



# Forest Resources Inventory – 2017-2027 Cycle

December 6<sup>th</sup> , 2018

## Overview



- Program strategic direction
- Known and unknown impacts
  - Elevation model
    - *Single photon LiDAR*
  - Field sampling program
    - *Area based Assessment*
  - Classification techniques
    - *Periodic (manual)*
    - *Continuous (automated)*
  - Information management and technology
    - *Accessible and enabled*



# Strategic plan: To be ‘Best in Class’

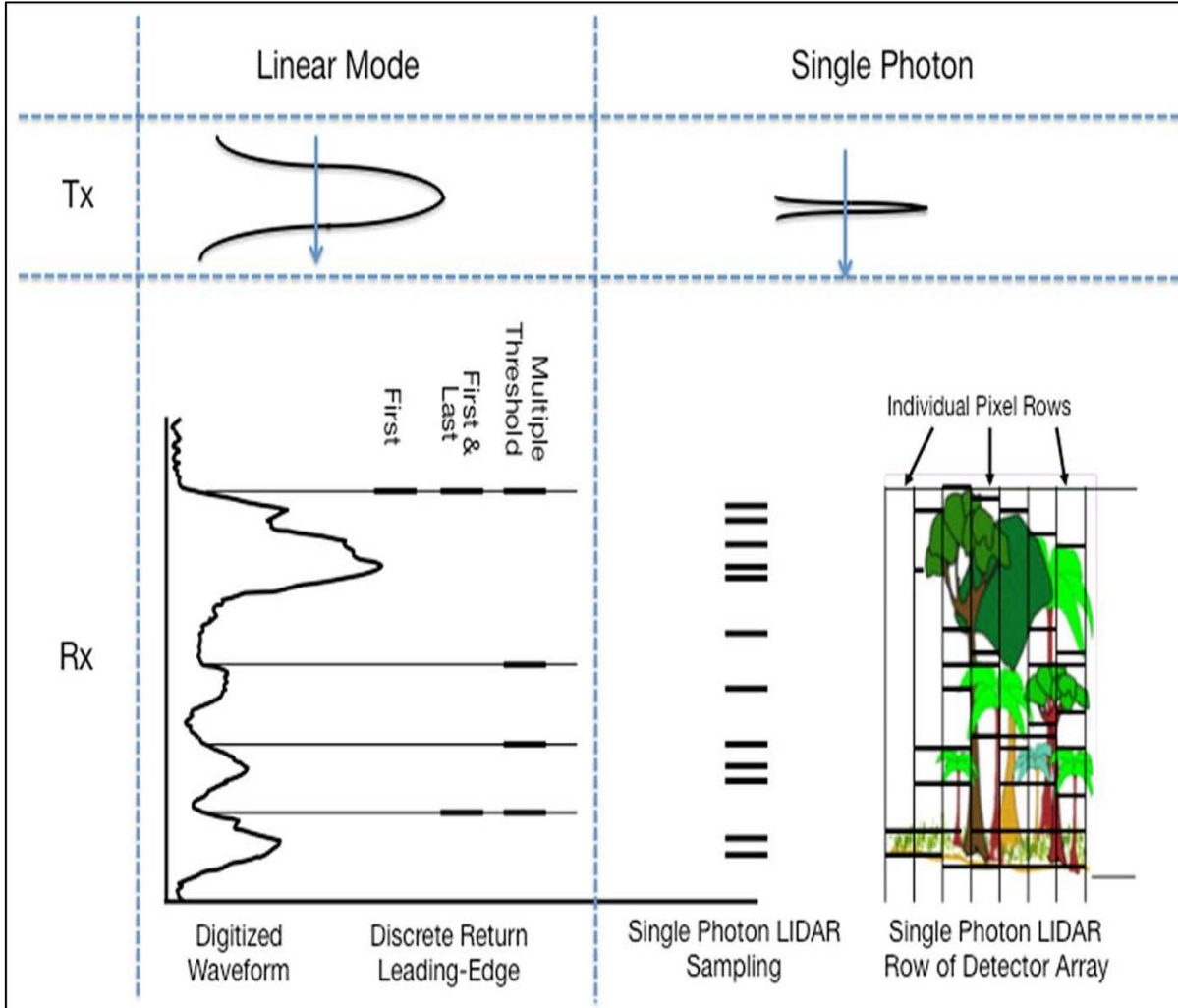
- Modern elevation model
- Continuous inventory
- Optical
  - Aerial
  - Satellite
- Focused research and development
- Modern technology
- Communications plan
- Technical and user group

