Estimating poplar plantation stand value and log product yields using terrestrial laser scanning and optimal bucking

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Timber Measurement Society Conference - Tacoma - April 2011

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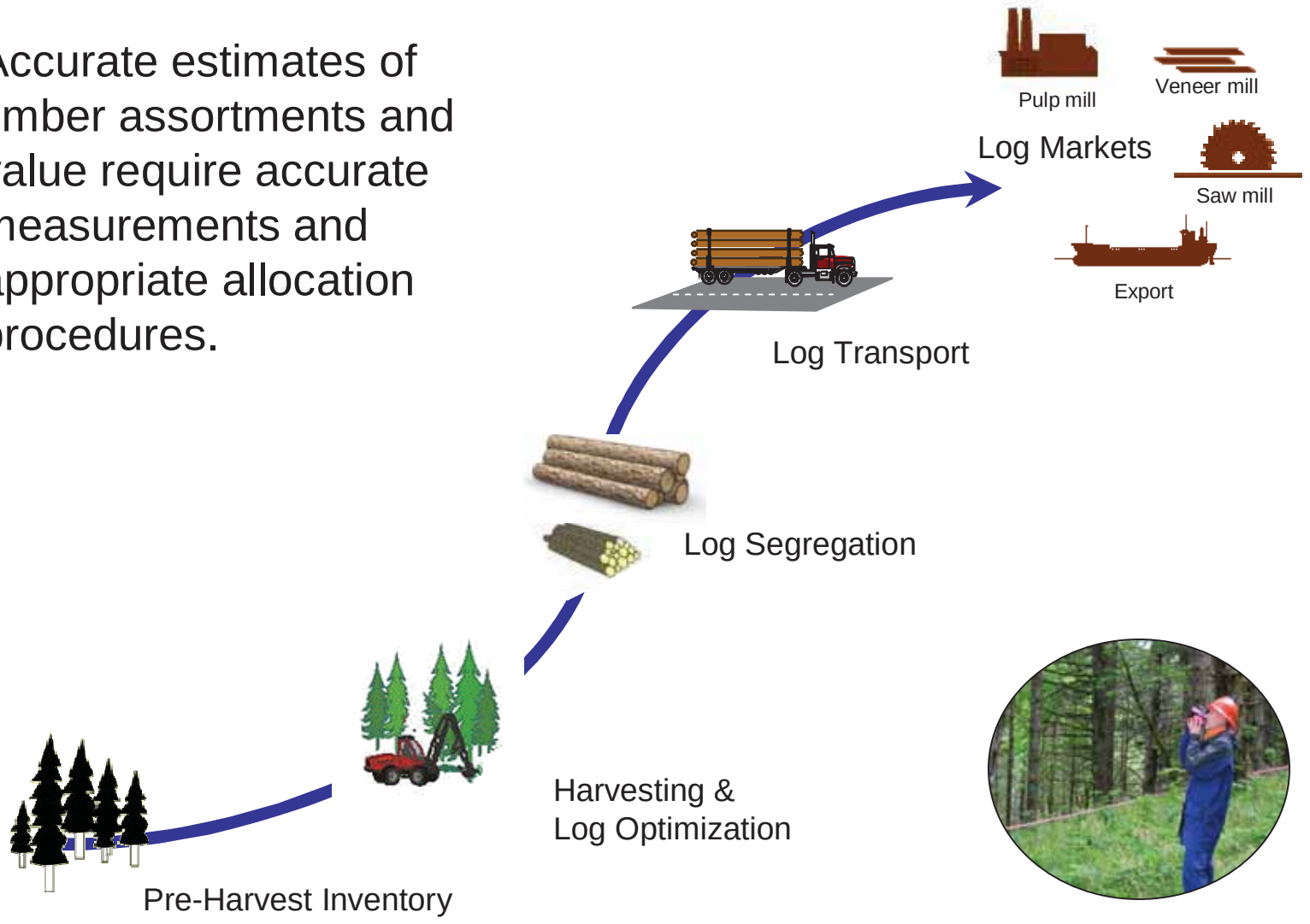
The Value Chain Opportunity

Foresters spend decades creating potential value in each tree.

The challenge is to optimally capture this value and deliver it to the right customers, in full, on-time and on-spec !!

Forest to Market Value Chain

Accurate estimates of timber assortments and value require accurate measurements and appropriate allocation procedures.



Purpose of Inventory

Some inventory methods are best suited for providing broad-based metrics (e.g. total volume) at the landscape or large area level.

Bucking simulation, based on detailed stem descriptions, produces the most accurate estimates for predicting timber assortment and value recovery for specific stands.

Malinen et al. 2007.

