Photo: TLA Staff

LIDAR CAN PROVIDE INSIGHT INTO PTSA'S PATCHY INVENTORY

By Jean Sorensen

LiDAR is the enhanced, more accurate, inventory tool providing users with information never had before. So, why isn't BC's forest ministry, charged with getting the highest revenue from forests, not using this tool, especially in the cobbled-together Pacific Timber Sale Area now undergoing its first timber supply review?

Light Detection and Ranging (commonly called LiDAR) is the aircraft-borne laser scanning tool that is providing users with a mother lode of forest and topographical inventory data. The Canadian Forest Service in Victoria issued a 2013 best practices guide based on 25 years of research and BC forest companies are snapping up the new technology. Even Alberta's forest ministry has embraced the technology, flying it province-wide.

Yet, BC's Ministry of Forests Lands and Natural Resources Operations (MFLRO), charged with reviewing all 38 timber supply areas (TSA) to ensure sustainable annual allowable cuts (AAC), has been slow to adopt LiDAR.

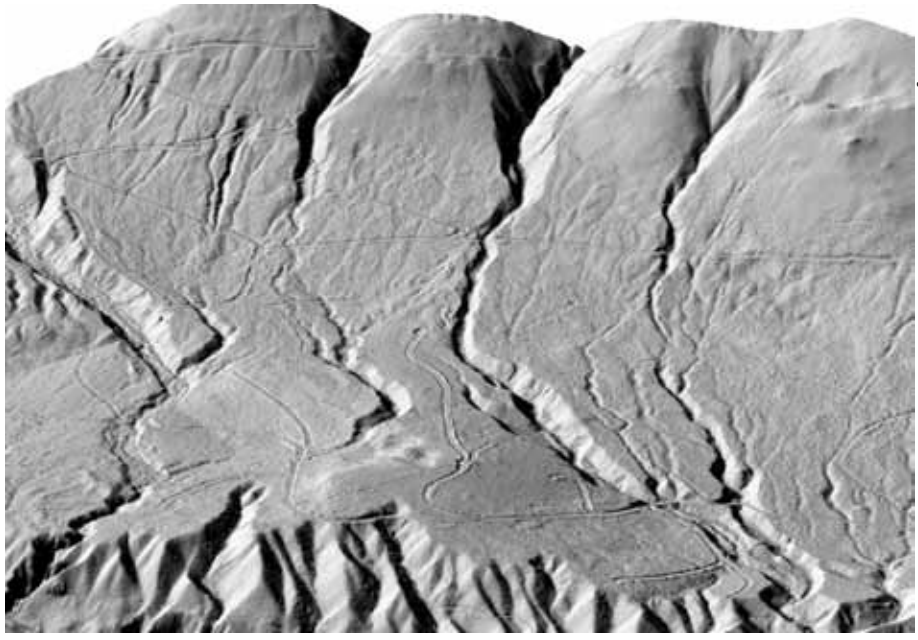
The Truck Loggers Association has made the recommendation to the ministry that it deploy LiDAR in its Pacific Timber Sales Area (PTSA) review as the TFL take-backs have made the inventory patchy.

Created in 2009, the PTSA is cobbled-together from take-backs, with 30 blocks shot-gunned throughout Vancouver Island, mainland coastal areas and Douglas Channel. Erin Boelk, RPF, works at BC Timber Sales (BCTS) and is spearheading the PTSA timber supply review. She said the *Forest Act* mandates reviews at least every 10 years. The take-back areas of the PTSA were most recently reviewed in 2001 and "this will be the first timber supply review on the PTSA as a unit," she said. The PTSA's current AAC is 1,507,119 cubic metres.

LiDAR isn't playing a big role in the PTSA. LiDAR, Boelk said, has been used by BCTS in more remote TSA areas, but has not been acquired for much of the PTSA. It is a more expensive technology. "BCTS is still looking at where the cost benefit lies," she said.

The chief forester will consider gathered information alongside the social and economic needs of the province to determine future AAC. "It is not so much a calculation as a judgment," said Boelk.

Dwight Yochim, a past TLA Executive Director, said the inventory issue facing areas such as the PTSA is one of forest sustainability, an image BC projects worldwide. "Yet, how can we determine how we are doing in terms of sustainability if we do not have good inventory information?" he asked.



All LiDAR Images: Chartwell Consultants Ltd.

Using a visualization technique called hillshade, this image shows what the terrain looks like with vegetation removed—drainage patters and roads are now clearly visible.