| MISSION  |   | VISION  | PRINCIPLES  |         |
|--|---|---|---|---------|
| To deliver and maintain a timely and effective forest resources inventory to improve the understanding and management of Ontario's forest resources.   |   | Ontario's forest resources inventory is Best In Class   | Provide value for money to the Province, enable stakeholders, stay current, innovate as needed, deliver a suite of products, think long term (10 year cycle), support a province-wide strategy. |         |
| FOCUS AREAS  | STRATEGIC OBJECTIVES  | GOALS   | TIMELINE  |         |
| The program delivers and updates stand level forest inventories for all lands in the area of the undertaking and southern portion of the Far North planning area (eFRI program area) and broad scale forest inventories for the rest of the province | <ul style="list-style-type: none"> <li>• Forest resource inventories are in place and assessed for all lands in the eFRI program area</li> <li>• Update and assess inventories produced during the first 10-year cycle</li> <li>• Maintain a non-biased, permanent, forest inventory monitoring network</li> <li>• Maintain the broad scale forest inventories in the Far North and Southern Ontario</li> </ul> | <ul style="list-style-type: none"> <li>• Complete and assess the forest resources inventories started/produced during the first 10-year cycle</li> <li>• Develop and implement a regular update cycle for far north land cover and SOURS</li> <li>• Acquire and process satellite imagery for all lands in the rest of the province</li> <li>• Acquire and process comprehensive high resolution imagery (suitable for producing stand level inventories) on a regular schedule for the eFRI program area</li> <li>• Acquire and process digital elevation data to produce a DEM that is suitable for FRI purposes</li> <li>• Update and assess inventories in the eFRI program area using high resolution imagery and field sampling</li> <li>• Re-measure all permanent forest inventory photo plots and ground plots (~10% per year)</li> <li>• Maintain a robust portfolio of remote sensing research projects</li> </ul> | 2017 to 2020  | Ongoing |
| FRI products are accessible and valuable for stakeholders across Ontario   | <ul style="list-style-type: none"> <li>• Provide efficient data transfer</li> <li>• Enable private sector development</li> <li>• FRI is recognized as an authoritative data source</li> </ul>   | <ul style="list-style-type: none"> <li>• Establish an on-site imagery storage infrastructure</li> <li>• Implement an enhanced information management system</li> <li>• Implement a comprehensive FRI production process and infrastructure including technology, software and tools.</li> <li>• Establish an IM/IT infrastructure to allow access to FRI inventory products/data by users/producers/public</li> <li>• Develop techniques and procedures to create and maintain a provincial forest inventory layer</li> <li>• Make a provincial forest resources inventory data set available for public consumption</li> </ul>   | 2017 to 2019  | Ongoing |
| The FRI program will continue to innovate and adapt to remain current and sustainable  | <ul style="list-style-type: none"> <li>• Support research, development, and training</li> <li>• Adopt/adapt technologies for cost effectiveness</li> <li>• Allow for innovative and adaptive management</li> <li>• Promote the use of FRI products to further research and development in the province</li> </ul>   | <ul style="list-style-type: none"> <li>• Identify short term priorities and continue the Forestry Futures Trust Committee KTID program</li> <li>• Continue FRI's focused research and development projects to evaluate technologies and methodologies</li> <li>• Review inventory programs in other jurisdictions/regions</li> <li>• Evaluate project results (cost/implementation) to determine feasibility</li> <li>• Communicate what FRI products are</li> <li>• Provide tech support for FRI products to stakeholders</li> </ul>   | 2017 to 2020  | Ongoing |
| FRI information is well communicated to stakeholders and the public  | <ul style="list-style-type: none"> <li>• Plan for strategic communications</li> <li>• Improve communication between the FRI program and forest industry/inventory producers/users</li> </ul>  | <ul style="list-style-type: none"> <li>• Prepare and implement a communication plan with a review schedule</li> <li>• Develop communication products and protocols based upon the communication plan</li> <li>• Publish an inventory calendar</li> <li>• Produce and maintain a "Forest Inventory Procedure for Ontario" manual</li> <li>• Implement the IM/IT infrastructure to provide a communications portal and dashboard reporting</li> </ul>   | 2017 to 2020  | Ongoing |
| The inventory is structured, scalable, and adaptable to allow it to expand across the province as required   | <ul style="list-style-type: none"> <li>• Enable the addition of new attributes and expansion of the geographic scope</li> <li>• Leverage FRI products to meet stakeholders' needs</li> <li>• Keep the production schedule adaptable to change</li> <li>• Enable linkages between the FRI program and other programs/organizations that collect land related information</li> </ul>                              | <ul style="list-style-type: none"> <li>• Regularly adapt and make available comprehensive procedural documentation</li> <li>• Define and document a structured core set of attributes</li> <li>• Develop a moderately flexible schedule</li> <li>• Engage stakeholders in identifying possible expansion in geographic scope and content</li> <li>• Ensure stakeholders are using the information provided to enable the capture of existing, new, and modeled attributes.</li> </ul>   | 2017 to 2020  | Ongoing |
| The FRI is defined, understood, and accountable to stakeholders and the public, to provide value for money   | <ul style="list-style-type: none"> <li>• Align strategic and operational plans</li> <li>• Develop a dashboard to illustrate progress of measurable results to create an accountability standard</li> <li>• Engage the advisory committee so they can develop and monitor key performance measures and review finances</li> <li>• Define and document standards for data collection and attributes</li> </ul>    | <ul style="list-style-type: none"> <li>• MNR and the PFAC document the strategic and operational plans</li> <li>• Establish key performance measures and program assessment strategies with the PFAC and MNR</li> <li>• MNR documents forest inventory responsibilities in the FRI technical specifications</li> <li>• FRI technical committees/user groups are established and support the development of definitions for data collection</li> <li>• Develop, implement and continue to update the Dashboard</li> <li>• The PFAC meets on a regular basis per terms of reference, with strategic plan review after 3 and 6 years</li> <li>• Conduct all procurements per Management Board of Cabinet approval</li> </ul>   | 2017 to 2018  | Ongoing |