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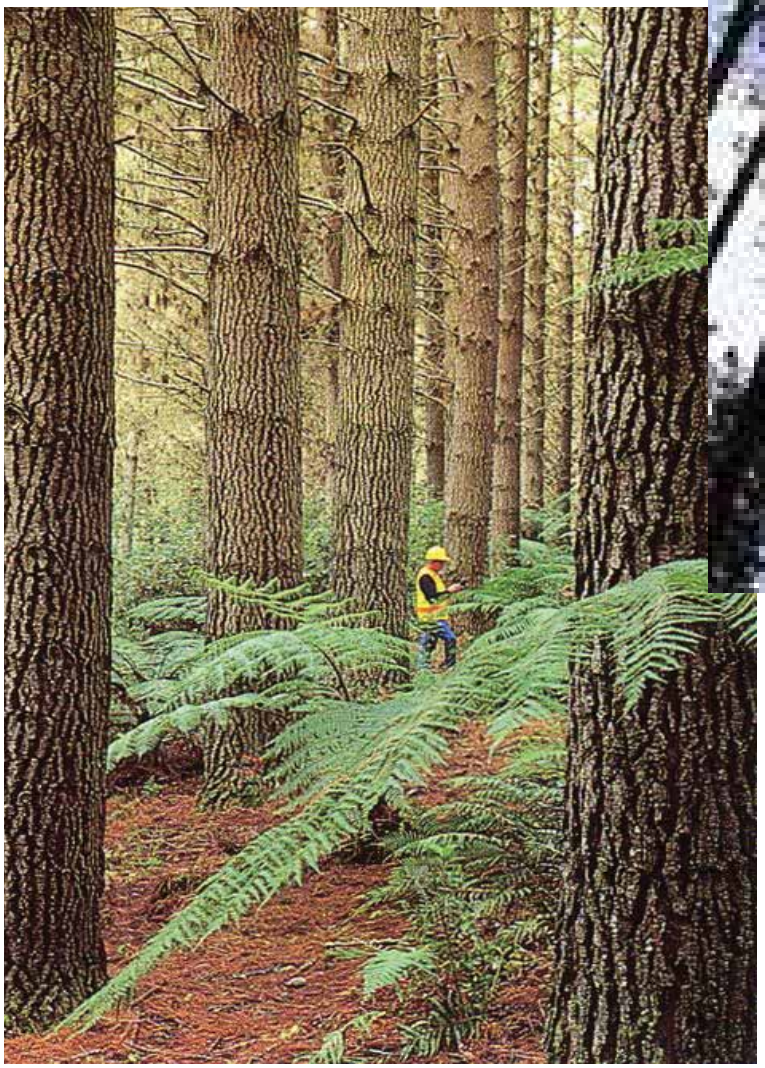
Detailed tree descriptions



Detailed assessments of stem size, shape and quality within each forest unit

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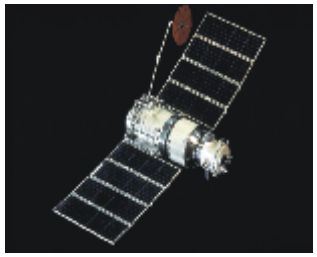
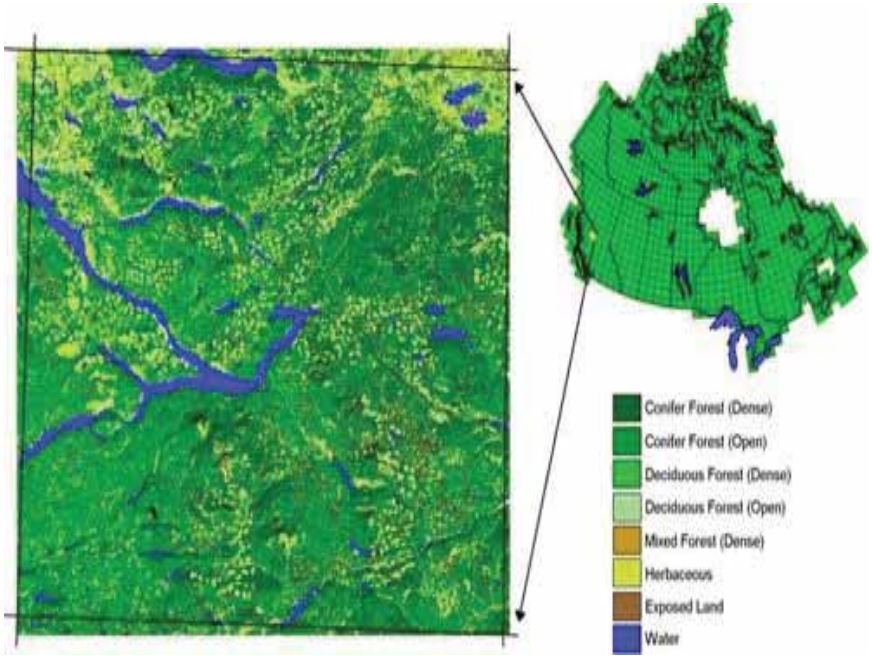
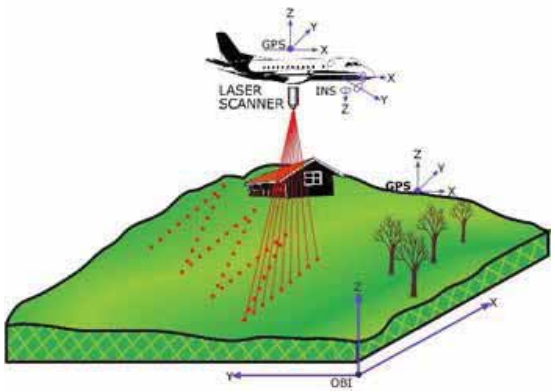
Non-Traditional Approaches

