## SUMMARY

LiDAR data for TFL 37 acquired in the summer of 2016 was used to review tree heights in stands aged between 40 and 100 years old. The mean tree height and associated standard deviation based on LiDAR-derived tree heights was calculated for each forest cover polygon. The 85$^{th}$ percentile tree height (mean + 1 standard deviation) was compared to the projected inventory height.

The data indicates that on average inventory height is 2 m less than LiDAR height. As height is the main determinant within growth and yield models for stand volume, this review indicates that the yield tables being used in the TFL 37 timber supply analysis are conservative.

Comparing LiDAR heights to TIPSY generated heights for 40-54 year old stands indicates that LiDAR heights are on average 1.3m greater. This indicates that the TISPY volume yields being used in the TFL 37 timber supply analysis are conservative.

## PROCESS

Use Forest Cover polygons as Base data – select stands between 40 and 100 years old (~24,300 ha) from the data set created to analyze OAF1. The 101-140 year old stands were excluded due to the low number of samples available.

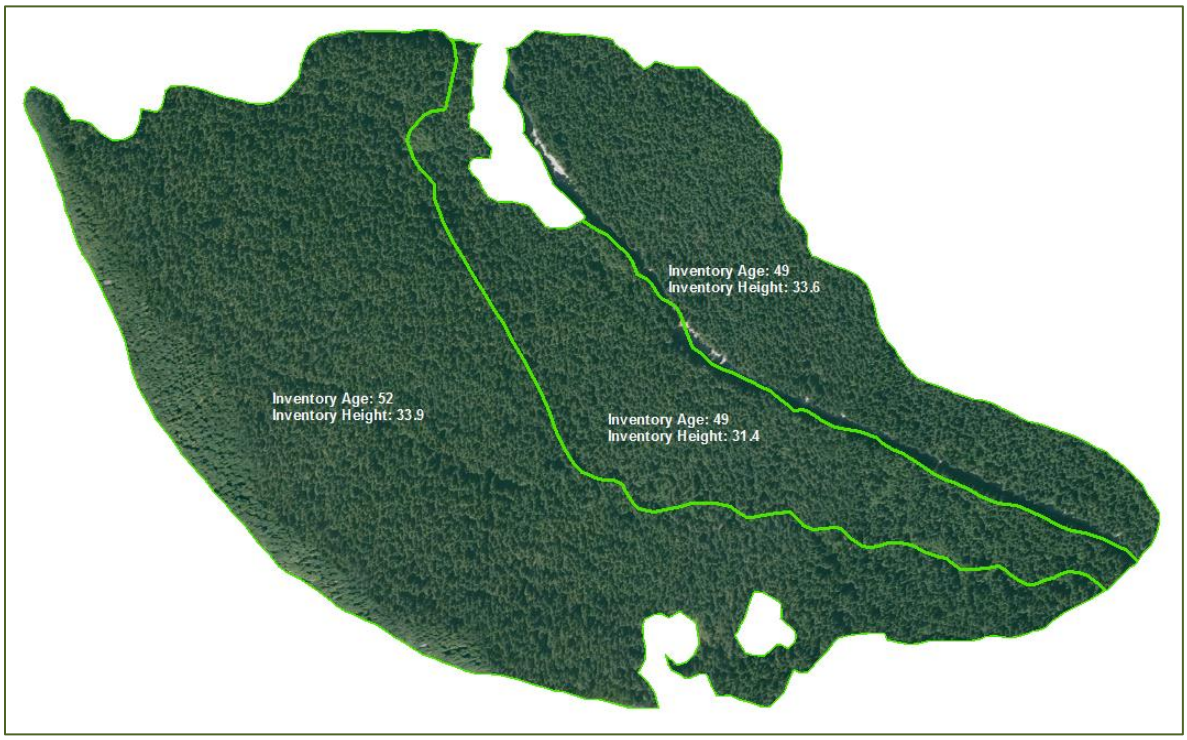


Figure 1 - Orthophoto and Inventory Data

Generate LiDAR-based crown height model for selected stands.