Ministry of Natural Resources and Forestry 2017-2020 Strategic Focus Plan for the enhanced Forest Resources Inventory Program (DRAFT May 2017)

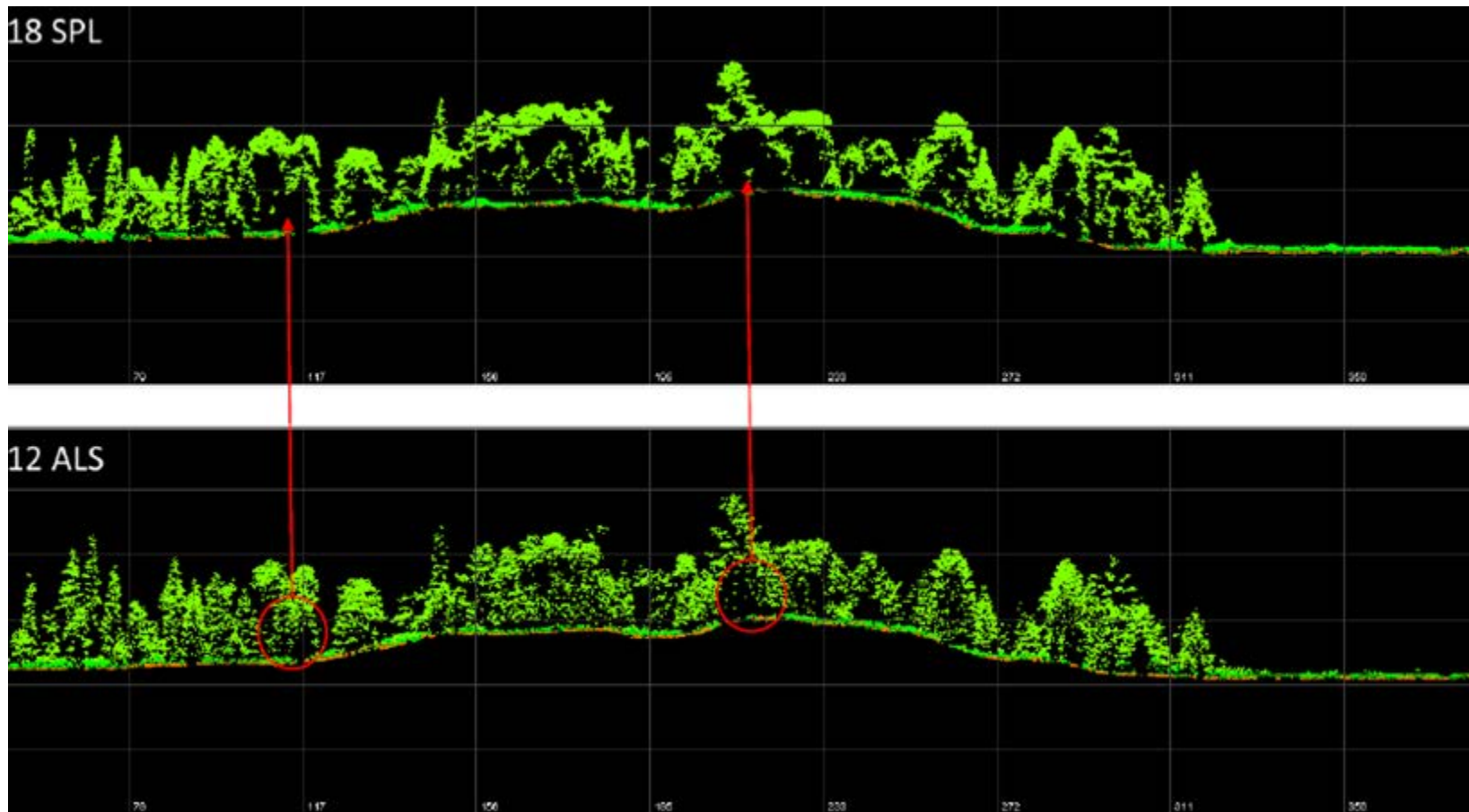
## Adaptive management/lessons learned/feedback

- Operate within the policy framework
  - Accommodate new processes
  - New technology
  - Applied research and development
- Communications plan
- Improved business processes
  - Procedures and policy framework documents
  - Integration to other business units
  - Improvements to current technology and business model
  - Standardized, consistent, repeatable
  - Improved Great Lakes/St. Lawrence classification / plot design