Remote Sensing

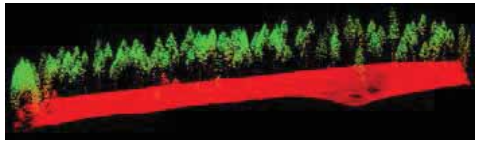


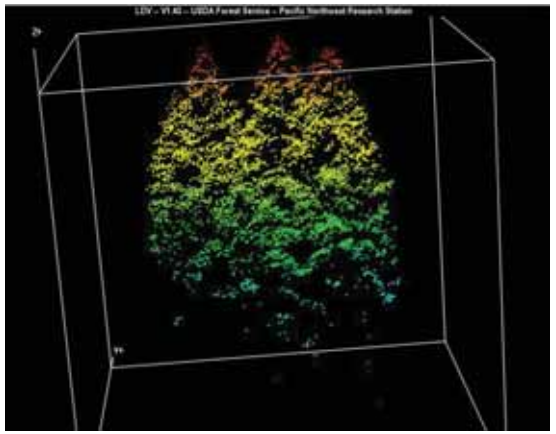
Satellite





Aerial LIDAR





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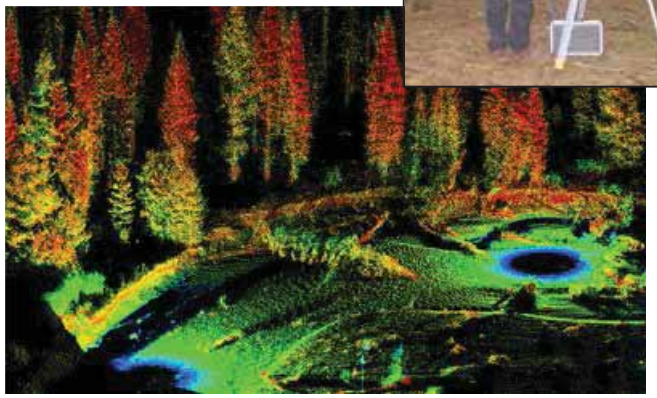
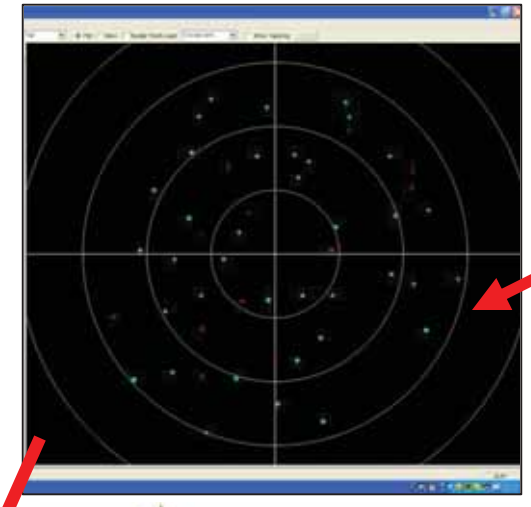
Non-Traditional Approaches

New Inventory Technologies

“Data mining” harvester stem descriptions from nearby stands or pre-sampling with the harvester



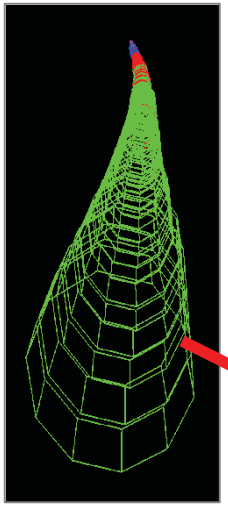
Terrestrial laser scanning



TREEMETRICS

Automated tree detection and stem profiling with Autostem

Gathering data with laser scanner



Terrestrial Laser Scanning

VALMAX™

Forest Value Management Tools

Tree bole measurements linked to markets and combined with wood density profiles and biomass expansion factors

C

Above Ground Carbon

Log Product Yields

$$$

Stand Value

Past Research

- Douglas-fir plantations in Oregon, USA
- Sitka Spruce plantations in Ireland
- Radiata pine plantations in Australia
- Eucalyptus plantations in Australia

- Ash and oak hardwoods in Poland
- Maritime pine in France
- Spruce and pine in Scandinavia

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Greenwood Resources, USA

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Greenwood Resources, USA

Greenwood Resources, USA. Poplar Plantations

Intensive management – seedling to sawmill. Largest drip fertigation (fertilizer and irrigation) system in the world. Automated soil moisture sensing. Manage energy and water use for cost control as well as environmental reasons.

Growth rates 40 m^3 per ha per year.

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Greenwood Resources, USA

Logs for veneers and sawn wood products

Chips for pulping fibers and fiber board

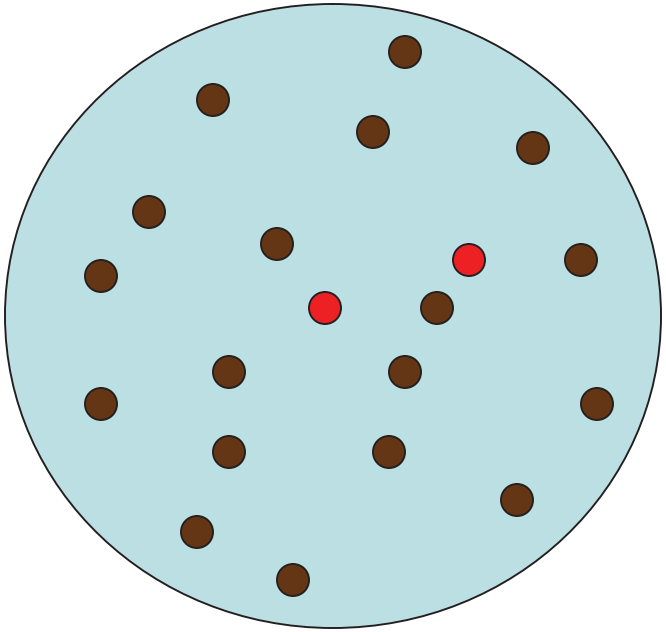
Biomass for co-generation and liquid fuels