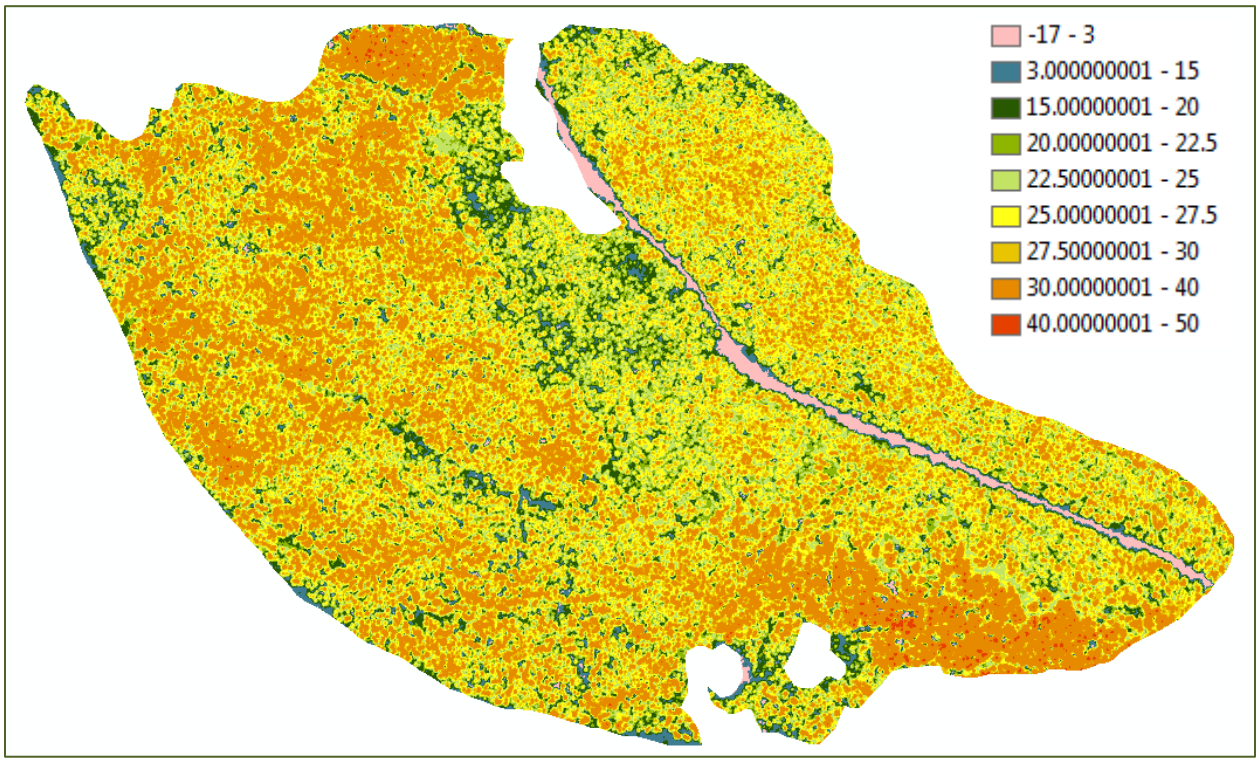


**Figure 2 - Crown Height Model from LiDAR**

Identify individual trees and their height.

