Canadian LiDAR Industry

Airborne Imaging Overview

Calgary based LiDAR provider

Established in 2004 as Airborne Imaging Inc.- employee owned

Part of Eveready Income Fund in 2006

August 2009 became a Clean Harbors Company (NYSE:CLH)

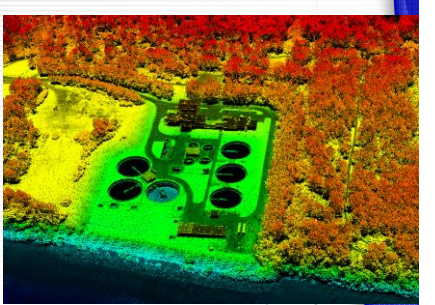
Company Profile

- We have 24 full time employees on staff in Canada and the US- up to 32 in peak season.
- Sales offices in Ottawa, Vancouver and Houston
- Organization of Surveying, Engineering, and Geomatics backgrounds
- We fly projects throughout the western Hemisphere

AIRBORNE IMAGING
A Clean Harbors Company

Airborne LiDAR

We own 4 airborne LiDAR systems



AIRBORNE IMAGING
A Clean Harbors Company

Mobile Mapping- Truck LiDAR

AIRBORNE IMAGING
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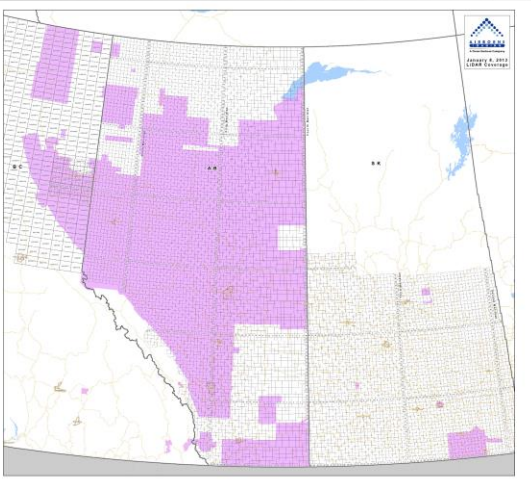
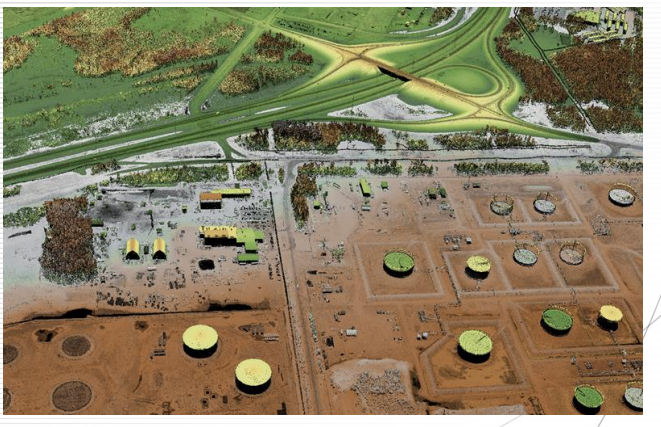
LiDAR Library Data

- +650,000km² in Canada and US
- Readily available
- Any shape or size
- Density of 1.25-2 returns per square metre
- 1m DEM and point cloud in .LAS
- Pricing based on volume



LiDAR Industry in Canada

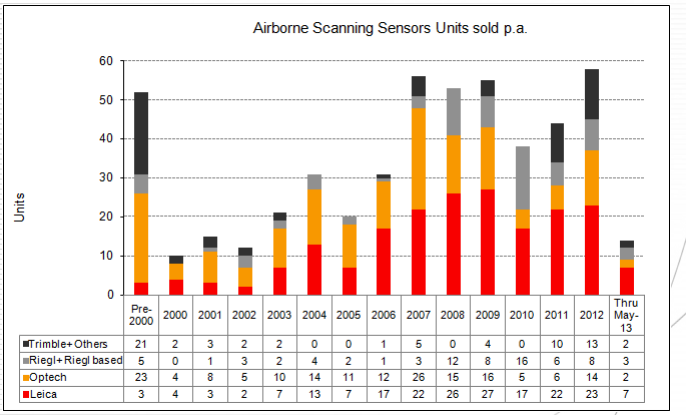


LiDAR Industry Overview

- **LiDAR is no longer a new technology. It is proven and established.**
- **It has earned steady confidence for over a decade now, from both service providers and end users.**
- **There has been drastic improvement in the systems (and service providers ☺) for both functionality and reliability.**