The unit's timber supply profile will rely upon using vegetation resources inventory (VRI) which is an aerial photo-based, two-phase vegetation system consisting of aerial photo interpretation and then ground sampling. Boelk said that such inventory information will be combined with current information acquired by TFL holders during the take-backs.

It has long been known that BC's inventory information is lacking. Forest


Photo: TLA Staff

consultant Ian Moss's inventory report for the Association of BC Forest Professional in 2011 indicated that "approximately 41.9 per cent of the province is represented by inventories that were completed prior to 1990 and 29.9 per cent prior to 1980".

Yochim said: "Without a full inventory, it becomes difficult to determine if we are really sustainable and if our AACs are at the appropriate levels."

LiDAR can identify where dense brush may pose a problem for planting new trees or show accurately the heights of regenerating stands.

BC forest companies are using LiDAR and are aware of the demand from international customers for sustainable forest products. Chartwell Consultants, a natural resource consultancy firm based in North Vancouver, builds client groups to use LiDAR making it more affordable for businesses. Cliff Roberts, RFT, General Manager at Chartwell confirmed, "Industry is well ahead of government use; industry is just zooming ahead."

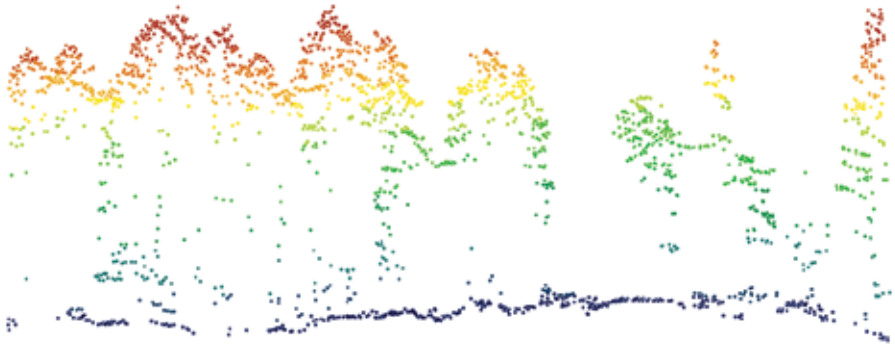
BC has a number of aerial survey companies that fly LiDAR, which emits pulses of laser light from the aircraft to the ground below. As the laser pulses strike objects below (albeit rock, brush, the lower branches of a tree or the tree's crown), reflected energy is registered by the LiDAR sensor, which records inertial movement, GPS data and the amount of time it takes for a rebound signal. Such information is transformed by specialized software into 3D points. After calibration and classification, the data is turned over to consultants such as Chartwell, which has developed programs to analyze and interpret the information according to a client's needs.

"LiDAR can be super-dense," said Roberts. "We are talking up to 12 pulses or more per square metre." As a result, forest planners and managers are collecting detailed information that they haven't been able to previously. BC's ministry has traditionally used VRI, but it provides little topographical or geological information. The alternative is to "put boots on the ground," but it is a process that is "slow and labor intensive," said Roberts.

Interpreting LiDAR's data is also faster and more accurate; it is done by computers rather than individuals interpreting traditional VRI photo imagery, a process subject to human error. Such errors can be carried forward into programs such as the MFLNRO's growth simulator model, which attempts to project a stand's growth.

"LiDAR is multi-purpose," said Roberts. While LiDAR does not identify species, it does provide tree height information and can provide indicators of canopy biomass. It can aid reforestation efforts identifying where dense brush may pose a problem either for planting new trees or show accurately the heights of regenerating stands. The information can also indicate areas that have the characteristics of a specific species habitat.

More importantly, the inventory information collected is placed in the context of elevation and topography of an area, said Roberts. A Chartwell generated schematic shows trees of different height color-coded. Such information, said Roberts, as he points to grouping of mature trees clustered in an area surrounded by high slope and limited access, can help plan harvesting methods such as heli-logging. LiDAR information can be manipulated to also show old roads or road that may have been built by a company several years ago. He points to a schematic's broken line, which translates into a slide breaking a road, something otherwise not readily apparent unless boots touched ground. Another diagram details streams and slopes. "This gives us an indication of streams and where drainage areas are," he said.



This image shows a cross section of points that are colour coded to indicate their height above ground, illustrating LiDAR's ability to map both the canopy and the ground beneath.