Current Research

- Three stands selected in Greenwood Resources poplar plantation at Boardman, OR
  - 12 year old, 725 trees per ha (290 tpa)
  - 7 year old, 550 trees per ha (220 tpa)
  - 7 year old, 360 trees per ha (145 tpa)

Plot size and number

- 10 m radius plots (~ 0.08 ac) plots established in July 2010
- 60 plots total: 20 plots per stand type
- Wind conditions recorded



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Laser scanner

Trimble FX Scanner

- 360º hemispherical scan
- 2 to 8 minutes per scan
- scans out to ~ 30 m radius
- phase shift scanning of distance
- wavelength: 690 nm

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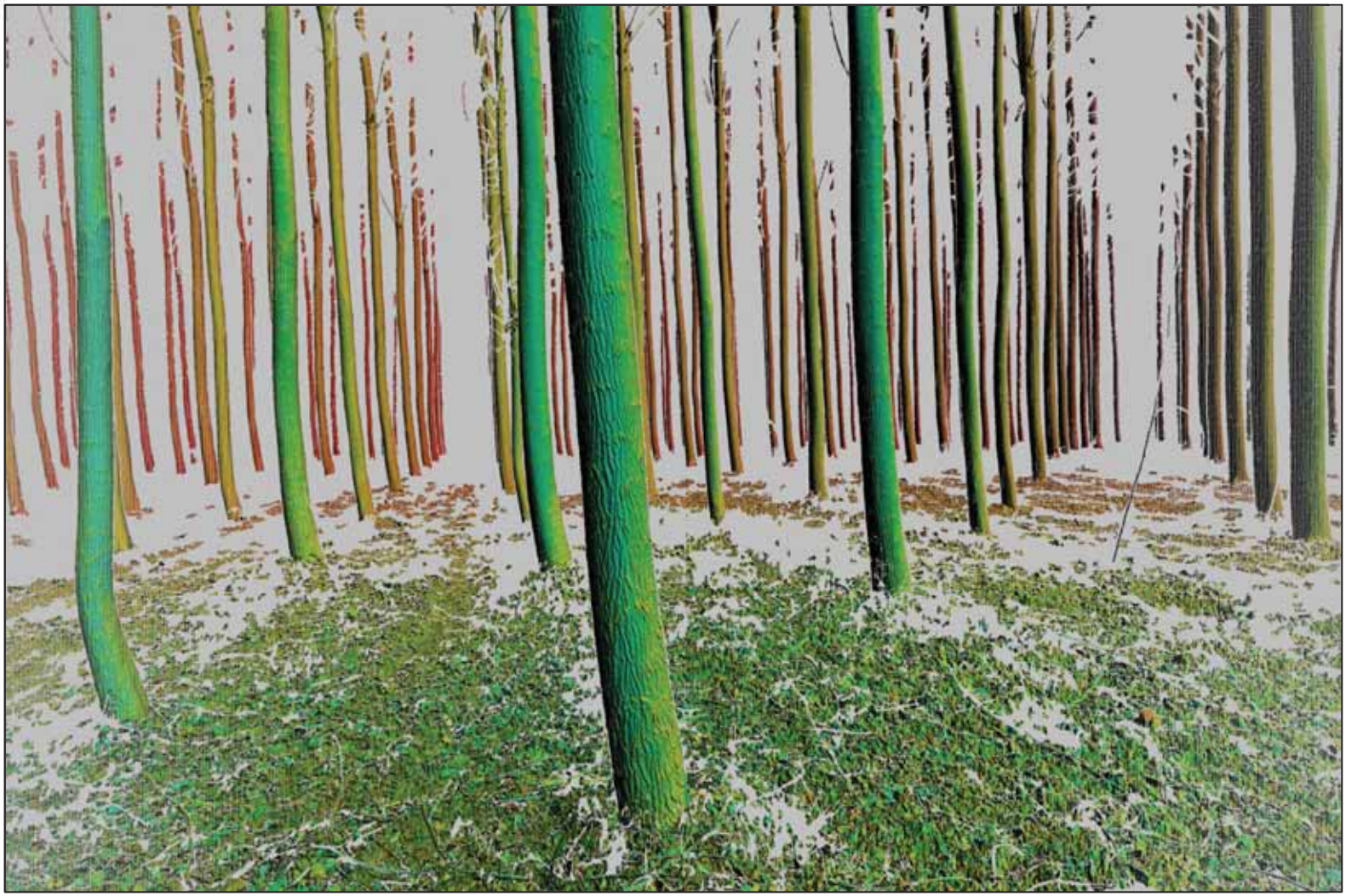
Trimble FX Laser Scan Data



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Rapid technology changes

FARO Focus 3D laser scanner

Price: ~ $40,000

Speed: ~ 1 million points per sec.