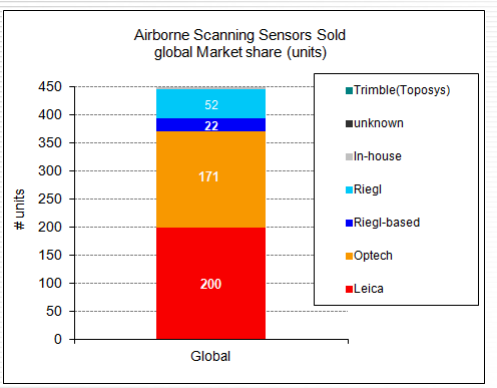
LiDAR Industry Overview

LiDAR Sensors Worldwide since 2000



	Pre-2000	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Thru May-13
Trimble+Others	21	2	3	2	2	0	0	1	5	0	4	0	10	13	2
Riegl+Riegl based	5	0	1	3	2	4	2	1	3	12	8	16	6	8	3
Optech	23	4	8	5	10	14	11	12	26	15	16	5	6	14	2
Leica	3	4	3	2	7	13	7	17	22	26	27	17	22	23	7

LiDAR Industry Overview



LiDAR in Canada

- In 2000, there were 4-5 companies in Canada with LiDAR sensors.
- They had roughly 6 sensors based in Canada.
- Most of them were proprietary systems, combining a laser with an inertial/GPS system. In essence assembled as components by the service provider.

Airborne LiDAR in Canada

- In 2013, there are 14 companies with LiDAR systems based in Canada from Fredricton, NS to Sydney, BC.
- There are a total of 26 active LiDAR systems (6% of the ~450 systems sold in the world, assuming they all still operate).
- >95% are off the shelf units.

LiDAR circa 2000

- Low repetition lasers -10KHz on a good day.
- Density of a half a point a metre was considered dense.
- System reliability was questionable-even off the shelf.
- Lot of reliance on proprietary equipment and service providers needing to have in-house expertise.
- Post processing packages were not overly developed.
- End users thought this stuff was “voodoo”.

ASPRS-Radar

- They wanted standards for LiDAR similar to photogrammetry.
- They established .LAS format. Since amended from V1.0 to V1.4 including waveform at V1.3.
- FEMA created guidelines and amended them. These became the norm for LiDAR field operations.
- USGS became involved with more stringent standards. Used throughout North America today.

LiDAR Circa 2004-5

- 100kHz systems, point density of >1/m2 the norm.
- Systems much better equipped with post processing software.
- Faster turn around capability.
- More system stability.
- More aggressive competition between manufacturers, Optech, Leica and Riegl.
- Still- clients were skeptical but warming up to the idea

LiDAR Today

- Systems up to 500KHz and growing
- MPIA- multiple pulses in the air simultaneously
- High density surveys up to 1, 2, 5,10, 30 points per square metre depending on the requirement.
- Waveform for structure analysis. A lot of data!
- Sensors with dual lasers (eg. Riegl Q1560- two LMS Q780)

Software Keeping up?

- Still very DSM, DTM, contours driven for deliverables.
- More and more clients want to work with the point cloud.
- Hardware at the desktop level has improved dramatically.
- QT Modeler, LP360, Virtual Geomatics, LAS Tools, Terramodel, ACAD, ESRI, Global Mapper all allow for loading and working with point cloud.
- Cost of some softwares are a barrier to working with the data more.

End User Drivers

- Cost
- Accuracy - clients ask for more and more
- Density requirement for penetrating canopy to improve the supplemental vertical accuracy.
- Better Density in mountain flying.
- Better definition of urban structure.
- Creating vectors from LiDAR? Lidargrammetry.

We Need Standards

- Many clients do not have a clear understanding of what they need. Too much or too little?
- Many do not understand the difference between fundamental vertical accuracy, supplemental and consolidated.
- There needs to be a base model specification . A reference guide.

LiDAR Standards

- Standards protect the end user and the service provider.
- They define clear, realistic accuracy expectations.
- They define clear minimum field procedures that all vendors need to adhere to.
- They maintain the integrity of the industry.

Thank You!