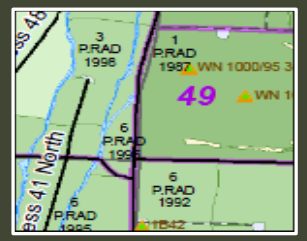

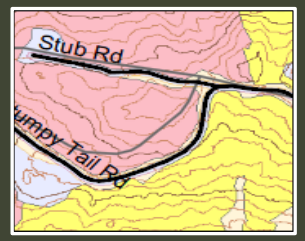

Seeing the Wood for the trees

Using LiDAR data to improve the accuracy of forest information

Bev Taylor NZEUC 2017

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www.ernslaw.co.nz

Waimarino Forest

- 100km North of Wanganui
- Altitude range 35-785m asl

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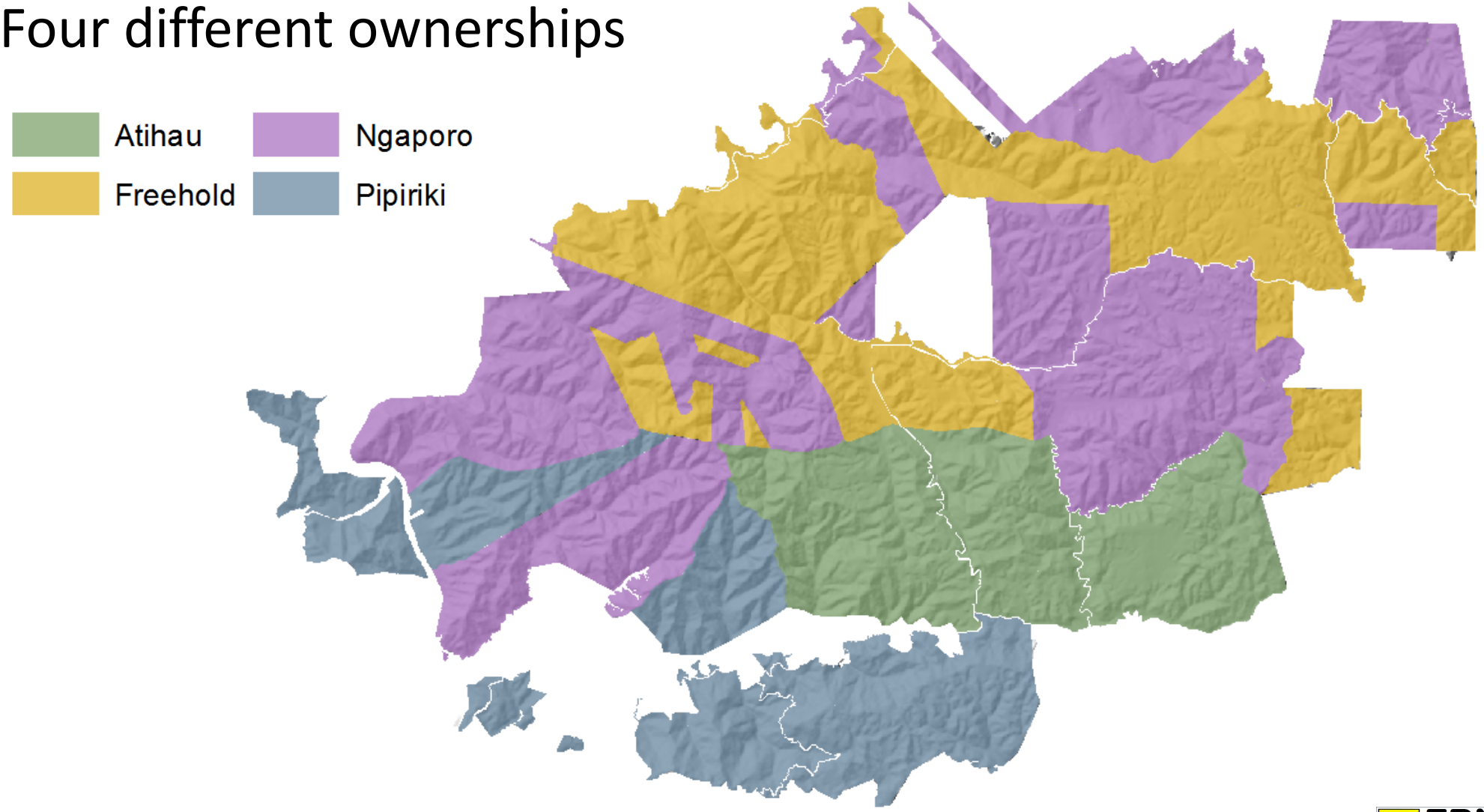
Ownership

Four different ownerships



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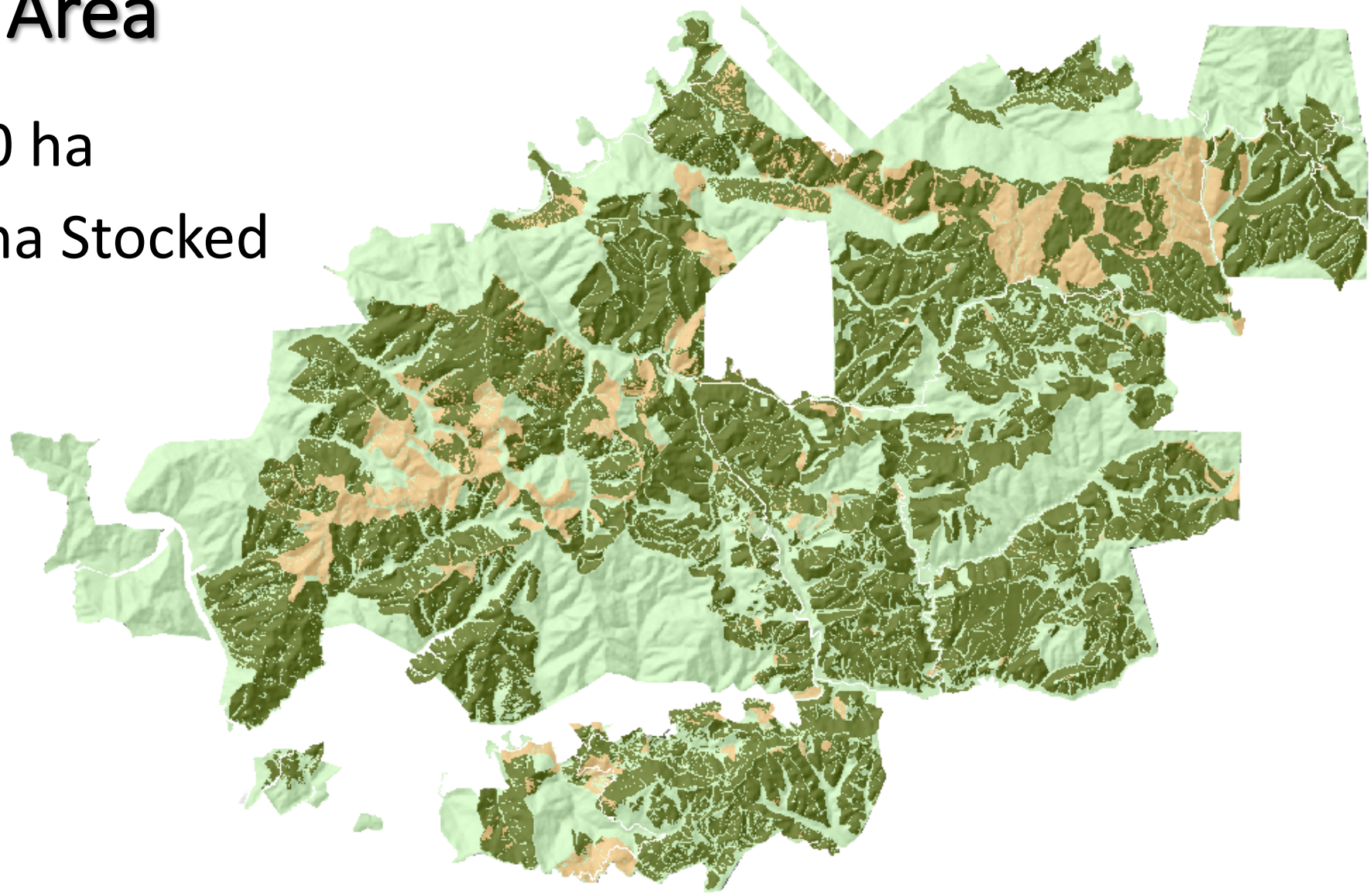
Area

13,800 ha

7000 ha Stocked



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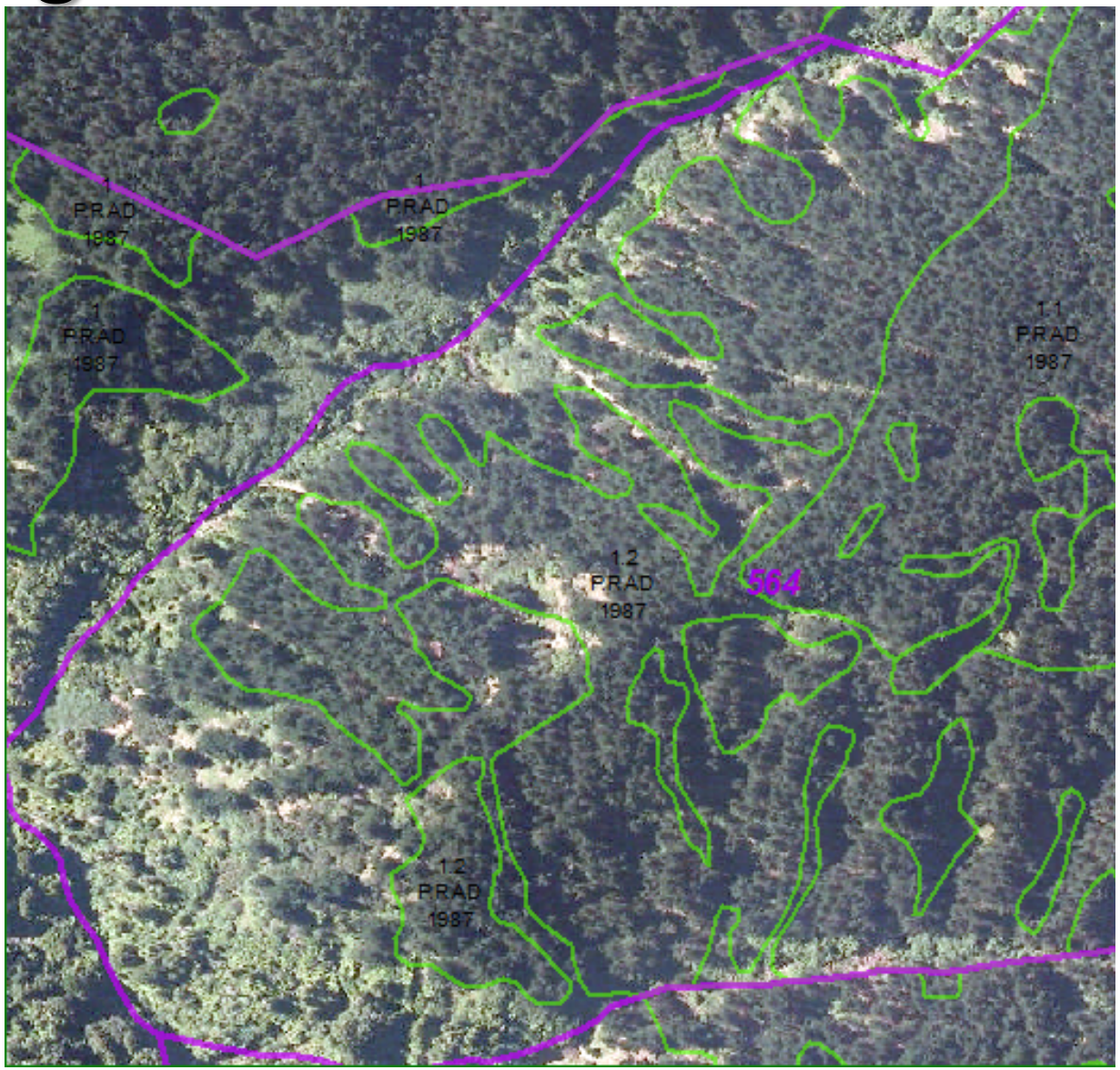
Issues - inherited mapping



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Issues – Lease areas

- Lease areas differ

Example only	2007	2015
Available plantable area	1584	1291
Non- productive	895	1194
Total lease area	**2479ha**	**2485 ha**