Weight: < 5 kg

Built in: computer, color camera

Standing and felled tree measurements

- All trees numbered
- Diameter breast height
- Tree height (five trees per plot)

- Four to eight plots in each stand felled (remainder to be rescanned and measured in summer 2011)
- Overbark & underbark diameters measured at 0, 3, 6, 12, 18 … m above stump

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TLS scanned stems harvested

4 to 8 plots per stand were felled, extracted to roadside, trucked to mill, bucked at about 17 m

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Stems delivered to mill scanner

Some scanned with both bark on and bark off.

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Scanned stems bucked

Nelson Brother scan data captured for all stems.

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Bucked logs enter mill

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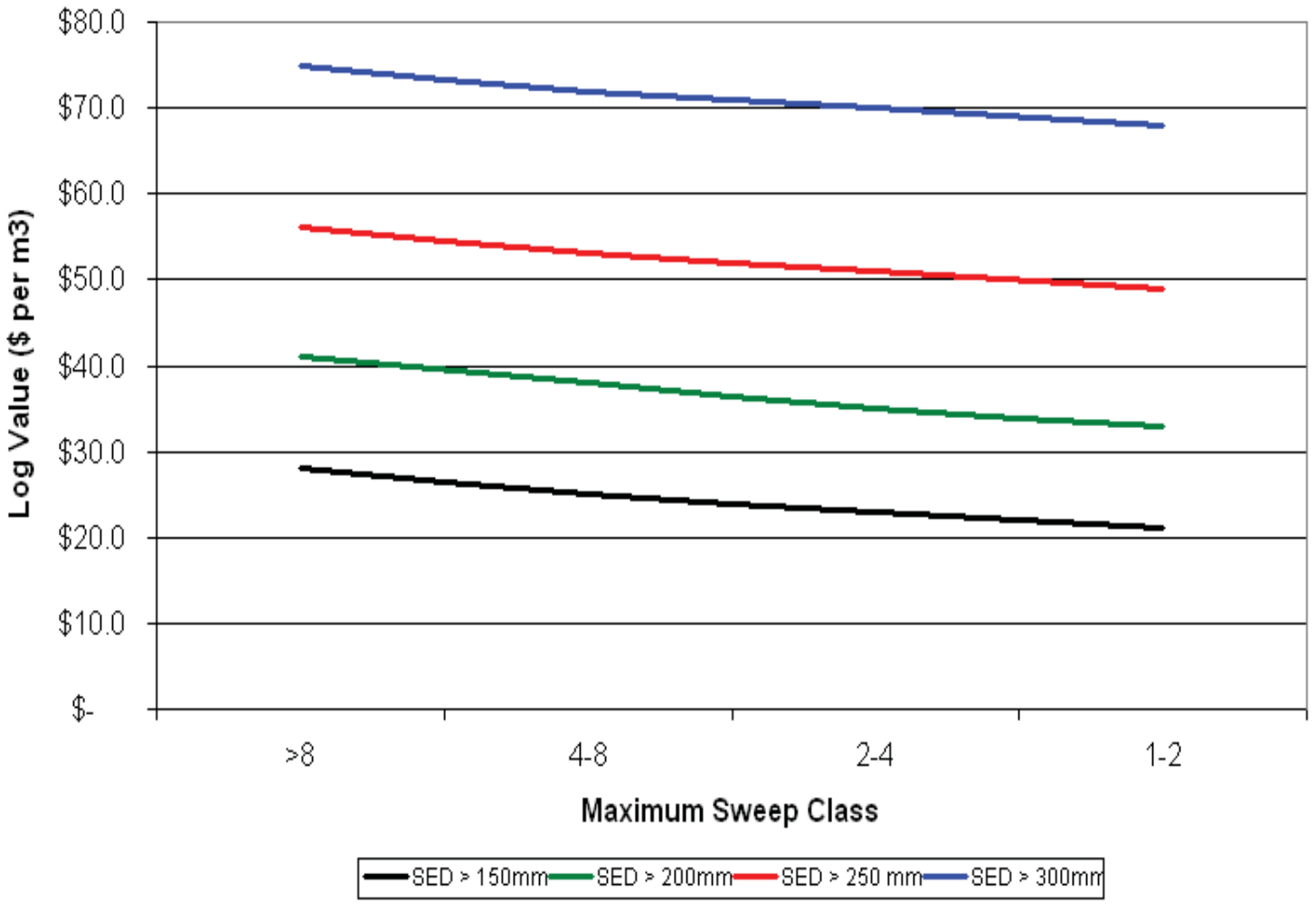
Logs Sawn

Lumber yield and grade data also captured.

Sawlog Value: SED & Sweep



Value based on lumber plus chip sales minus mill costs.

Chiplogs and Veneer Logs

- Chiplog values based on $80 per bdt FOB for chips. Less transport and chipping costs ($28 per bdt) ➔ $23 per GT ➔ $21 per m^3.