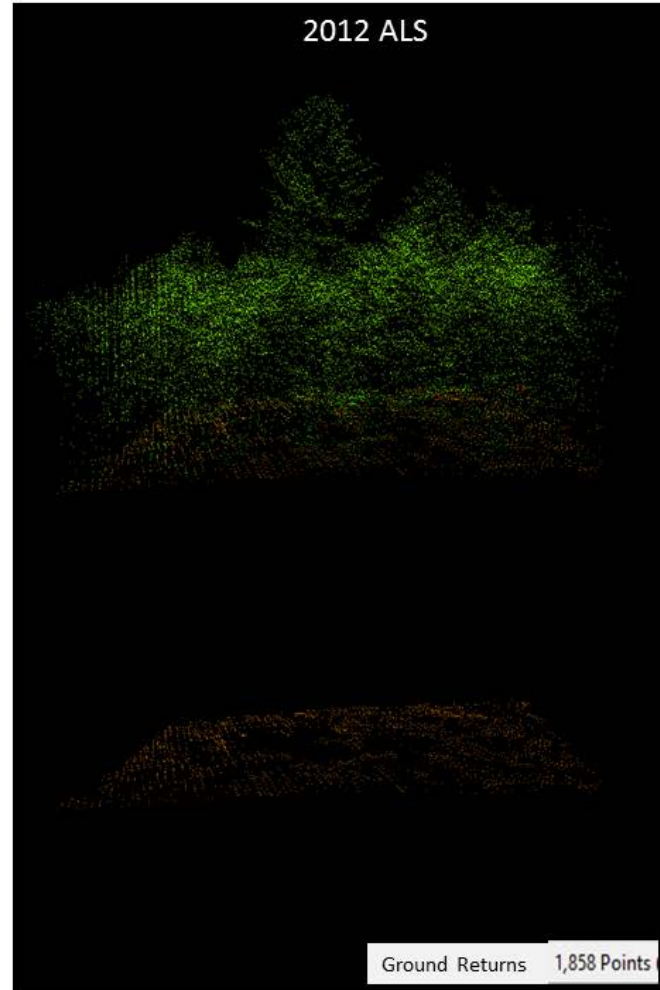
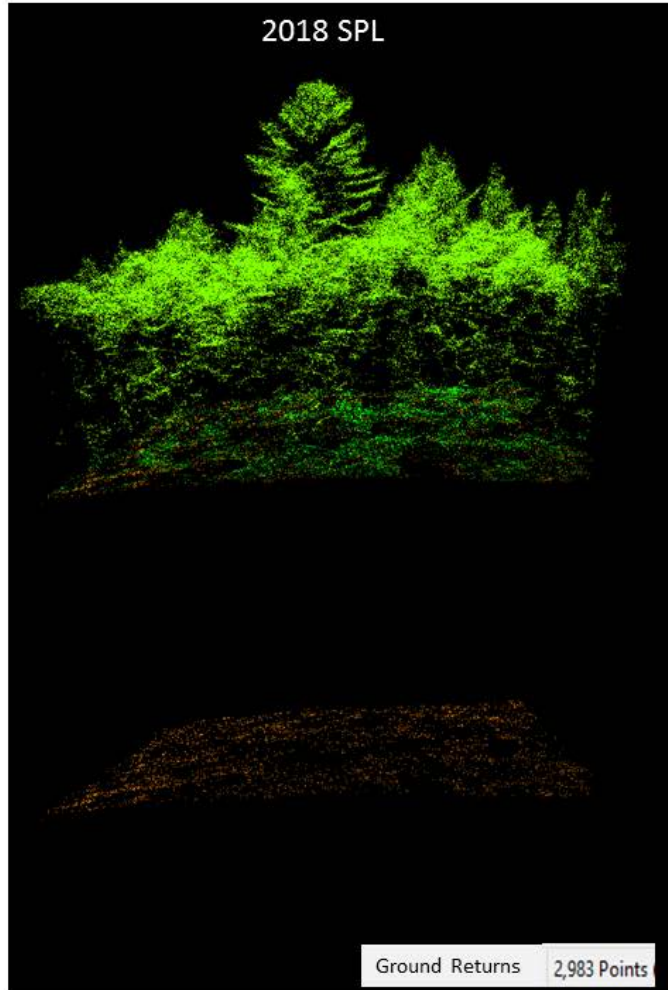
## Traditional LiDAR compared with single photo LiDAR

Five metre oblique image of Aerial Line Scanning (traditional LiDAR) compared with single photo LiDAR (current product being collected)



# Single photo LiDAR compared with aerial scanning

Single Photon LiDAR @ 25 pts/m compared to the Aerial Line Scanning @ 15 pts/m





# Area based assessment inventory

- Specifications to be developed to support new design (Forest Information Manuals and supporting technical specifications)
- Supports multi-scale inventories
- Supports Continuous Forest Inventory model with standardized, consistent, and repeatable
- Requires fixed area plots but can utilize existing network