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Issues – Yields

Dissatisfaction with

predicted yields/ vs recovered volume

TRV	**632** m3/ha	**683** t/ha
Mean SPH	**340** (for extraction)	
Mean Piece Size	**1.86** m3	**2.01** t
Mean MTH	**41.7** m	
Mean BA	**55.9** m2	

Yield Summary

Stand: WAIM 261/1
(Total Area: 61.1 ha)
Source: Direct Entry
Yield as at
Yield age 27 derived from Direct Entry

Initial stocked area	**61.1** ha	TRV	**632** m3/ha	**683** t/ha
Area with yield data	**61.1** ha	Mean SPH	**340** (for extraction)	
Area standing	**57.8** ha	Mean Piece Size	**1.86** m3	**2.01** t
		Mean MTH	**41.7** m	
		Mean BA	**55.9** m2	

Product	Volume (m3/ha)	PLE	Volume (m3)	Volume Standing	Conv Factor (m3/t)	Weight (t/ha)	Total Tonnes	Weight (%)	Tonnes Standing	PLI
P40	125		7641	7223	0.92	136	8306	19.9	7851	
PS	3		190	179	0.92	3	206	0.5	195	
P35	0		0	0	0.92	0	0		0	
P30	46		2812	2658	0.92	50	3057	7.3	2889	
S40	78		4786	4524	0.93	84	5147	12.3	4865	
S30	0		0	0	0.93	0	0		0	
S25	140		8564	8095	0.93	151	9209	22.1	8704	
A	125		7623	7205	0.93	134	8197	19.6	7747	
K	0		0	0	0.93	0	0		0	
L40	5		275	260	0.93	5	296	0.7	280	
L25	28		1699	1606	0.93	30	1827	4.4	1727	
KI	6		348	329	0.93	6	375	0.9	354	
Pulp	75		4591	4339	0.92	82	4990	12.0	4717	
Minor	2		104	98	0.92	2	113	0.3	107	
Total	**632**		**38634**	**36517**	**0.93**	**683**	**41721**	**100.0**	**39435**	

But we're only getting less than 500 m3/ha

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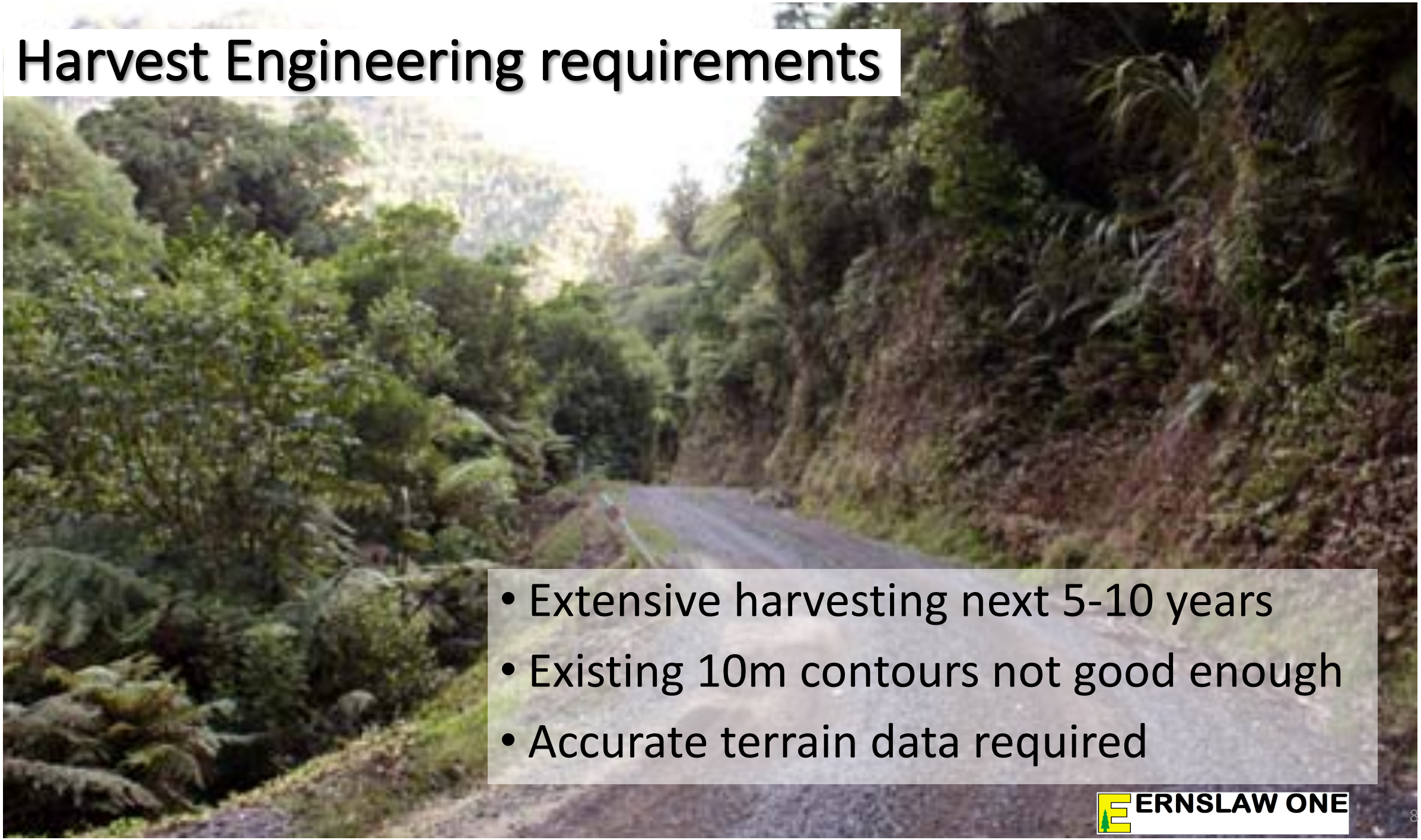
Harvest Engineering requirements



- Extensive harvesting next 5-10 years
- Existing 10m contours not good enough
- Accurate terrain data required

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But LIDAR is costly

- Want more than just the terrain
- And better value than previous

	2006	2012
	East Coast forests	Tolaga forests
Cost	$203000 AUD	$46630 NZD
Coverage (ha)	43,200	13,100
$ per Ha	$4.70	$3.60
PPSM	1	1
deliverables	5m contours Drain vectors Road vectors	Unclassified and classified points DEM, DSM, nDSM 5m contours

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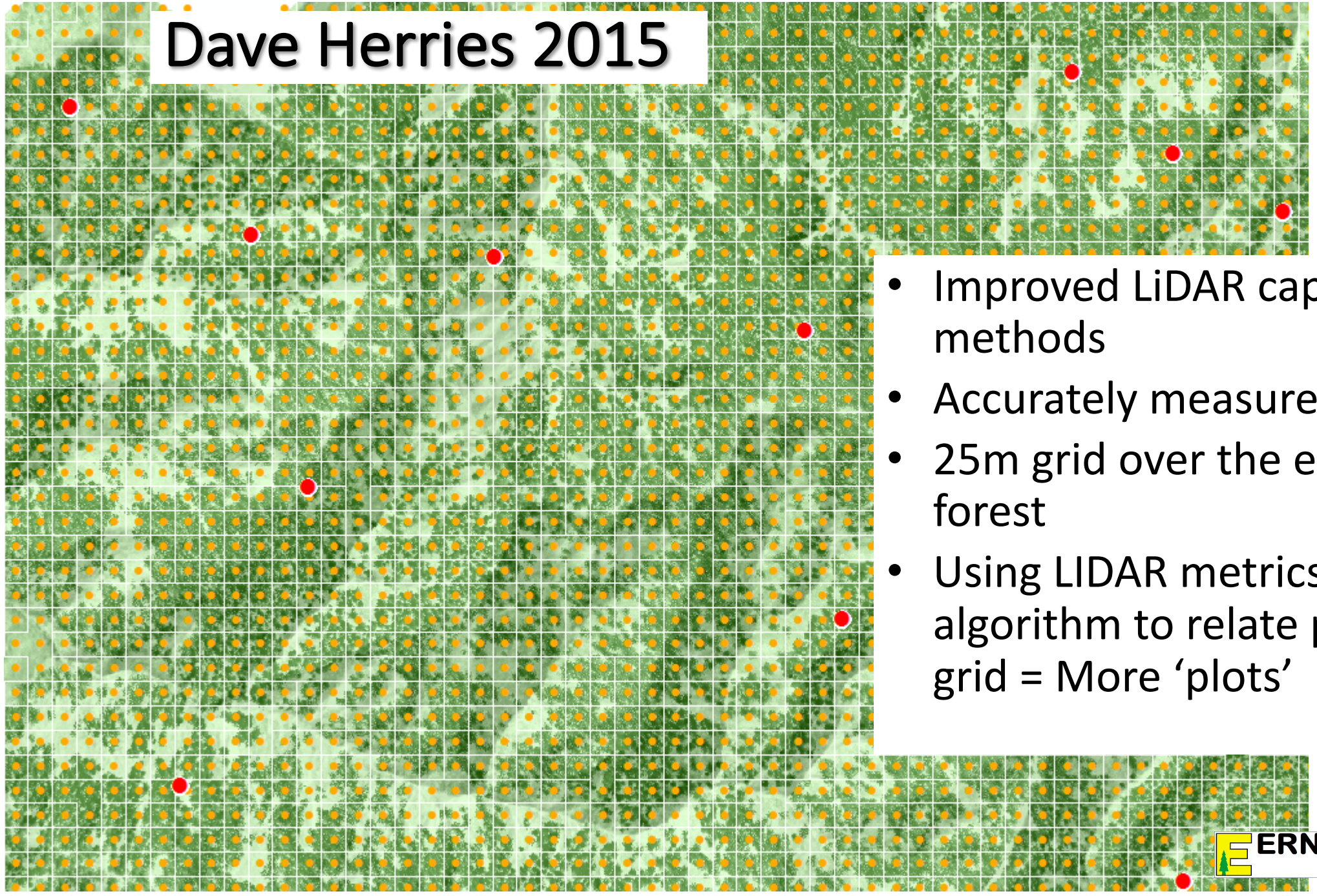
Above ground data

- What above ground information can we get?
- Will it improve yield data
- or help accurately map stands?

Dave Herries 2015



- Improved LiDAR capture methods
- Accurately measured plots.
- 25m grid over the entire forest
- Using LIDAR metrics and kNN algorithm to relate plots to grid = More ‘plots’

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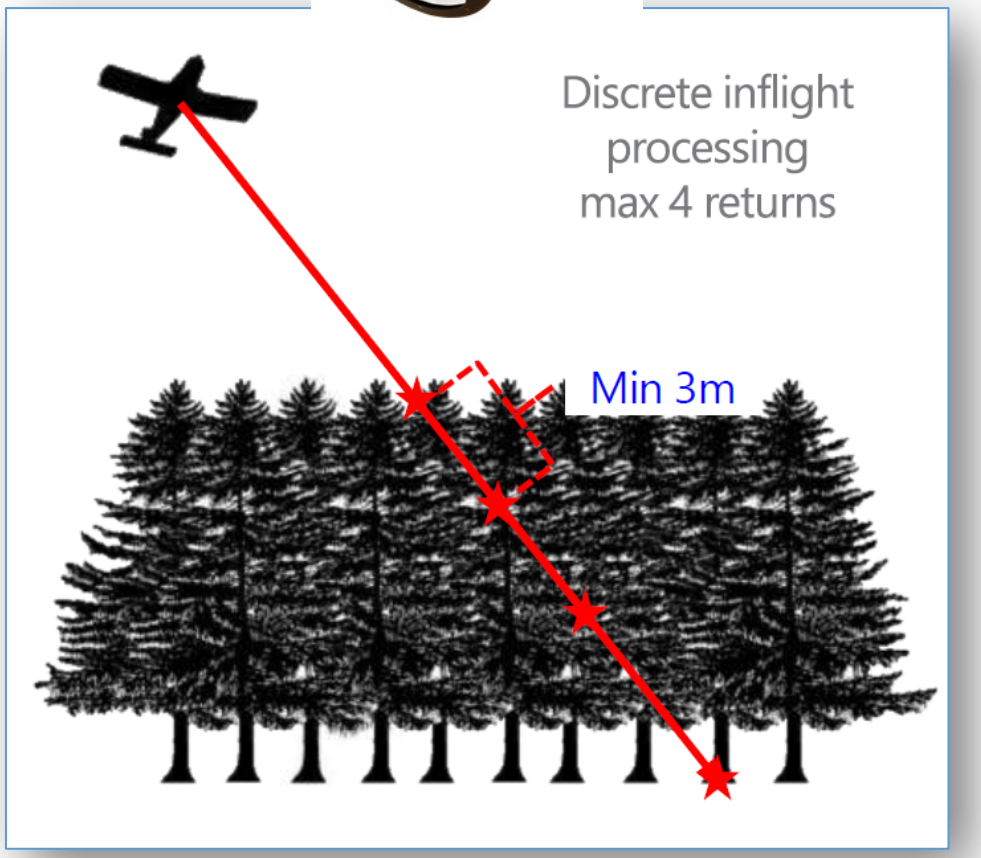
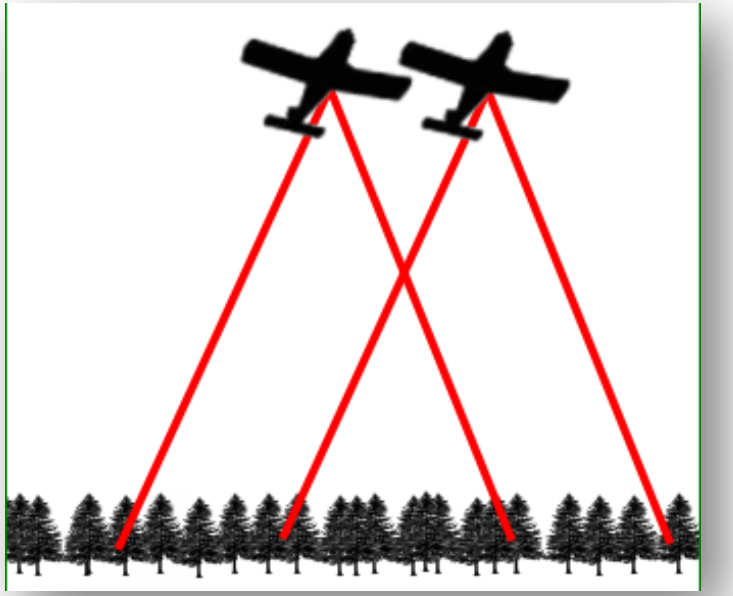
LiDAR Specs