- Veneer log values based on $300 per MBF at mill door
  - > 380 mm ….$73 per m^3
  - > 330 mm ….$67 per m^3
  - > 250 mm ….$60 per m^3
  - > 200 mm ….$53 per m^3

Planned data flows

Delivered veneer log prices

Tree descriptions from laser scans

Lumber and chip yields per log category (size and sweep)

Grade recovery data

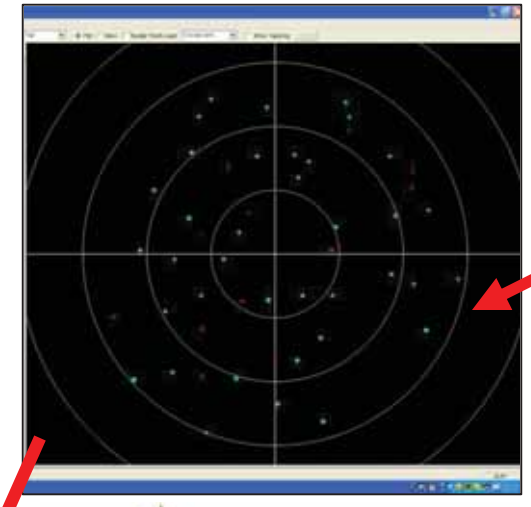
Lumber and chip prices

Mill operating costs

Delivered mill door breakeven price per log category for sawlogs and chiplogs

Treemetrics & VALMAX software

Optimal stand value and log yields



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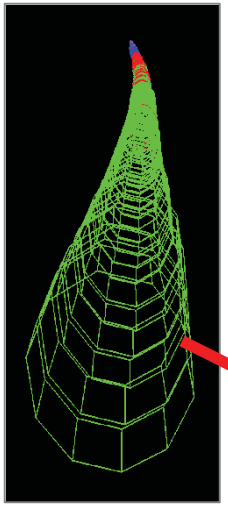

Terrestrial Laser Scanning

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Forest Value Management Tools

Log Product Yields

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Stand Value

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How good is the TLS data?

Preliminary Results from Stand 1

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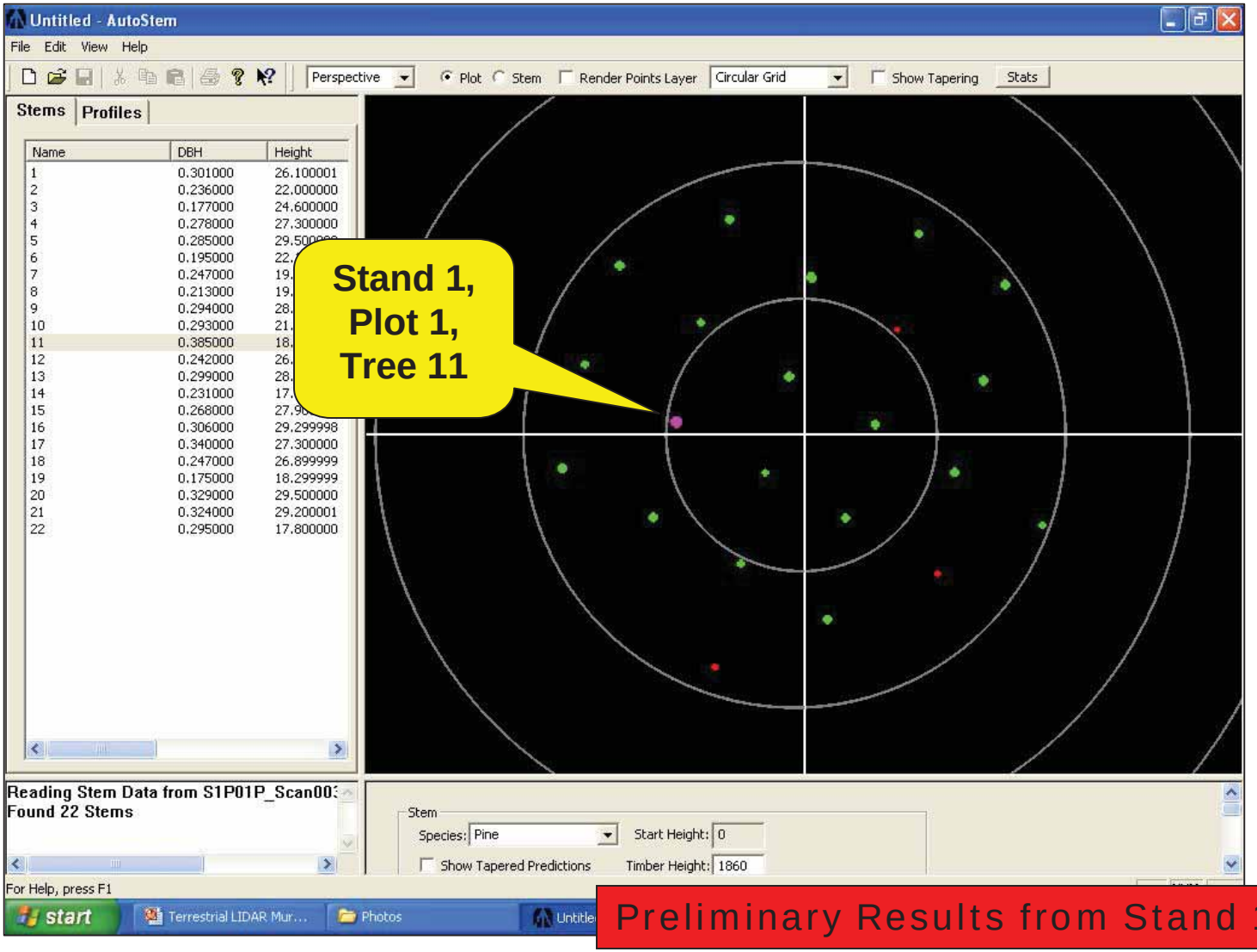