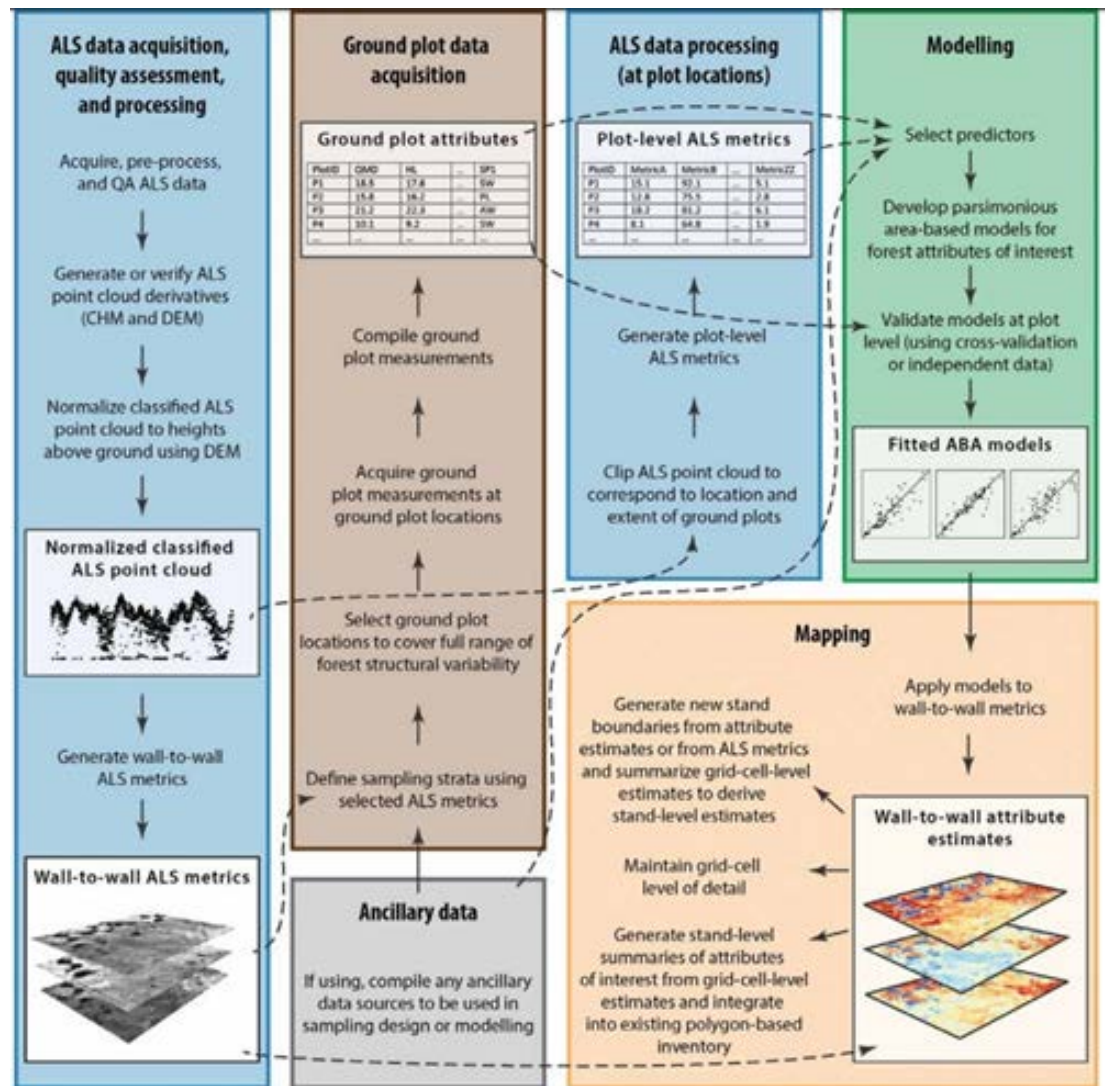
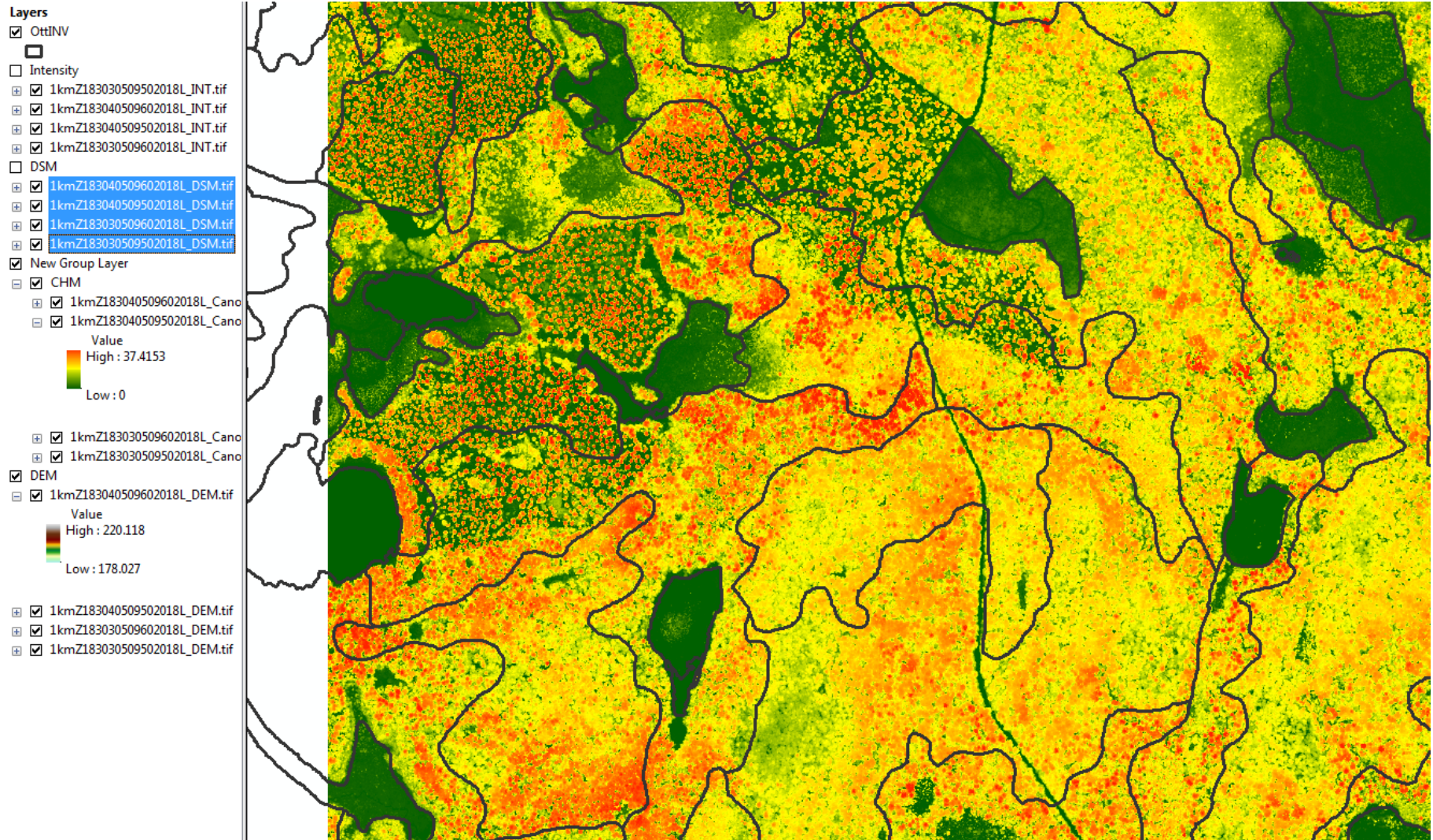