- improved sensors
- greater scan angles
  +/-14 degrees
- swath overlap 50%
- minimum 8 pulse/m2





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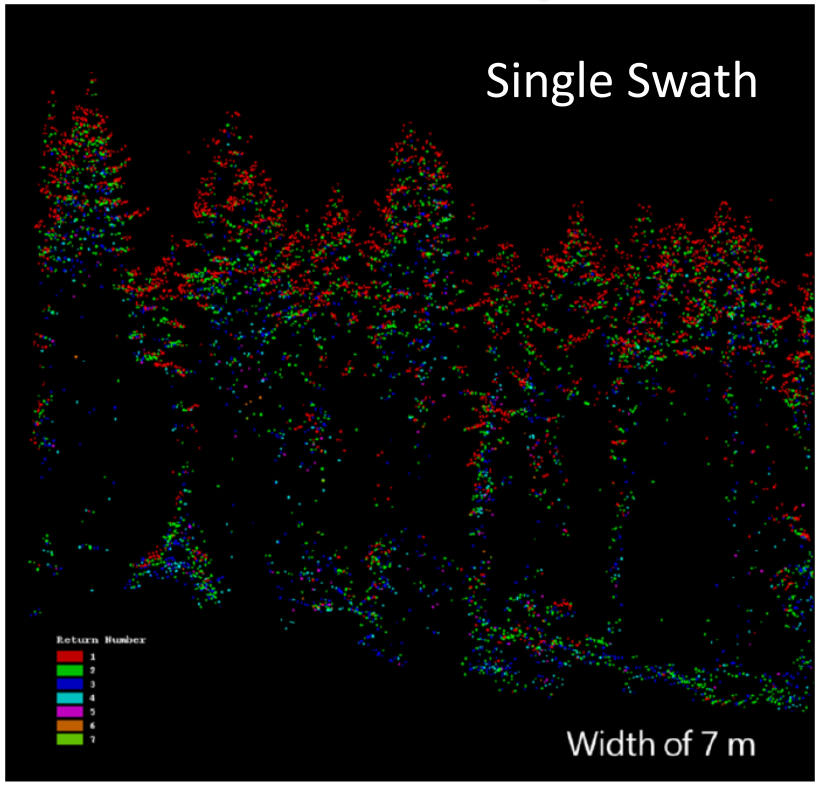
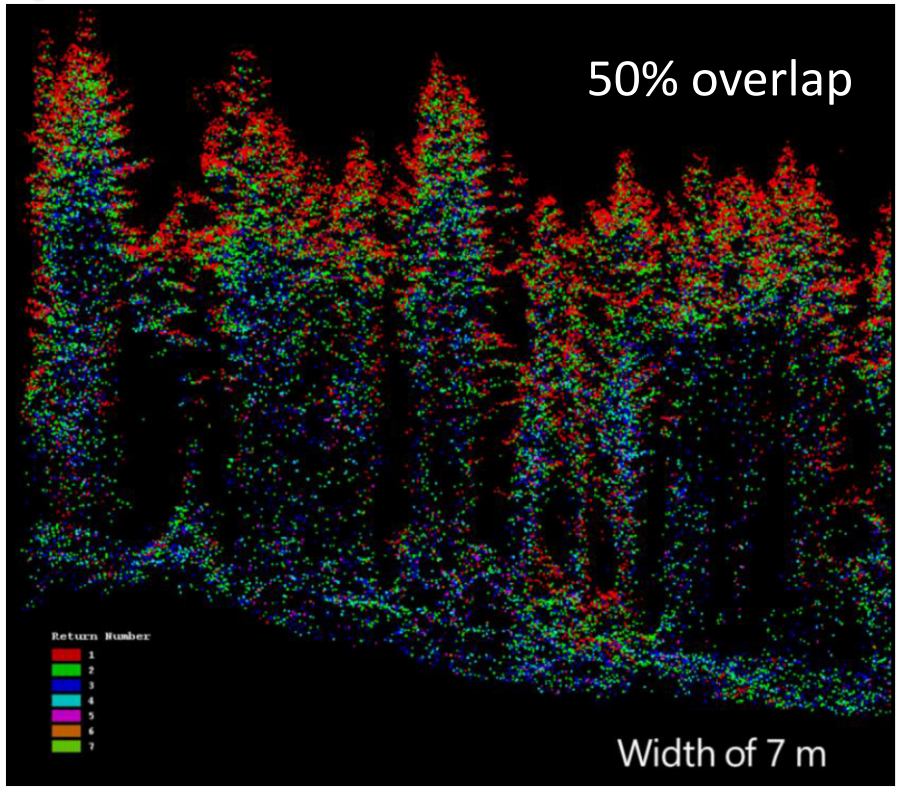
Point and pulse density





Variable	Single Swath Mean	50% overlap
Point density: (all returns (m2)	24.59	47.19
Point density: (last return (m2)	14.45	27.49
Spacing: all returns (m)	0.2	0.15
Spacing: last return (m)	0.26	0.19

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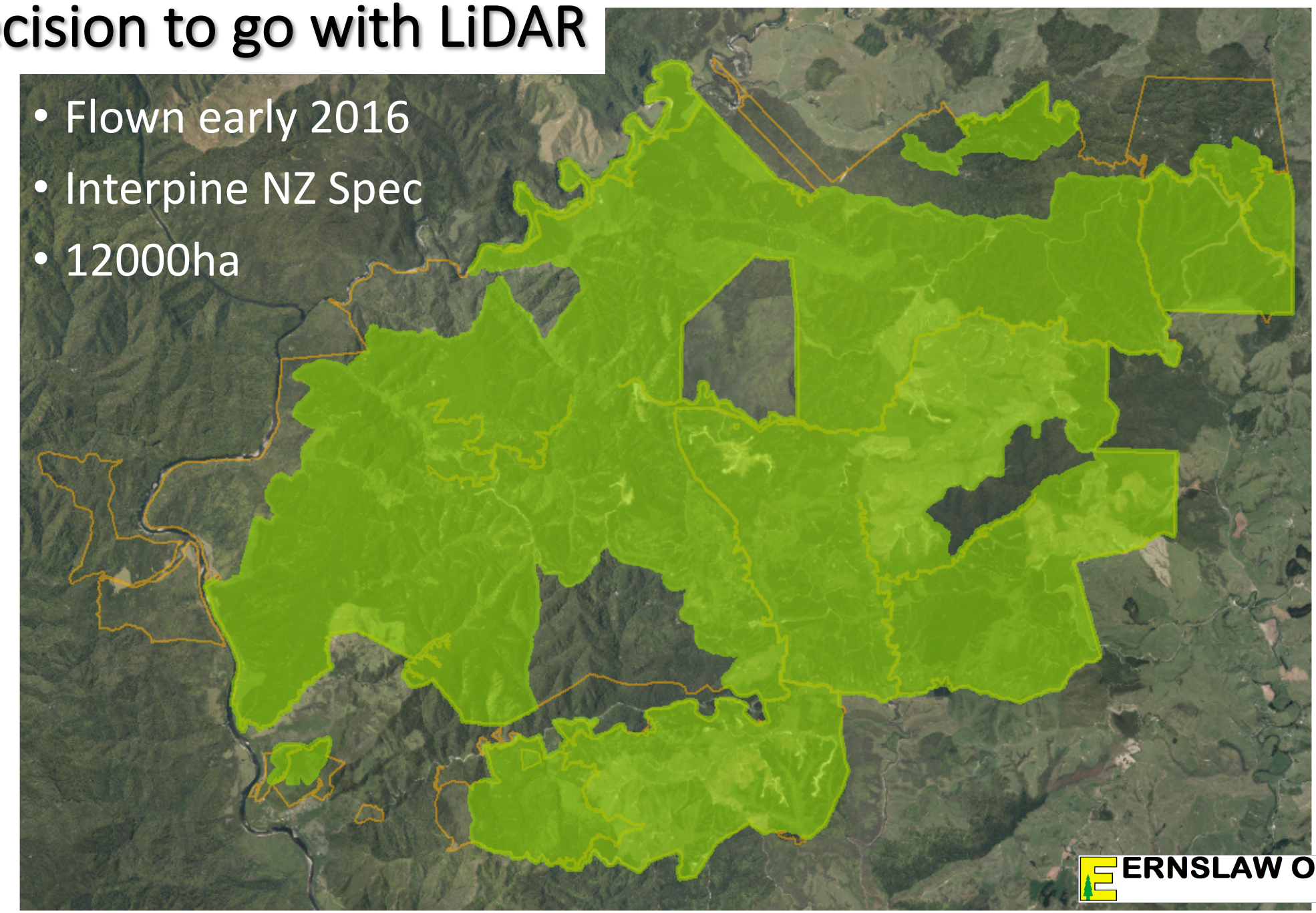
Decision to go with LiDAR

- Flown early 2016
- Interpine NZ Spec
- 12000ha



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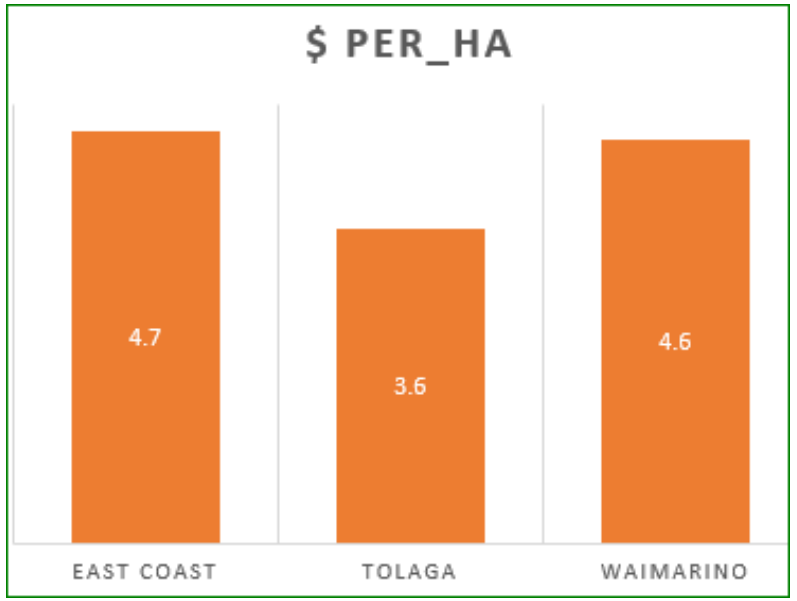
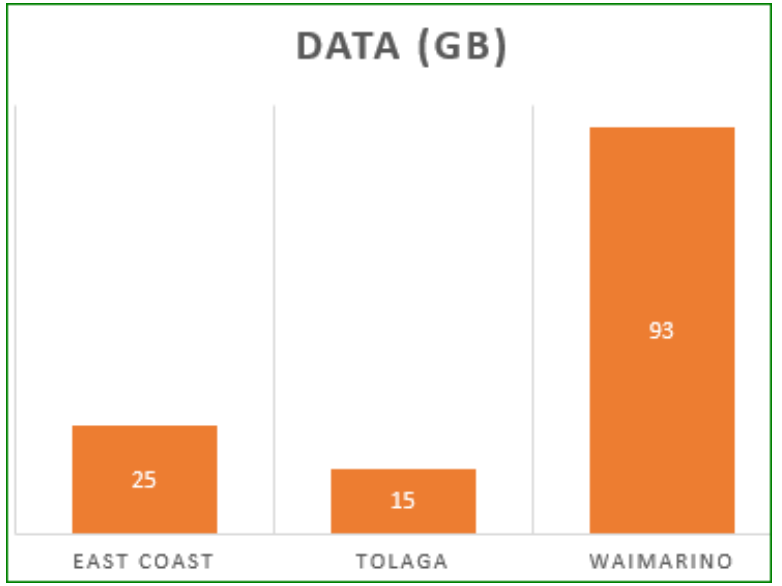
WAIM - Delivered