Preliminary Results from Stand 1

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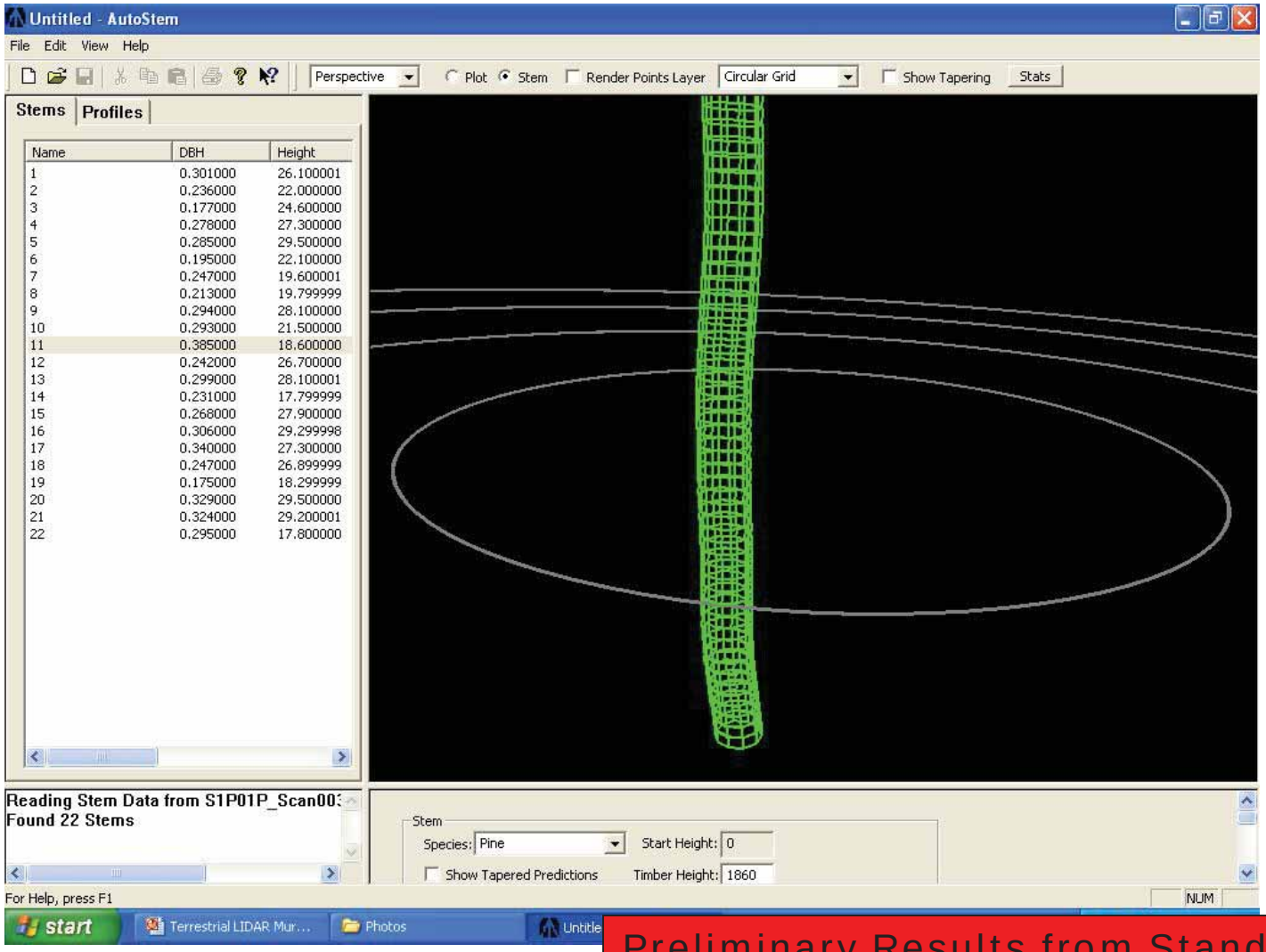

Preliminary Results from Stand 1

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TLS vs NBE vs Manual

	Diameter Underbark (mm)		
Height (m)	TLS	NBE	Manual
24	112	-	112
15	186	191	189
9	237	231	233
6	259	246	243
DBH	287	281	274
Butt	345	289	316

