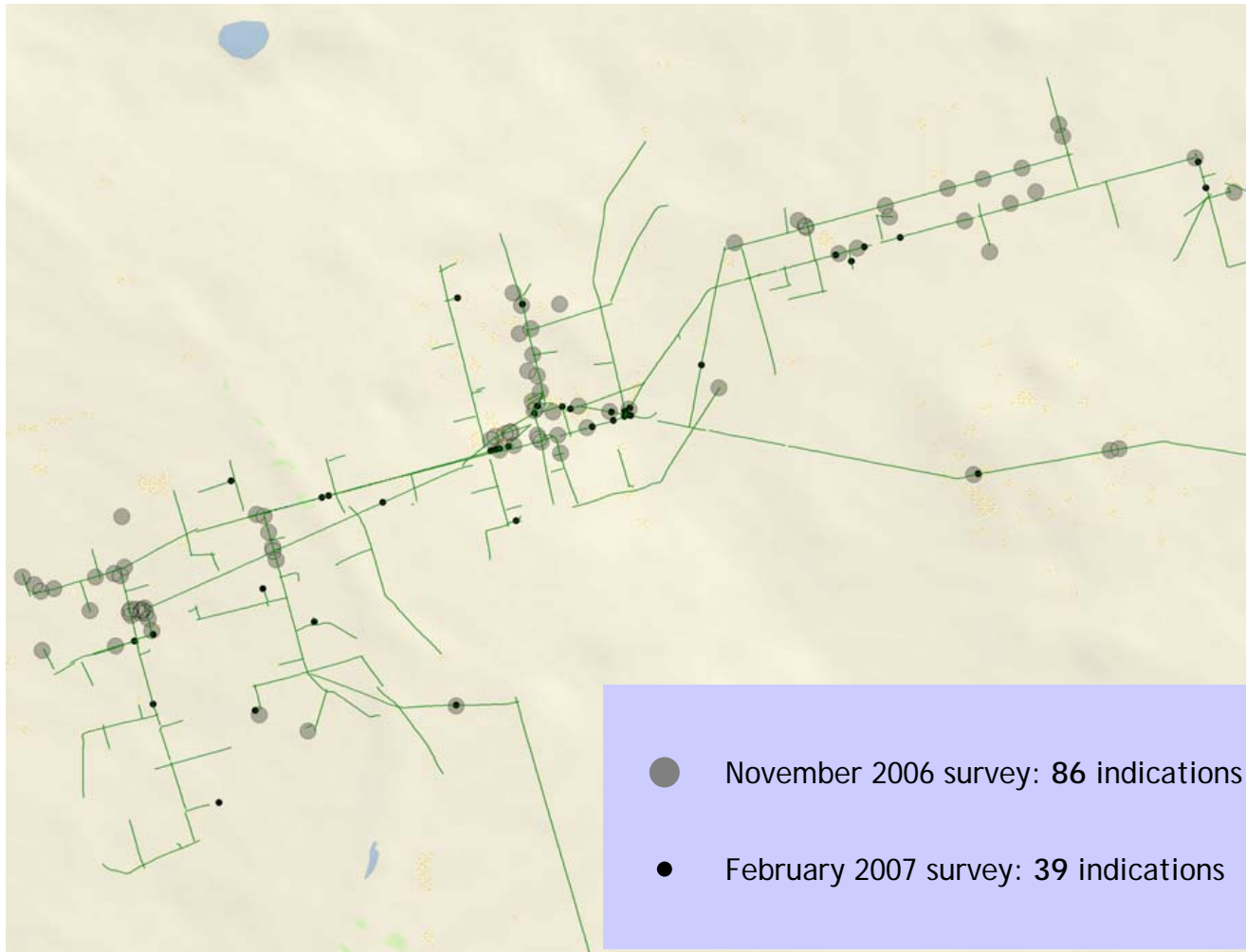
Right-of-Way High-Resolution Digital Imagery



DEFS Surveys 2006



Survey - Repair - Survey - ... Cycle



Field Results Summary

- Commercial application started: in 2004
- Total miles inspected in 2006: 4,719
- Total leak indications reported: 1,283 (approx. 1 leak every 3.5 miles)
- Customers served: 7