- Classified point cloud
- Unclassified point cloud
- DEM, DSM, nDSM
- 0.5m contours
- Total 93 GB data





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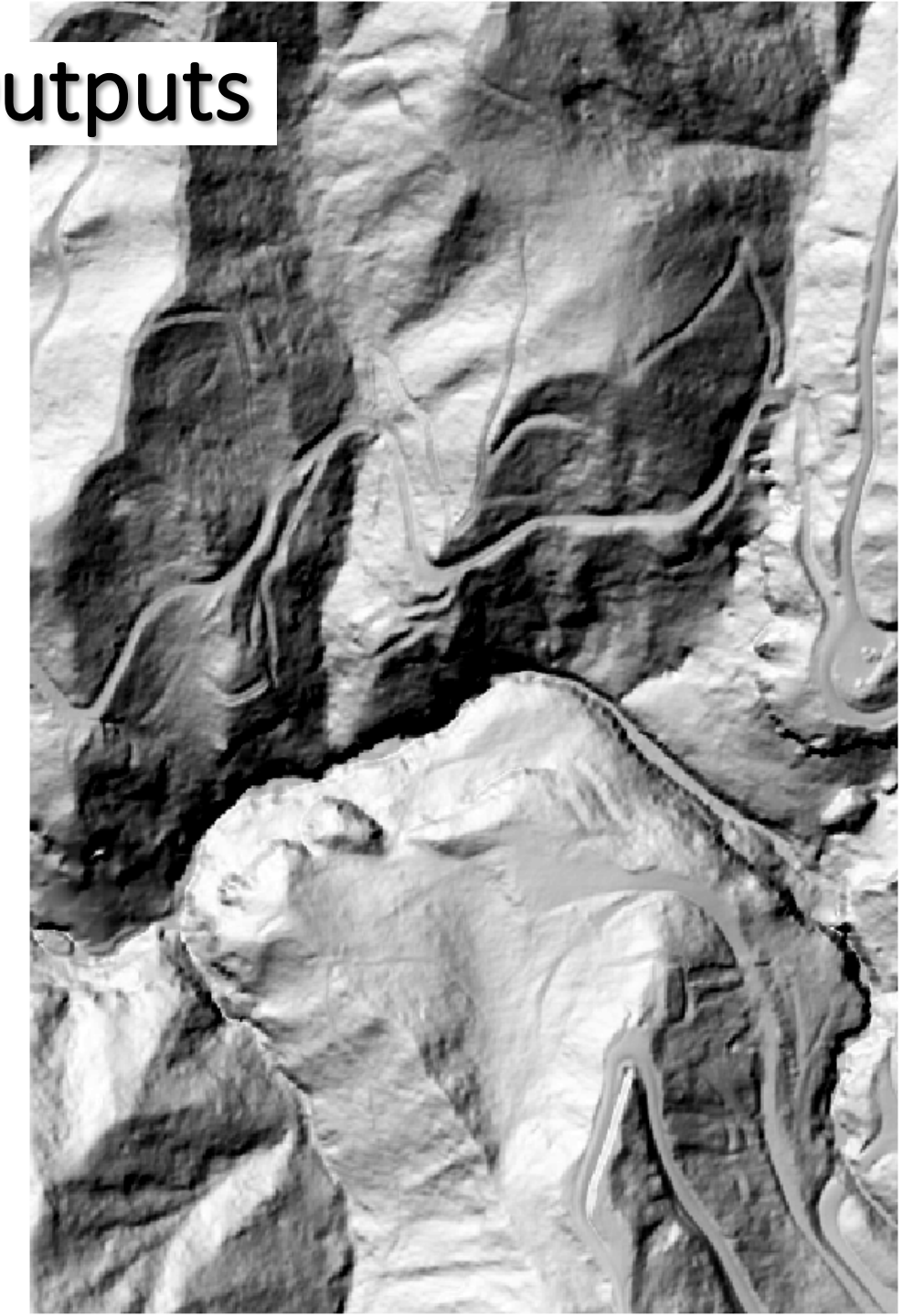
Outputs



Terrain > Hillshade

0.5m contours

= more accurate data for harvest planning

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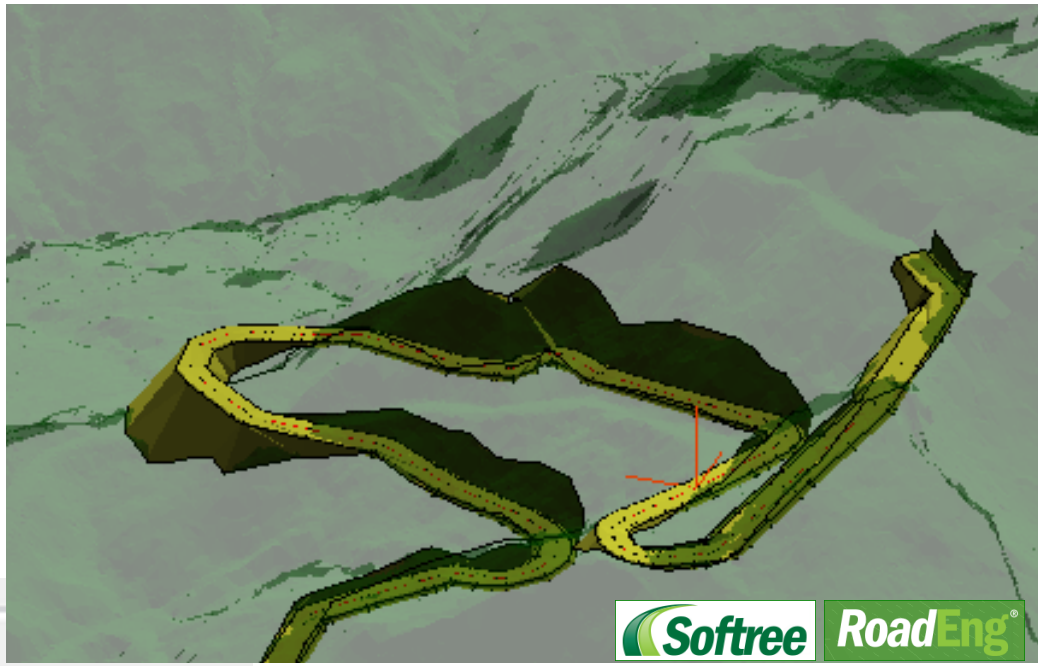
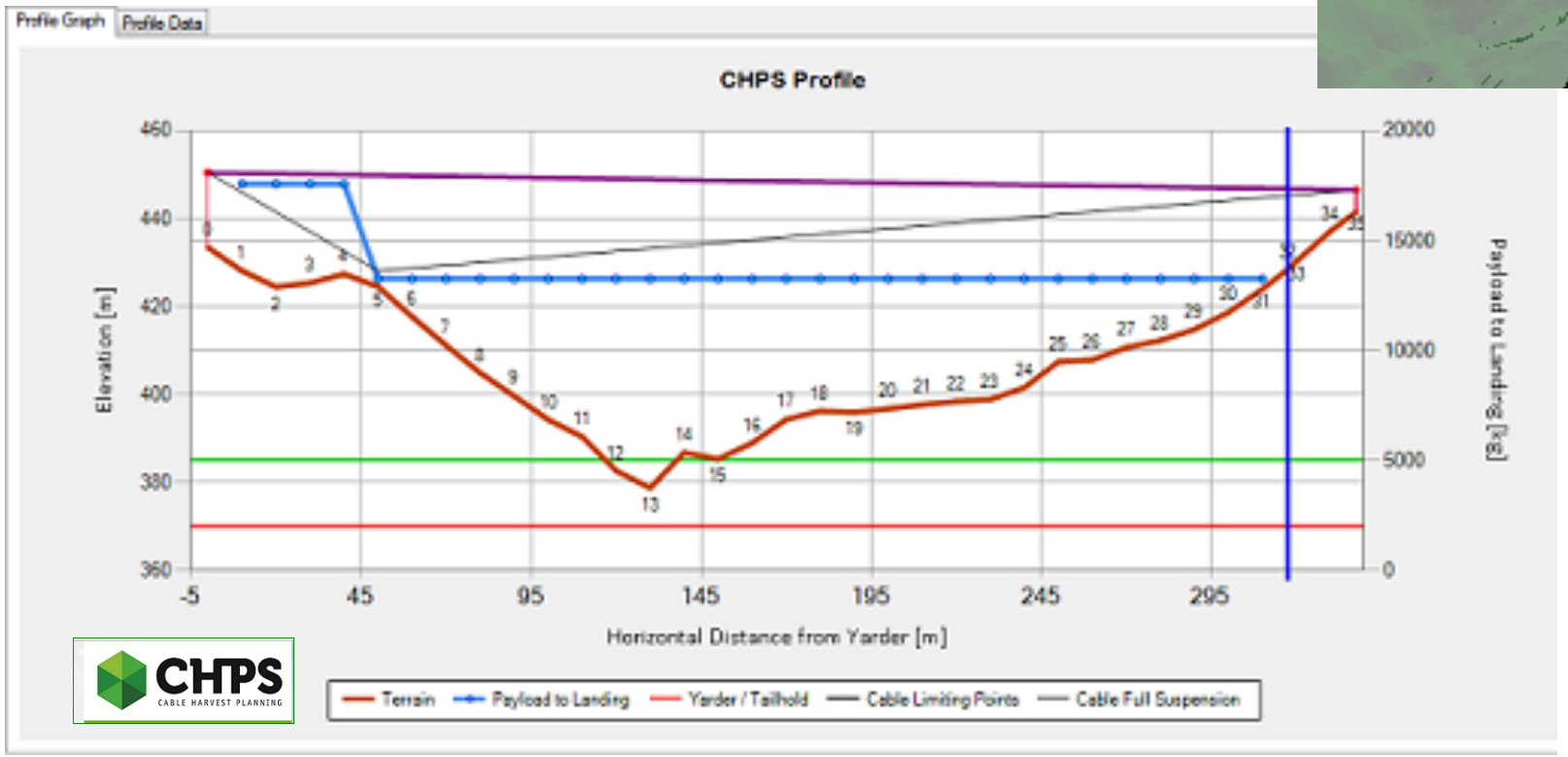
Terrain data uses