Information from LiDAR can also be downloaded as geo-fencing information onto hand-held devices or onto GPS guided machines to indicate when harvesting equipment is crossing a boundary, moving into an environmentally sensitive area or venturing onto a grade steepness that violates WorkSafeBC regulations.

Moss said that the Forest Analysis and Inventory Branch's failure to pursue better technology hinges on funding. It's an old story. The branch's budget of $6 million, not even half of the $15 million Moss estimated was needed in his 2011 report.

He said some ministry LiDAR pilots have been done. Companies and BCTS have partnered on northern Vancouver Island, the Okanagan and a project involving the UBC's research forest at Knife Creek. The government's role has been participatory but it has not contributed financially for LiDAR data acquisition, said Moss, although it has contributed to ground plot data collection.

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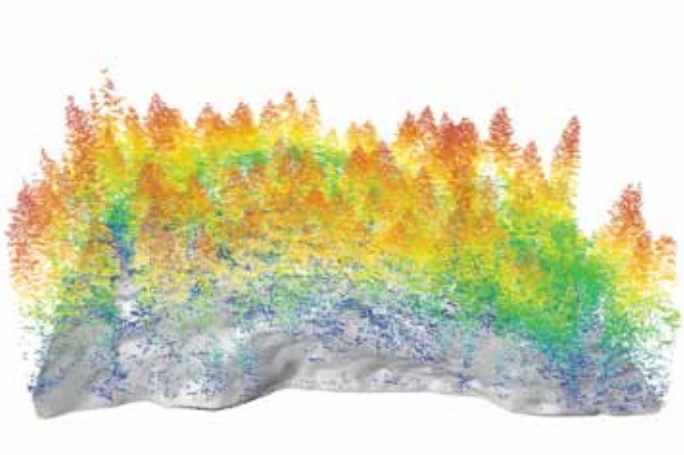
Island Timberlands is using LiDAR on its Vancouver Island holdings following a 2009 trial project and subsequent data collection throughout 2010-2011. "It provided the opportunity to enhance our inventory knowledge and be more efficient. The surprise came after the trial on the bare-earth model. It detected a wide variety of ground features beyond roads to smaller streams, rock out-croppings and holes such as old mine shafts," said Brad Rodway, RPF, Production Planning Manager. Island Timberlands is considering further LiDAR opportunities in resource planning, such as wildlife habitat. "We are going to see what works for us and what does not work as the company moves forward," said Rodway.

Island Timberlands has also considered the technology as an aid to dealing with weather changes in the coastal region. Company sustainability manager Morgan Kennah, RPF, said LiDAR's ability to show slope and drainage details can aid in determining not just best harvesting methods, but also in road construction planning such as where larger diameter culverts for rainwater runoff should be placed.

Still, BC continues to spend on its own systems. VRI inventory cost ranges from $1.50 to $2.50 per hectare. Including ground plots, LiDAR based inventories can be produced at similar costs in moderately rough terrain in areas of 400,000 hectares or more, Moss said. The branch has been developing a photo sampling based inventory known as Landscape Vegetation Inventory (LVI), which costs $0.30 per hectare. It uses Landsat, plus other imagery, with a low-elevation digital camera system. According to MFLNRO, the tool is used in areas where VRI is "not justifiable or cost-effective, such as lower forest complexity, areas outside the timber harvesting land base, parks or areas heavily impacted by mountain pine beetle are considered the primary targets for this type of inventory."

Rationalizes Moss: "What they should



This image is made up of a hillshade image combined with LiDAR points to show a model of forest from top to bottom. LiDAR "point cloud" datasets can be very dense.

This image is a modified aerial photo draped over a digital surface model. It is an example of how LiDAR data can be combined with other datasets to model stands and also to communicate with stakeholders by means of realistic and detailed 3D visualizations of a particular area.

do is drop VRI. VRI is not accurate at an operational scale. Just use the LVI but with the money left over prioritize the TSAs that are most at risk and use LiDAR to do inventories there." He said that government could retrieve extra value out of a more detailed, accurate, and higher resolution inventory, especially as today's forest users are diversified.

"Essentially, a poor inventory leads to poor utilization and poor environmental protection practices. It can't be otherwise. There is a tremendous opportunity cost due to the uncertainty in the current inventories and our leaders have been short-sighted in identifying information needed to preserve the province's forests' well-being," Moss said.

It is a stance that Yochim agrees as the PTSA review progresses. "Why not be a leader and invest in the best technology? The majority of our forests are publicly owned. I know there is a cost and the government has to balance other things happening in this province. But, you are going to have this resource long after LNG is gone."

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