Figure 3. Overview of the steps involved in implementing the area-based approach (ABA).

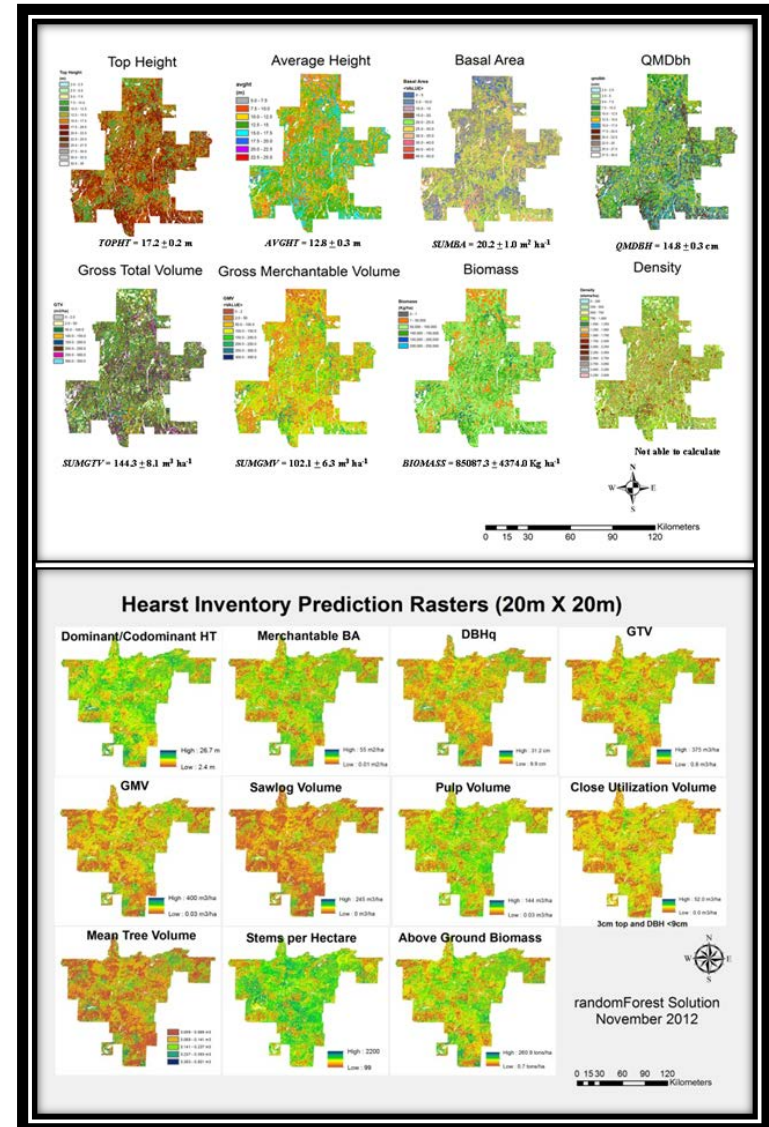


# LiDAR Derivatives: Tree Canopy Height Model (CHM)



# Additional attributes required in the Forest Information Manual

- Height (average, top, co-dominant, two tier)
- Quadratic mean Diameter Breast Height (DBH)
- Volume – gross and merchantable tree volume (GTV, GMV)
- Basal area
- Biomass
- Density\*
- Sawlog /Pulp Volume
- Size Class Distributions
- Vertical Structure
- Ecological Land Cover Classification
  - Soil moisture/wetness
  - Substrate family
  - Nutrient regime