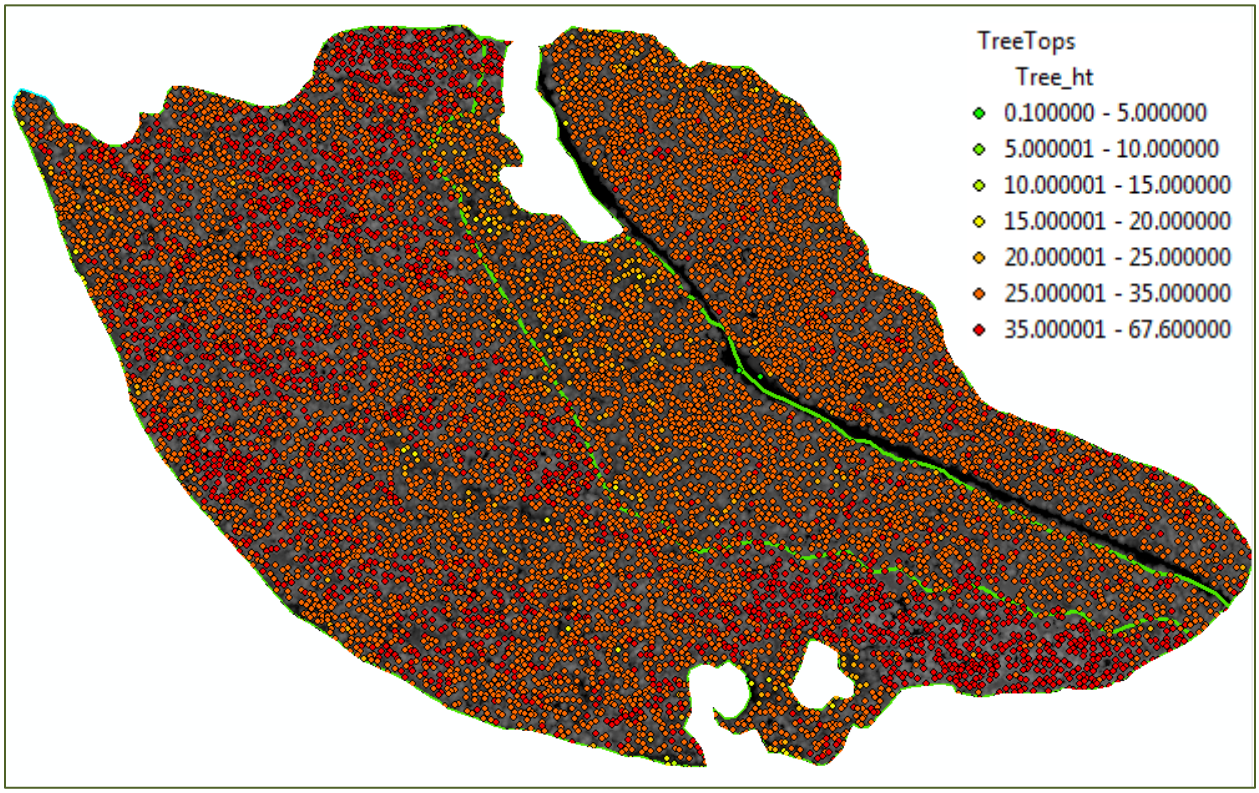


Figure 3 - Individual trees and heights from LiDAR

For each forest cover polygon the mean LiDAR tree height and standard deviation was calculated. The 85$^{th}$ percentile (mean + 1 standard deviation) of the identified individual tree heights from the LiDAR data was compared to the projected inventory height generated using VDYP 7. The 85$^{th}$ percentile height was chosen to represent the co-dominant trees within the stand.

**RESULTS**

The height difference is summarized against stand age and polygon count in Figure 4. Firstly, when stand age is considered the data indicates that VDYP underestimates the stand height. The blue bars in Figure 4 below indicate the sample number for polygons of the corresponding age. The vertical axis has been truncated in order to be able to indicate the ages with relatively few samples. The red line indicates the average difference between the inventory height and the LiDAR height. Negative values indicate that the inventory height is less than the LiDAR height. Note that where there is a large sample (indicated by blue column height) the red line tends to indicate a negative value indicating the LiDAR height is greater than the inventory height