- Road engineering
- Cable Harvest Planning





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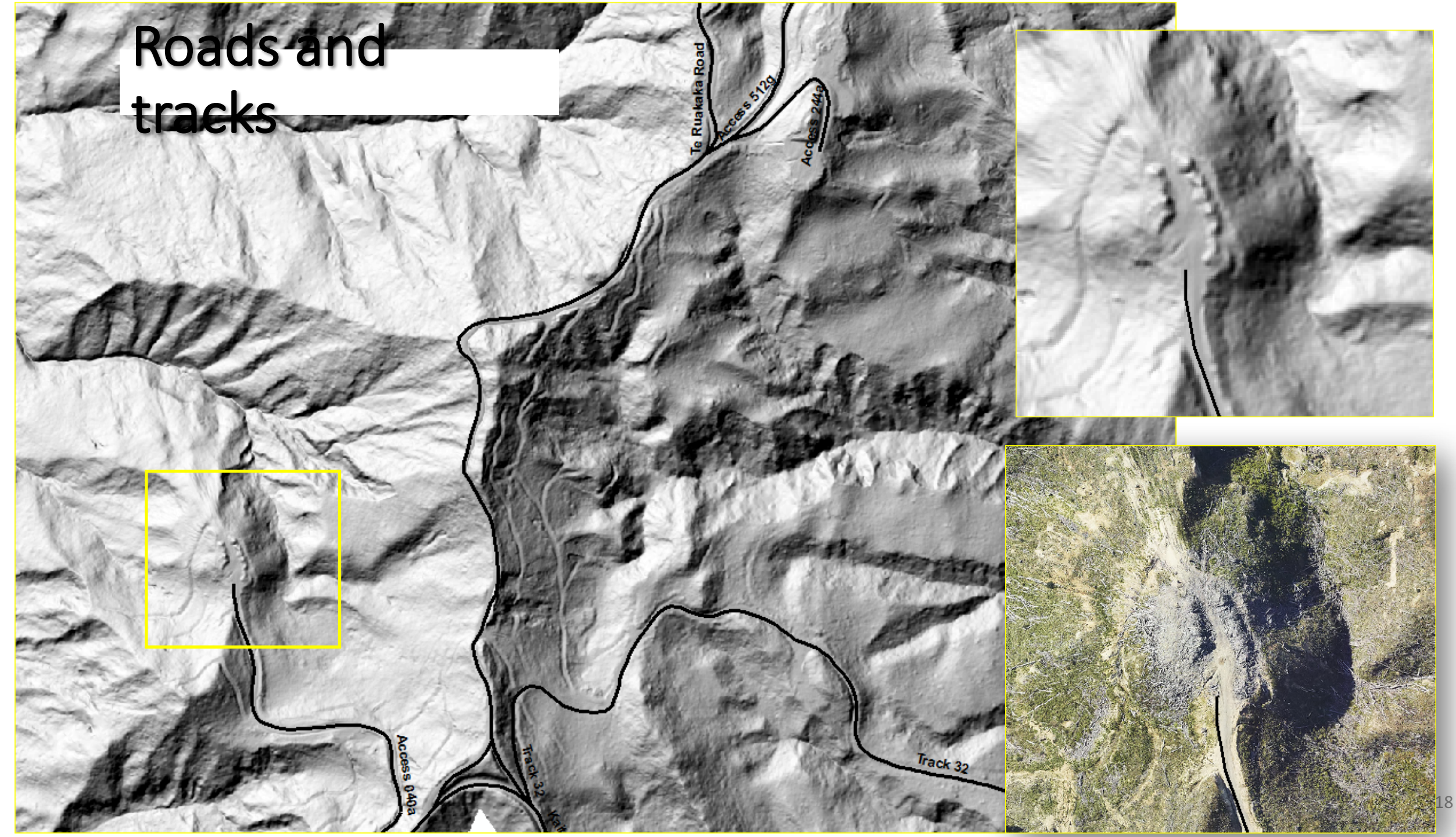
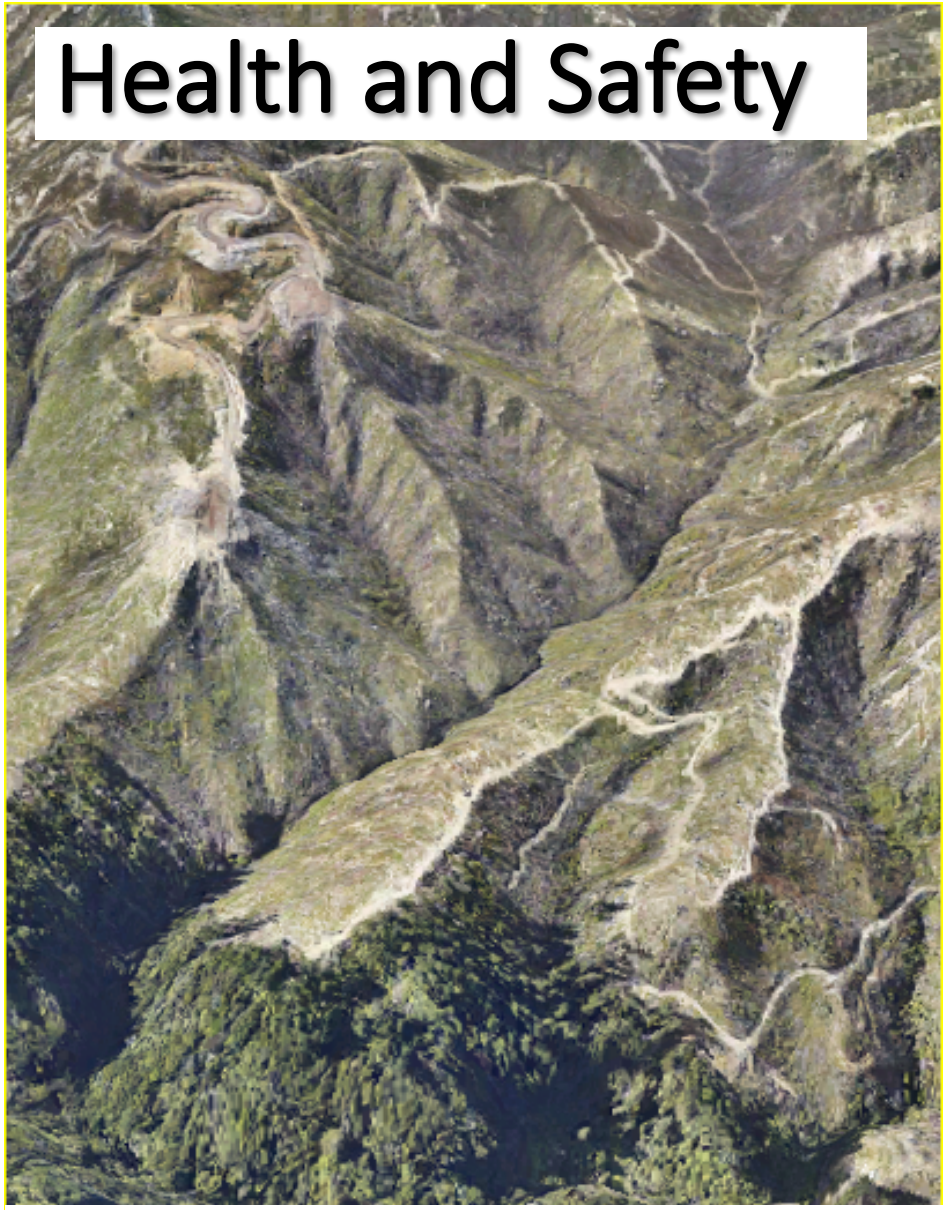
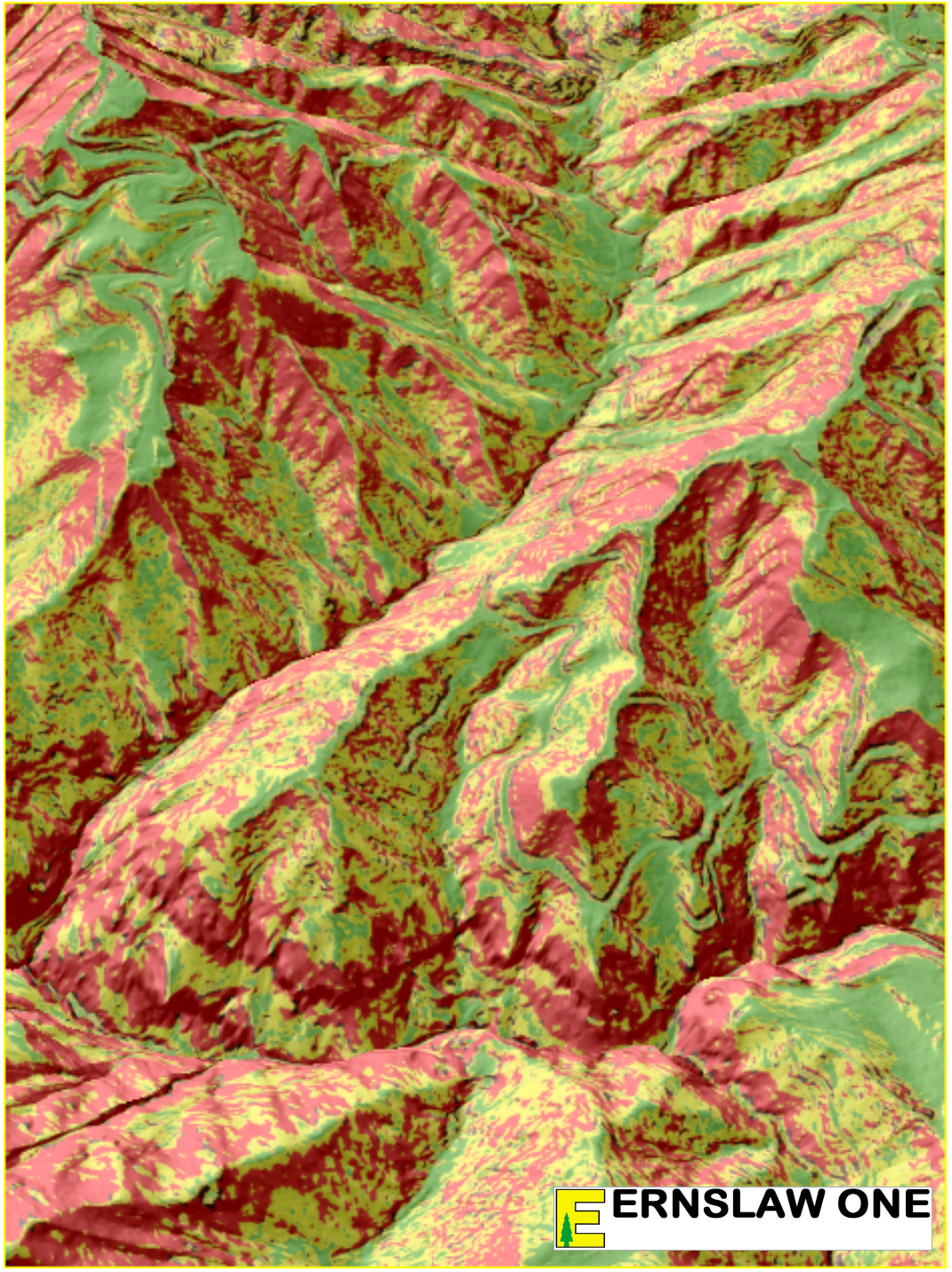
Roads and tracks