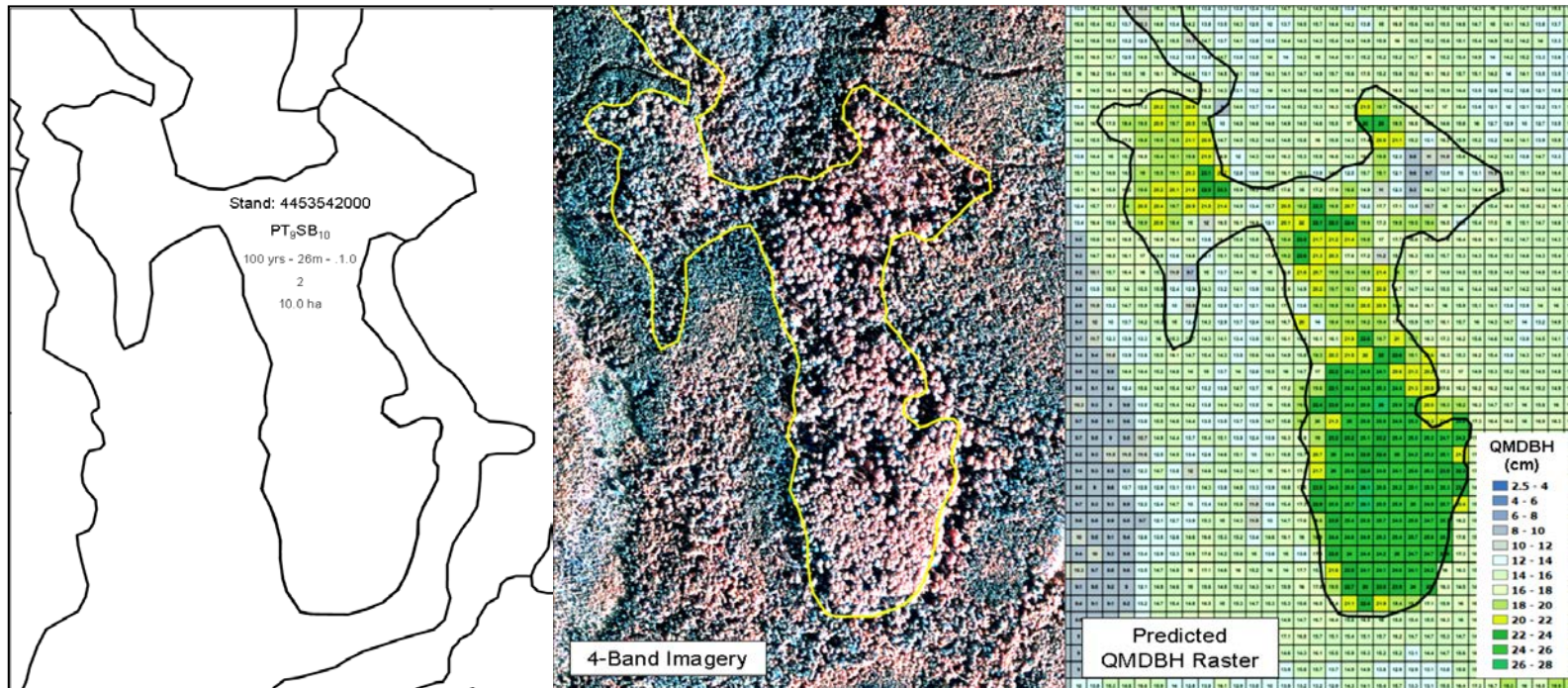


\* Calculated ...DBHq&BA



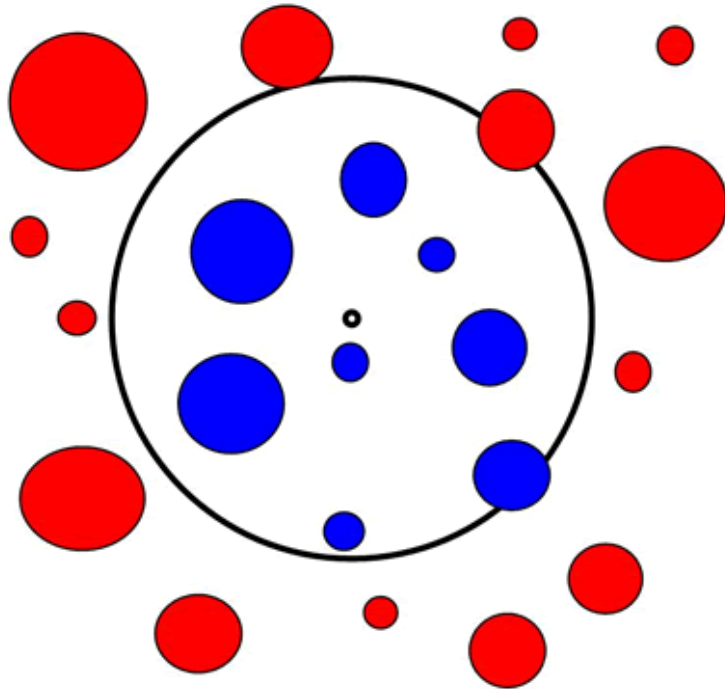
# Stand boundaries

- Obtain new boundaries from LiDAR predictive layers
- Obtain new boundaries by segmenting imagery
- Use pre existing boundaries