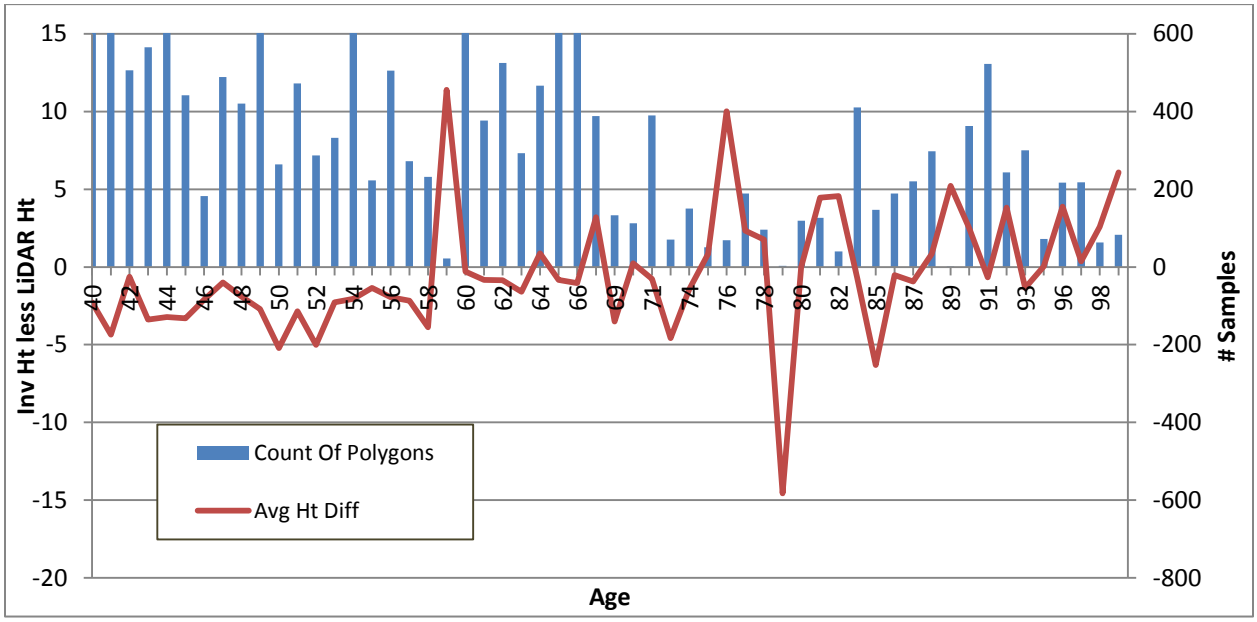


Figure 4 – Average inventory height difference and sample size by age

Eliminating age as a factor and outlier values with small sample size results in Figure 5. Note the large area where the inventory height it 2.7-3.2m less than the LiDAR height. Zero height difference is well to the right in the chart indicating the inventory height is less than the LiDAR height in the vast majority of polygons.