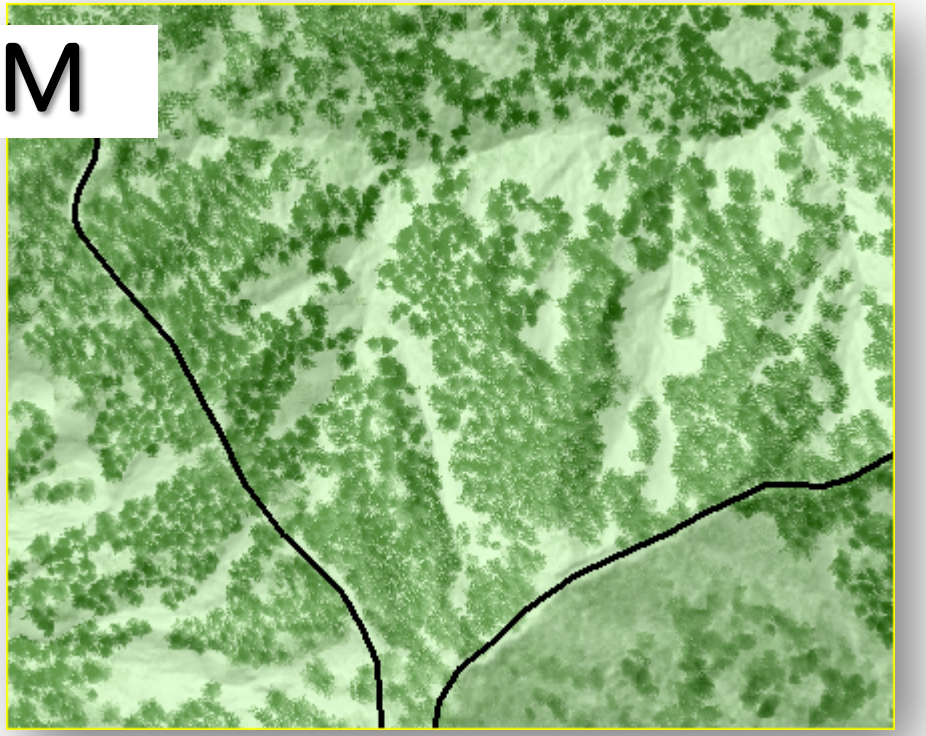
Health and Safety

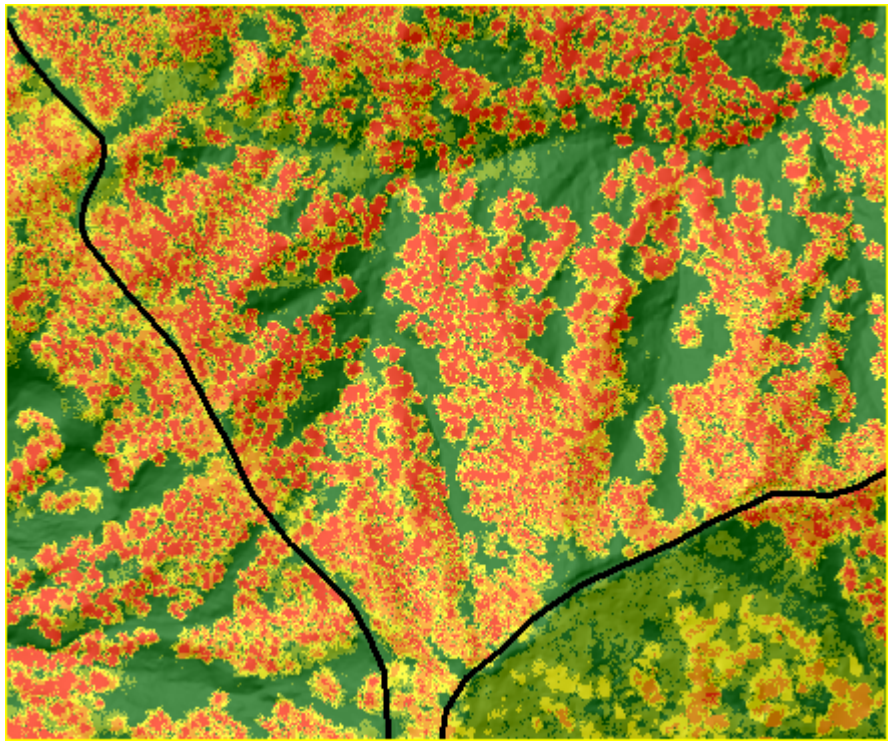


Steep Slopes are dangerous?



CHM





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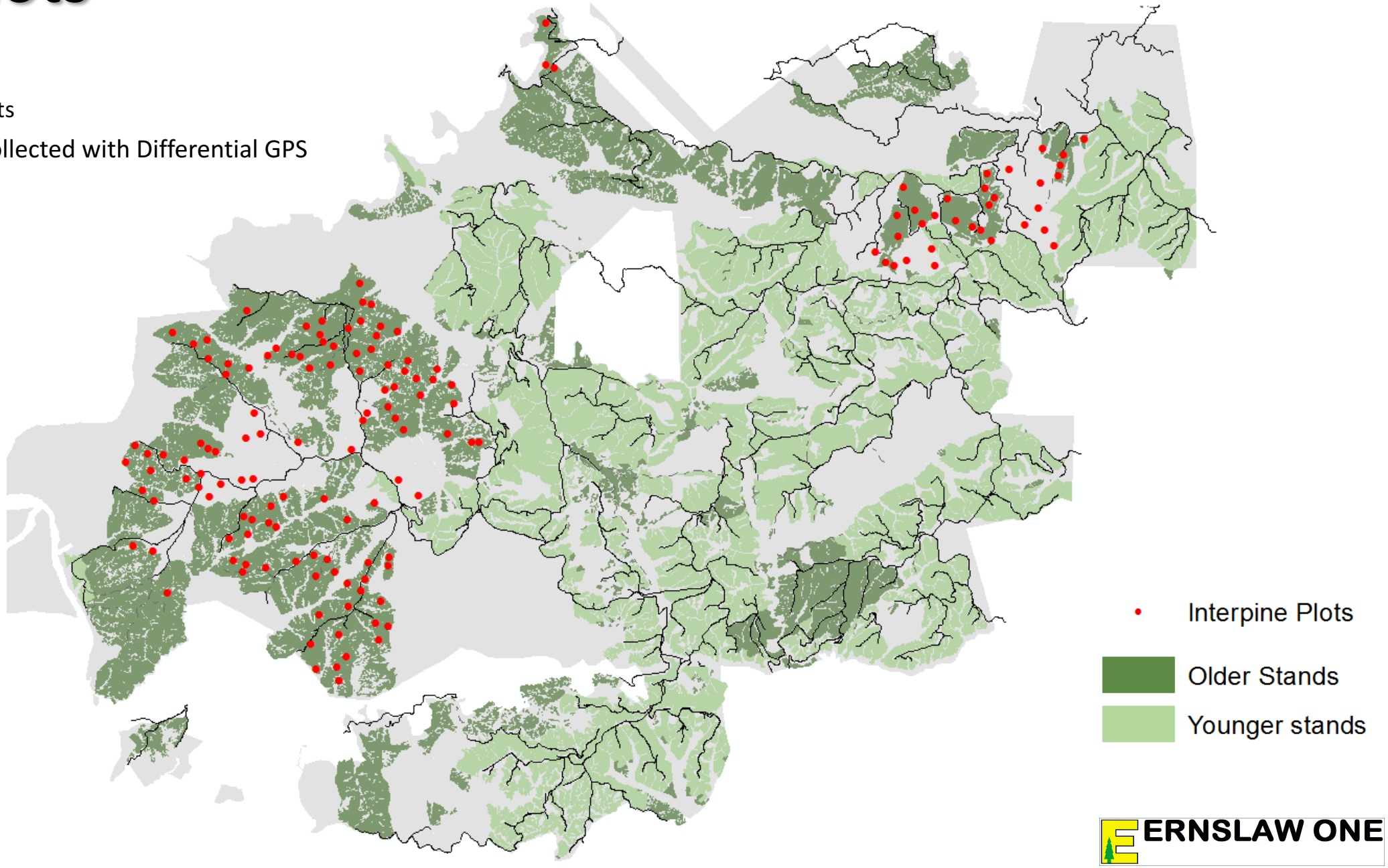
Plots

150 plots

Data collected with Differential GPS



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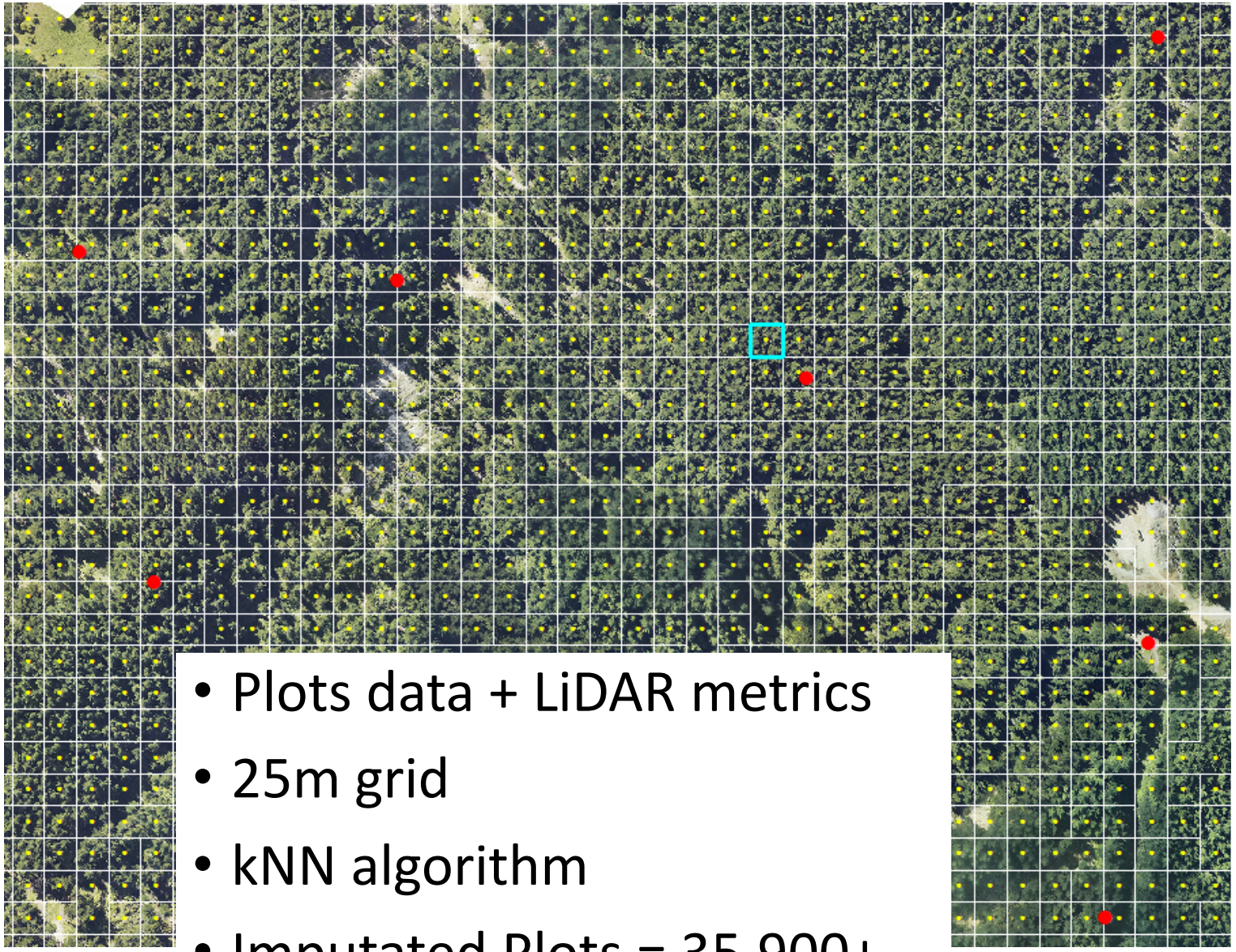
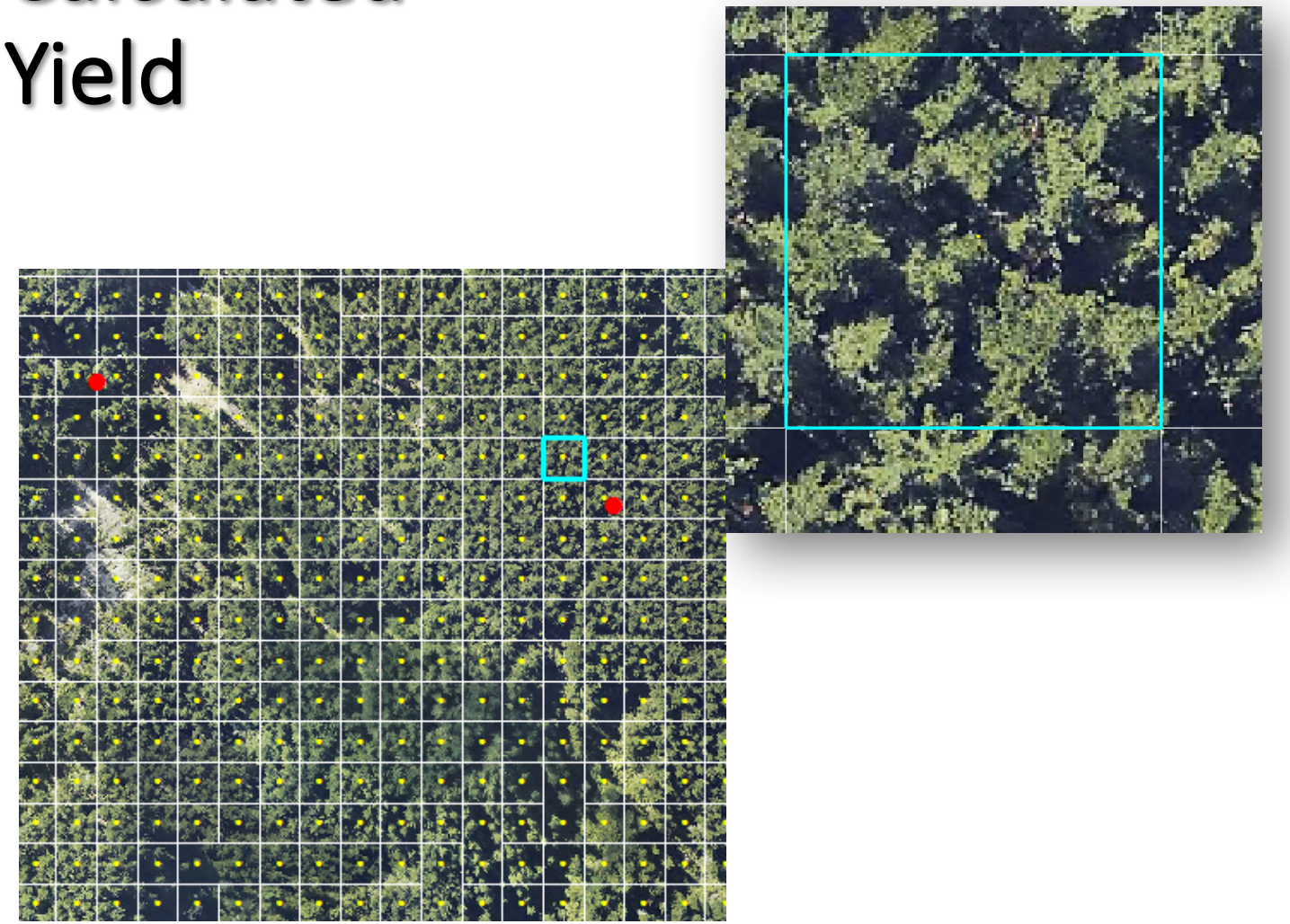
Imputation