# Plot design – Integrated Monitoring Framework

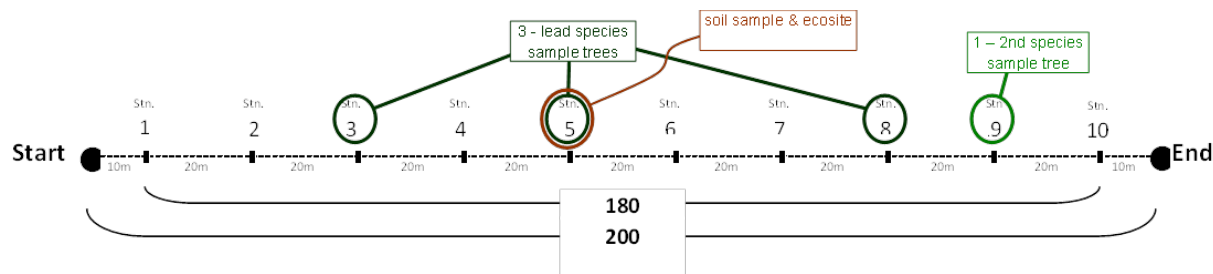


## Principles:

- Leverage existing plot networks
- Sample design based on variance in point cloud density/ canopy penetration (Principle Components Analysis)

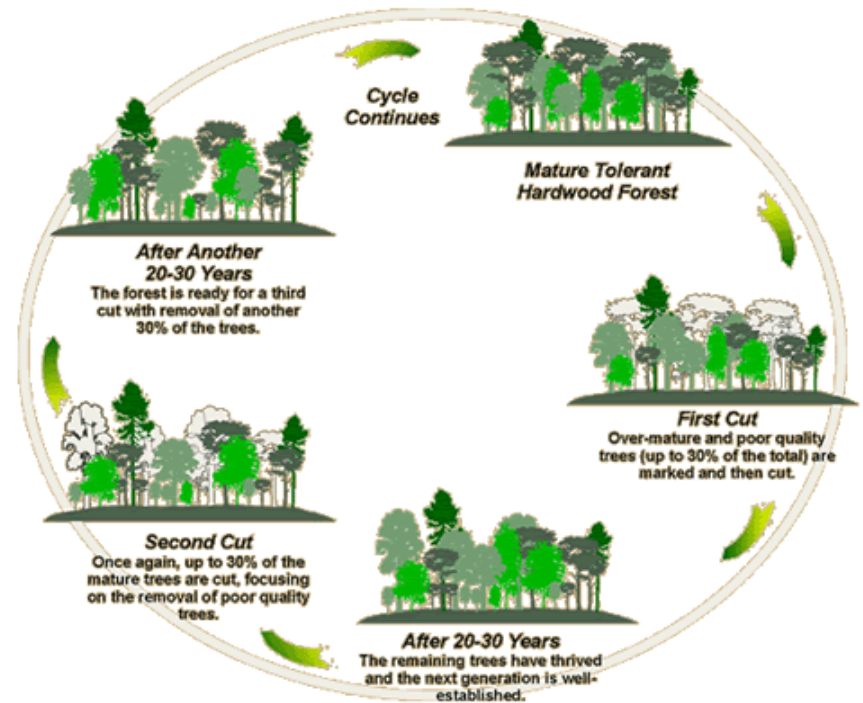
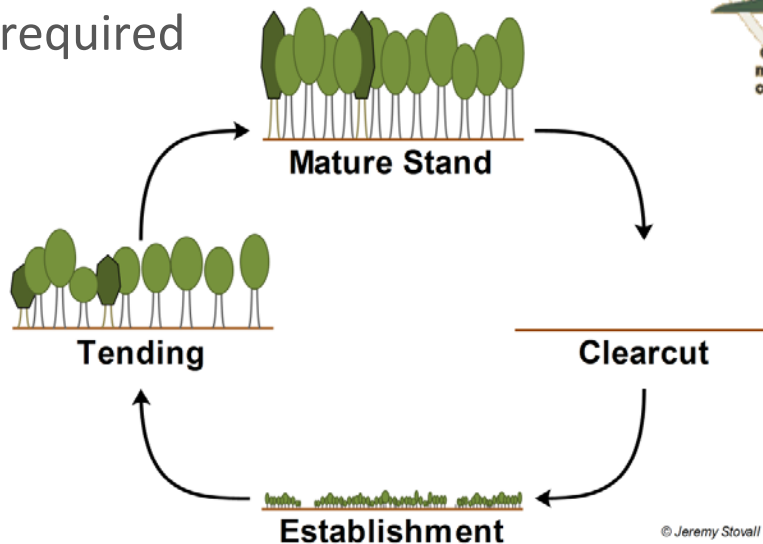
## Plot composition:

- Species composition
- Live vs dead
- Height
- DBH for all
- Age
- \*sub metre GPS collection
- \*exploring tLiDAR (terrestrial LiDAR), camera, thermal cameras



## Plot designs

- Great Lakes/St. Lawrence: larger crowns larger radius plots 14.25m 625m<sup>2</sup>
- Boreal Forest: small crowns smaller radius 11.28 400m<sup>2</sup>
- \*Small tree procedure 3.99m – 50m being considered (under 10cm)
- Input required



# Best practice guides





## Challenges

- Information Management/Integration Technology
  - Supports new business process through Information Management
  - Enhances analytics
  - Enables large scale predictive modelling
  - Enables all Forest Resource Inventory data to stakeholders
  - Client focused communications
- Tighter acquisition schedule
- Ages
- Assembling and leveraging existing field data
  - Gap analysis (missing age classes, cover types, ecological conditions)
- Unknowns at this point in time
  - Lots of research from other jurisdictions
    - Standard parametric
    - Non-parametric
    - Volume predictions
  - Knowledge Tool and Transfer Development (KTTD) projects that will develop remote sensing applications for 2017-2027

# Questions?