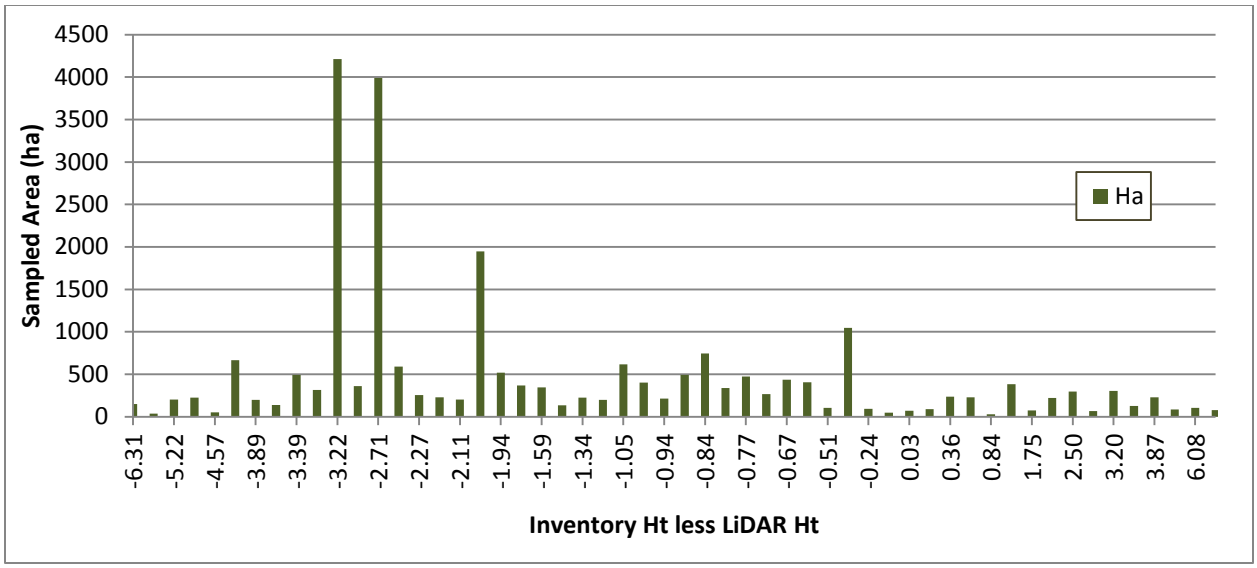


Figure 5 – Average inventory height difference and sample area

**DISCUSSION**

LiDAR data can provide very detailed information down to the individual tree-level. This allows accurate stand-level metrics to be derived. In this analysis, the mean and standard deviation of tree height from LiDAR data was calculated for every 40 to 100 year old forest inventory polygon within TFL 37. The 85$^{th}$ percentile (mean + 1 standard deviation) LiDAR tree height was compared to the VDYP 7 projected inventory height.

The results indicate that LiDAR heights are greater than inventory heights by an average of roughly 2 m. This infers that site index values are greater than indicated in the inventory. Given that stand height has the largest influence on yields derived from growth and yield models, the VDYP yields used in the timber supply analysis for TFL 37 are conservative.

In the MP #10 timber supply analysis, yields for analysis units for stands less than 55 years old are generated using TIPSY. A comparison of the analysis unit yield table height and LiDAR height was done for stands 40 to 54 years old. For comparison purposes the stands had to be grouped into 5-year age classes as that is how the TIPSY yield tables were generated. Figure 6 indicates the average height difference (LiDAR height less TIPSY height) for the 3 age classes available in the data. In total, 12,411 ha, of which 11,459 ha is THLB for the MP #10 analysis, were reviewed. The results indicate that the LiDAR heights are on average 1.3m greater than the TIPSY heights with a slightly greater difference in the 40 year age class.

As with the VDYP yields, this review indicates that the TIPSY heights are underestimated and therefore the corresponding volume yield is conservative.

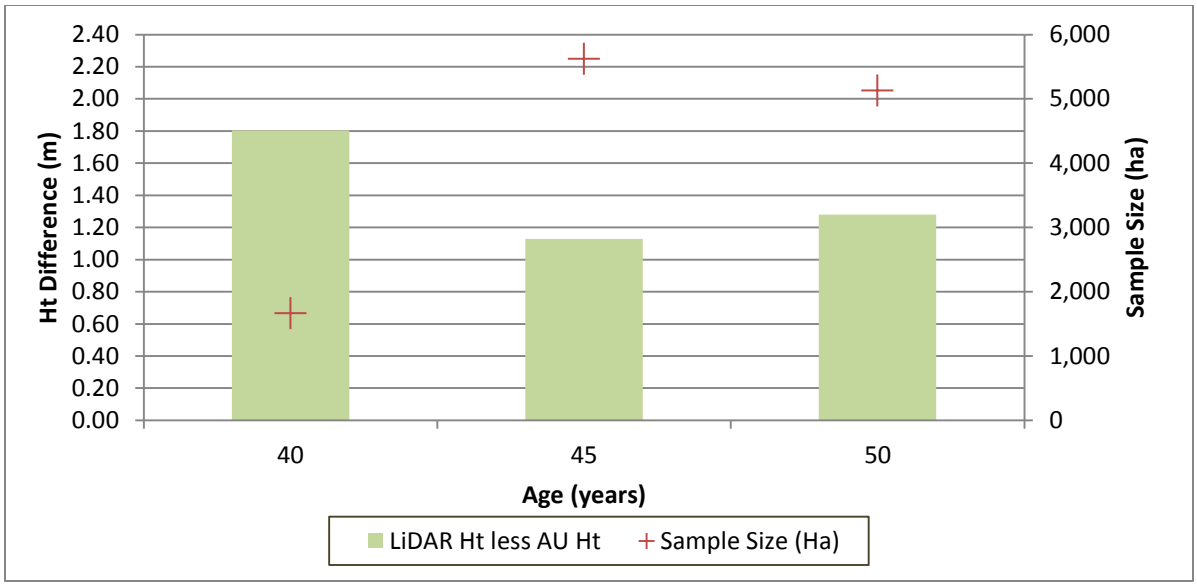


Figure 6 – Average height difference between TIPSY yield table height and LiDAR height