Effectiveness of Inspection

15 miles of transmission line inspected on April 13, 2006

Cost of Inspection \$1,875.00 *

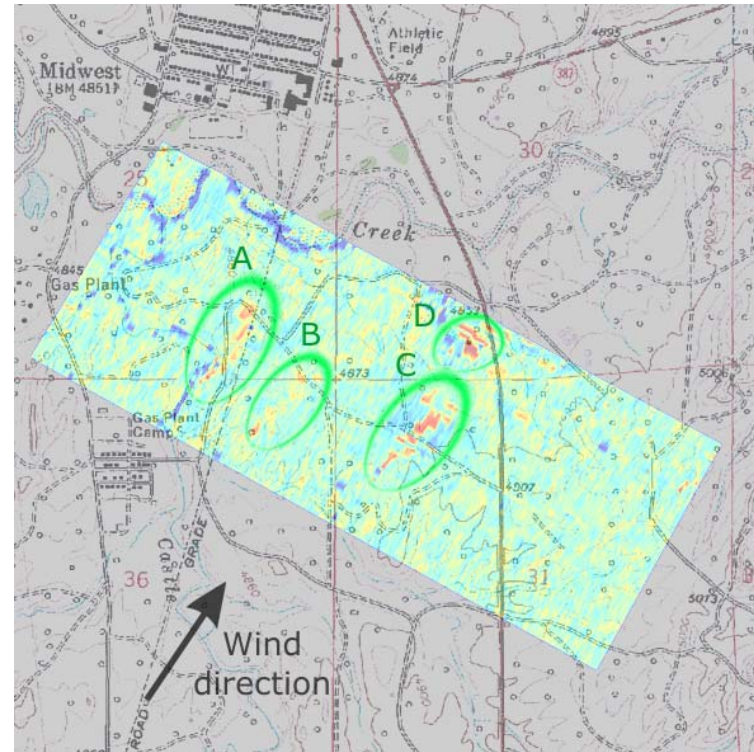
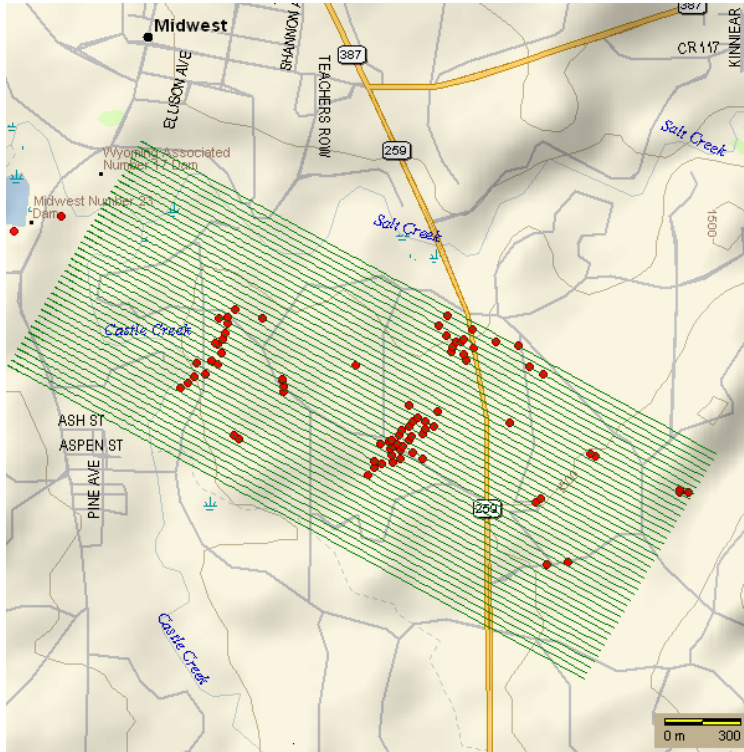
Annual Product Loss \$16,407.00**

<i>LASEN Marker</i>	<i>Indication size</i>	<i>As-Found Daily Leakage Rate (mcf)</i>	<i>Annual Leakage Rate (mcf) m=1,000</i>	<i>Annual BTU Loss</i>	<i>Annual product loss (\$)</i>	<i>Description of leak and repair</i>
A-210994	medium	0.1776	64.82	64,824,000	583.42	Leak found on fuel tap valve operator (booster station). Lubricated stem and operated valve to stop leak.
A-216681	small	0.4181	152.61	152,606,500	1,373.46	Leak found from plug in top of drip valve. Removed, cleaned, taped and replaced plug to stop leak.
A-231599	medium	0.1672	61.03	61,028,000	549.25	Leak found from plug in top of drip valve. Removed, cleaned, taped and replaced plug to stop leak.
A-316434	medium	0.5017	183.12	183,120,500	1,648.08	Leak found within booster station yard (piping). Will have to hand excavate to perform repair(s).
A-357112	large	1.5840	578.16	578,160,000	5,203.44	Leaking dresser coupling repaired with full encirclement sleeve.
A-357584	small	1.7280	630.72	630,720,000	5,676.48	Leaking dresser coupling repaired with full encirclement sleeve.
A-387233	small	0.4181	152.61	152,606,500	1,373.46	Leak was from a thermocouple in meter tube. Will isolate meter tube and replace leaking thermocouple.
Total		4.9947	1,823.07	1,823,065,500	16,407.59	

* Cost of inspection does not include setup fee

** Calculations are made based on the price of \$9 for 1000000 BTU

Congested Area Surveys



Results of grid-pattern survey of a partially abandoned oil field.
Areas marked as A,B,C and D represent identified plumes.

ALPIS Facts