- Plots data + LiDAR metrics
- 25m grid
- kNN algorithm
- Imputated Plots = 35,900+

Height	Ht to crown base	Max crown width
39.64	19.82	2.56
41.47	20.73	2.4
41.7	20.85	2.33
42.5	21.25	3.15
42.94	21.47	3.52
43.35	21.67	2.71
43.49	21.74	1.74
43.74	21.87	2.08
44.85	22.42	1.56
45.82	22.91	1.6

Calculated Yield



Field	Value
y	5633412.833
x	1776362.833
waste	26.084183
TotalStemVolume	1030.1518
TotalRecoverableVolume	897.085133
TopHeight	45.531093
top_	22.81595
stump	22.70487
Stocking	337.3832
Shape	Point
S25	461.082967
Pulp	140.598767
PS	6.052387333
PeriodNumber	2017.5
P40	121.58879
Minor	0
L35	159.8846
KI	3.806503333
id	63977
Grid_Id	12795
CA	4.071255
break	61.461423
BasalArea	73.578063
Age	29.333333

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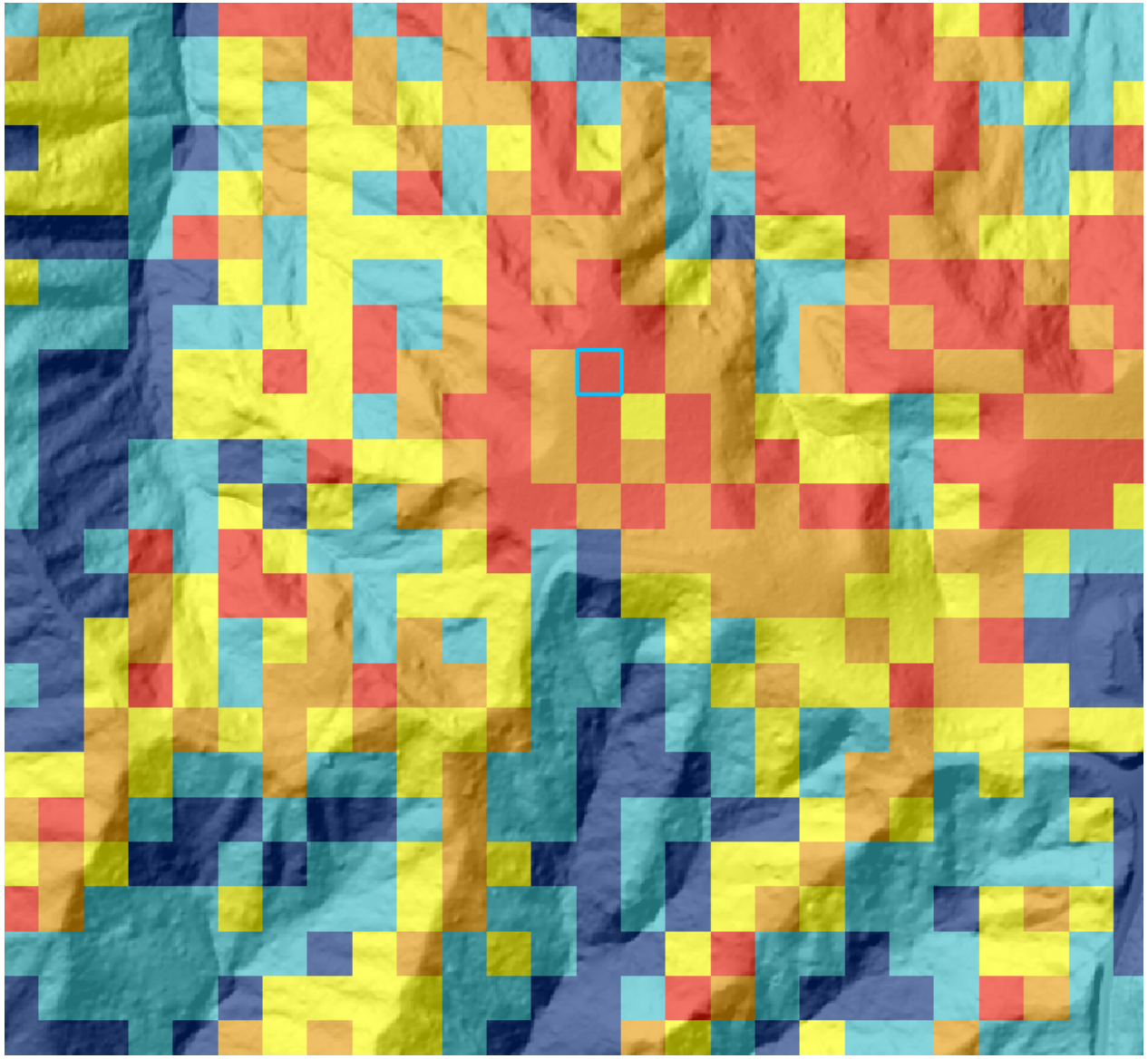
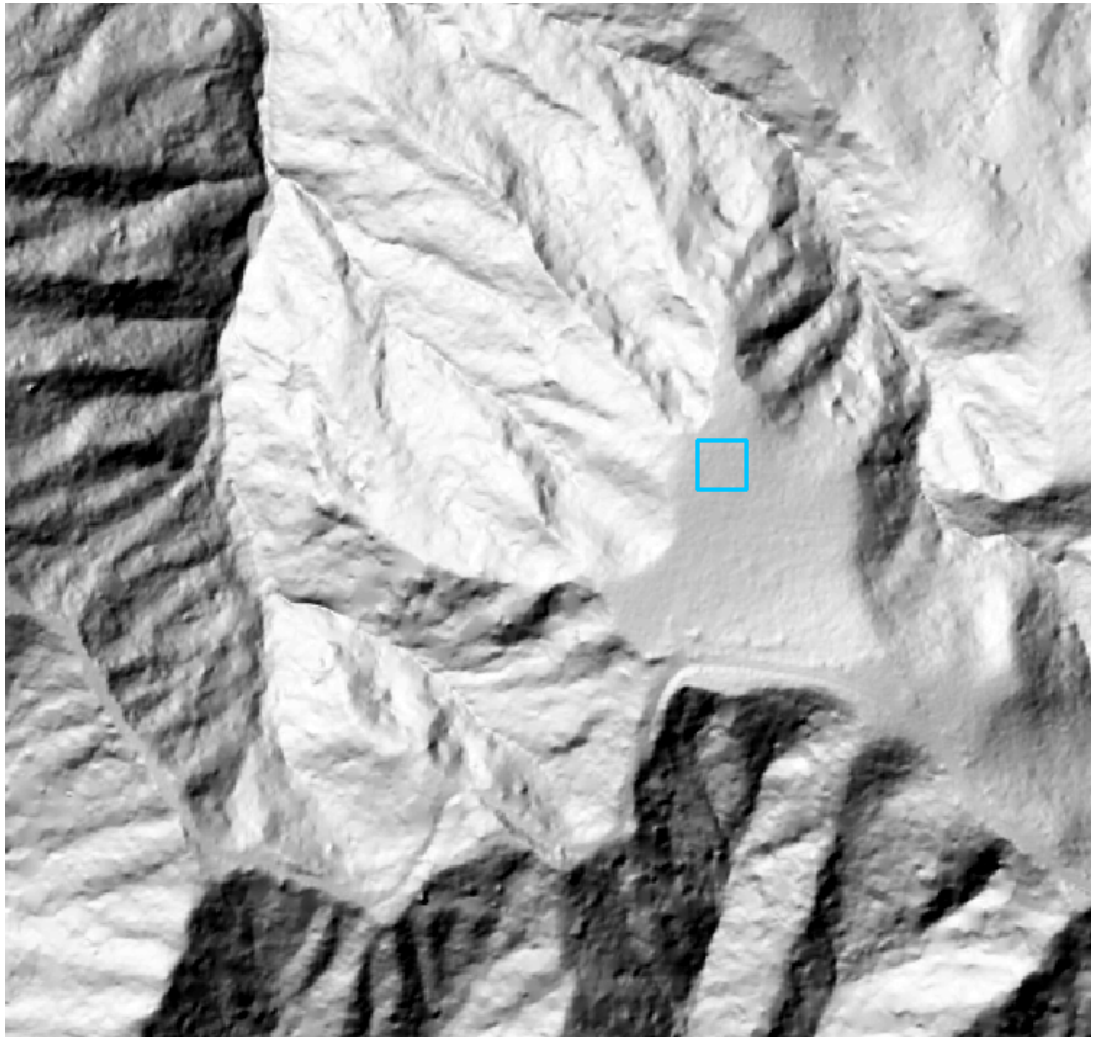
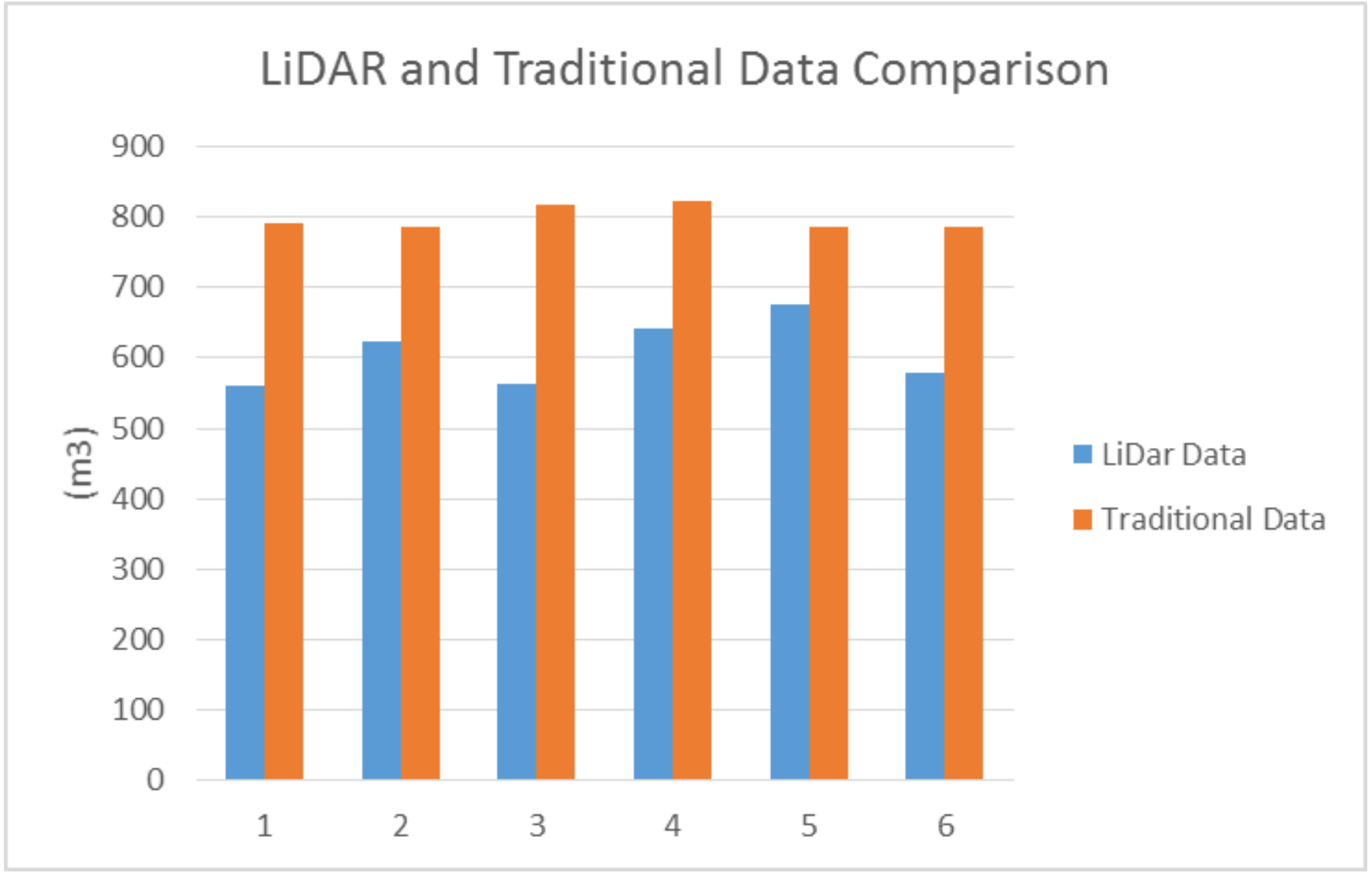
TRV