Tree 11 from Plot 1 of Stand 1

Preliminary Results from Stand 1

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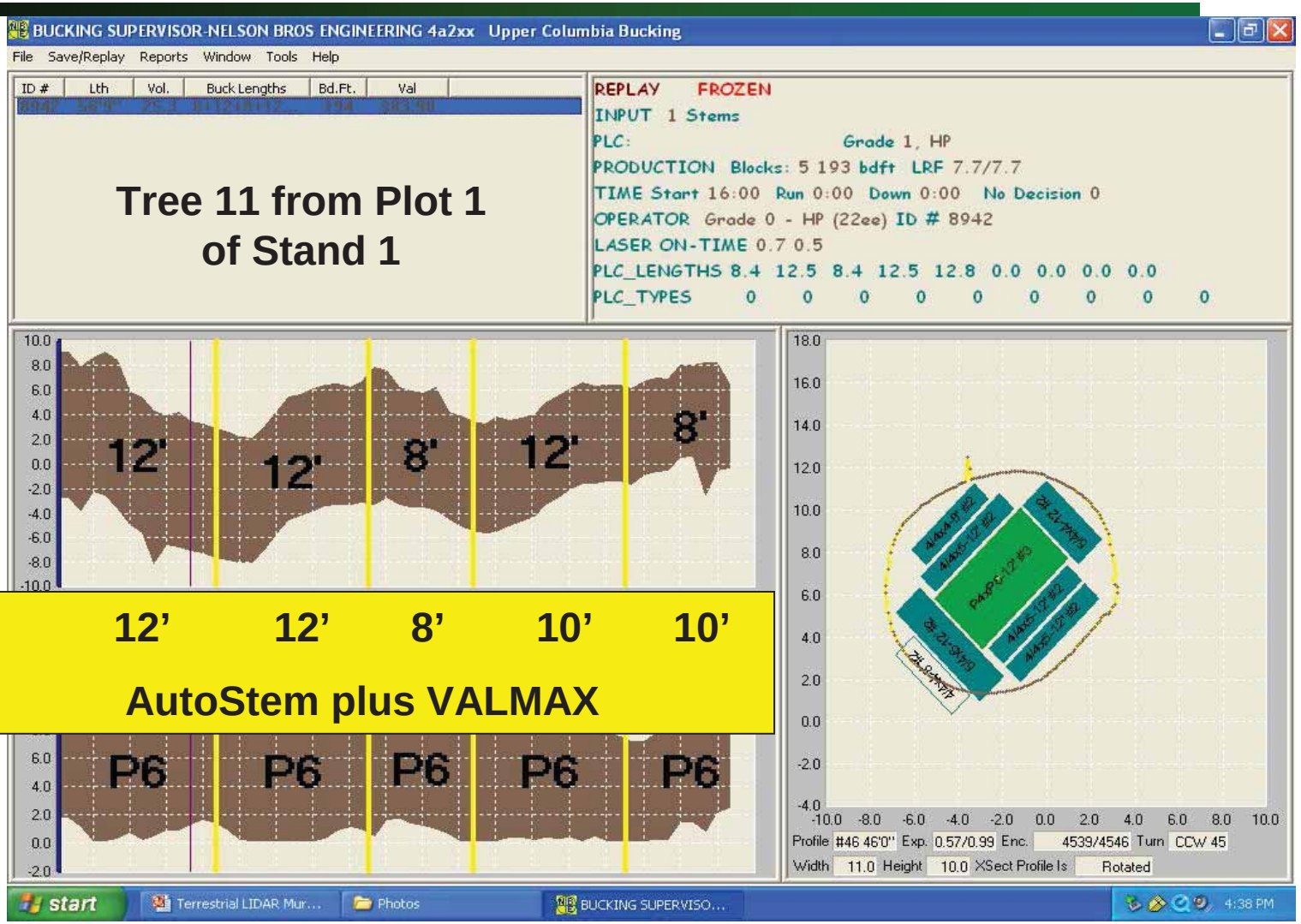
VALMAX vs NBE Buck4



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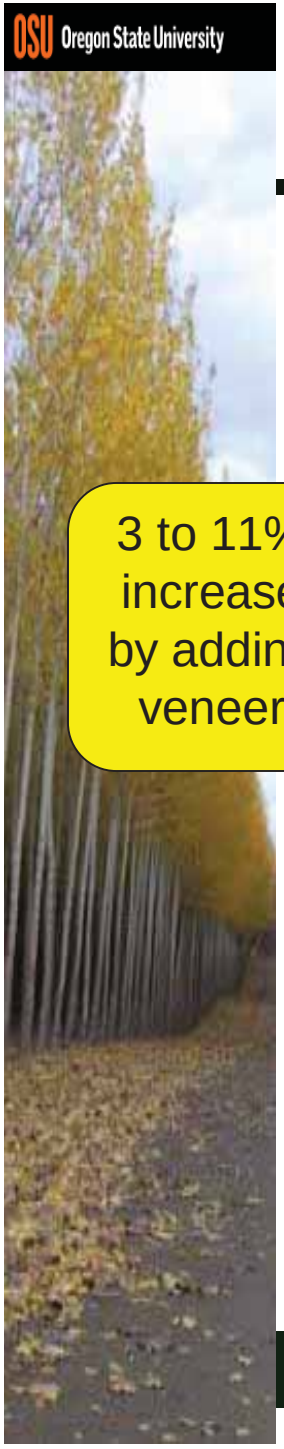

Value and Yields

Total Volume (m3/ha)	Total Value ($/ha)	Sawlog (%)	Chip (%)
523	$20,968	78.1	21.5

3 to 11% increase by adding veneer

Add another $1700 per ha if can get veneer from 200 to 250 mm SED

Preliminary Results from Stand 1 Plots 1 to 7

Bucking for Trucking

If buck at ~ 17.0 m (~ 56’9”)

- 9.4% of sawlogs (by number) would have extended above this point for Plots 1 to 7.

  Range 3.0% to 13.2%

Based on standing tree scans and AutoStem/VALMAX analyses.

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