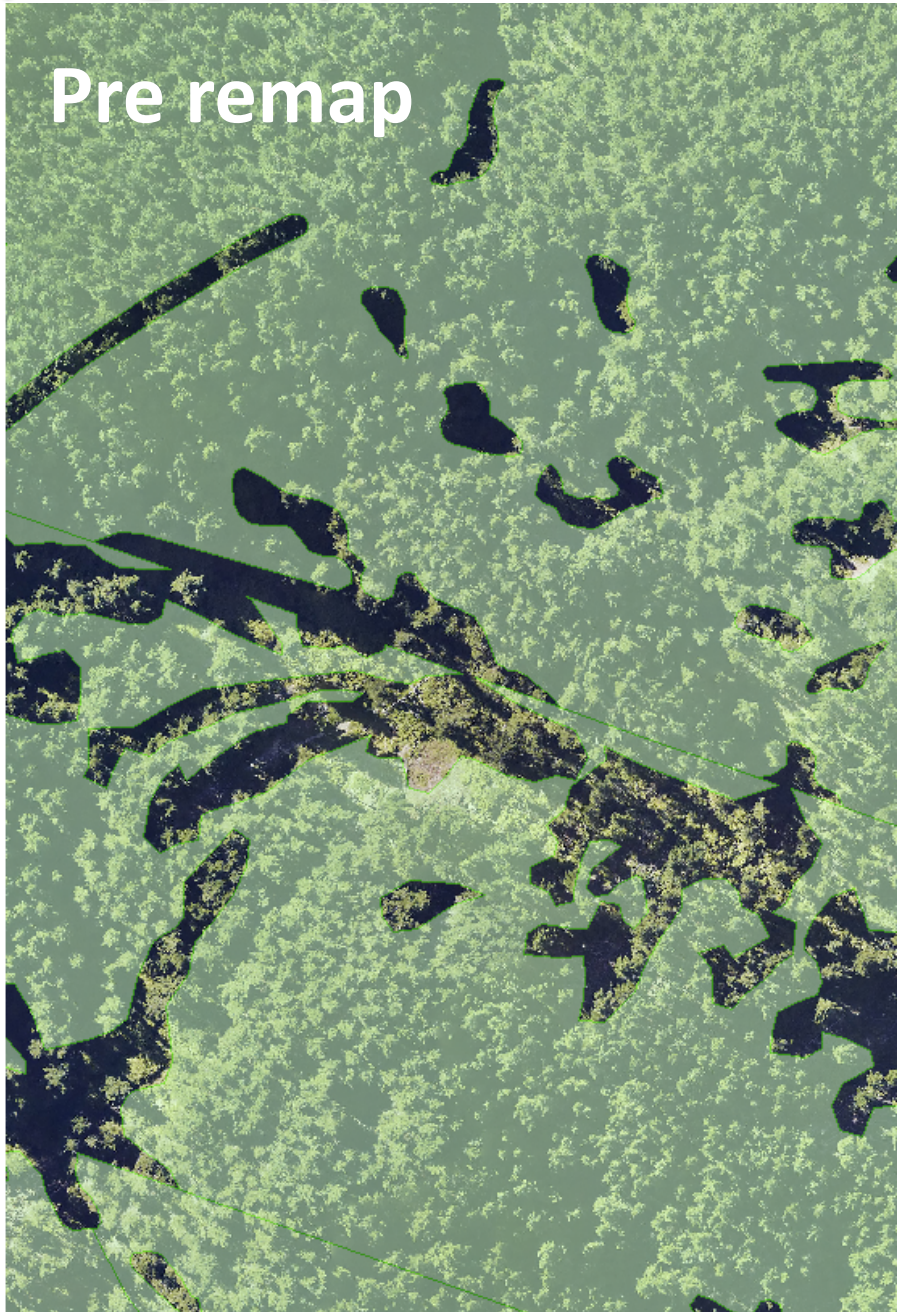
TRV comparison

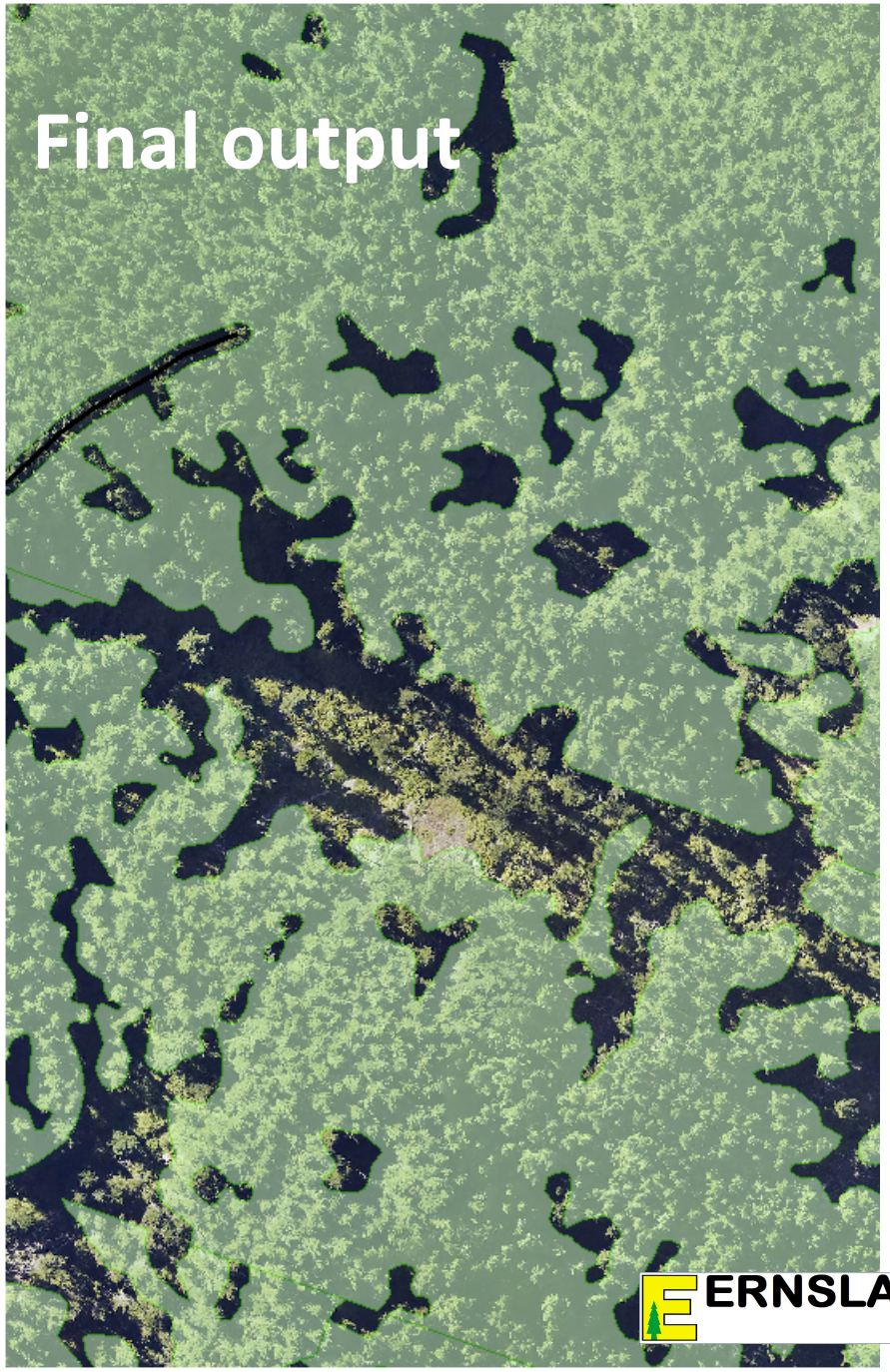


6 stands

24% difference

Mapping improvements





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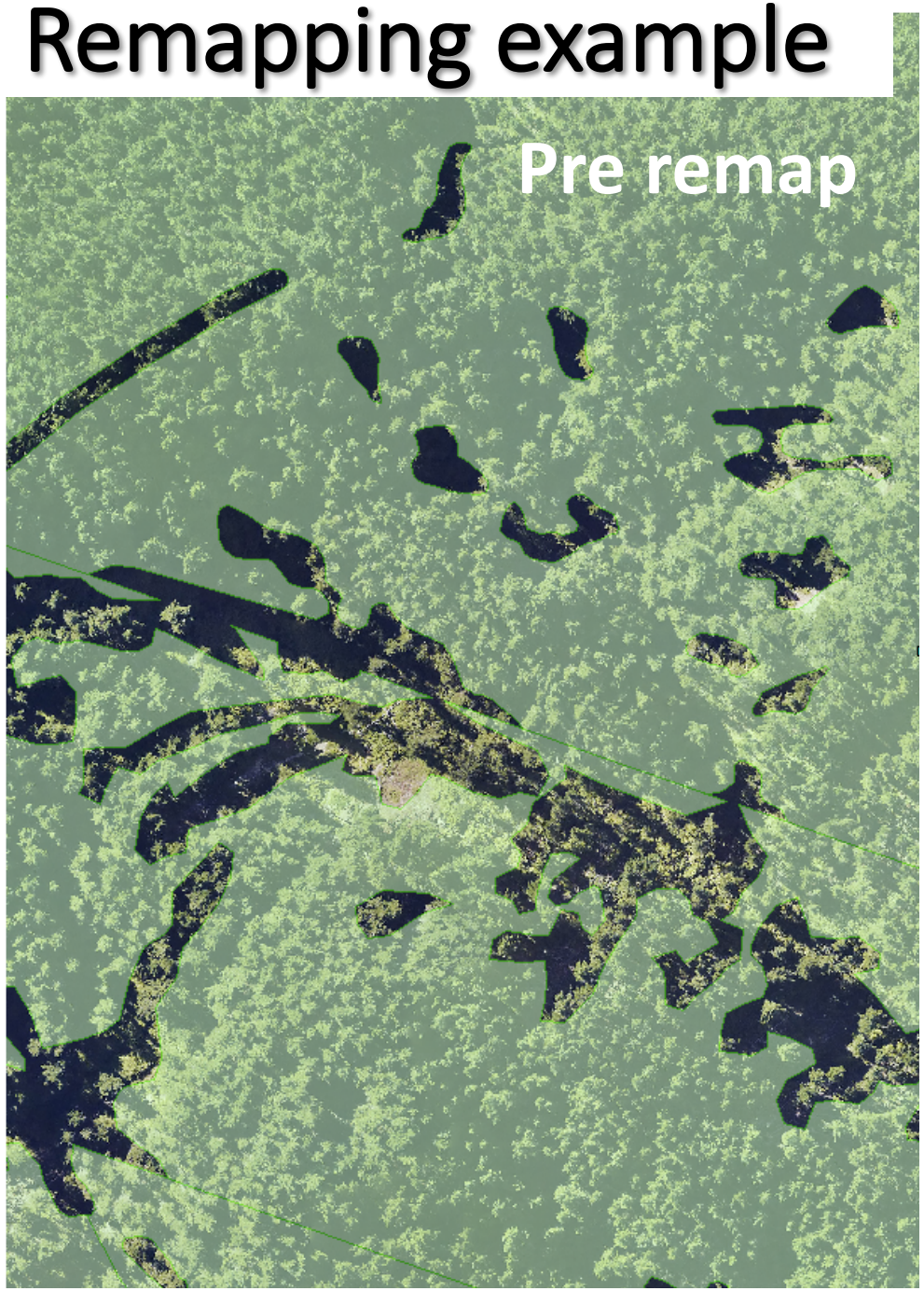
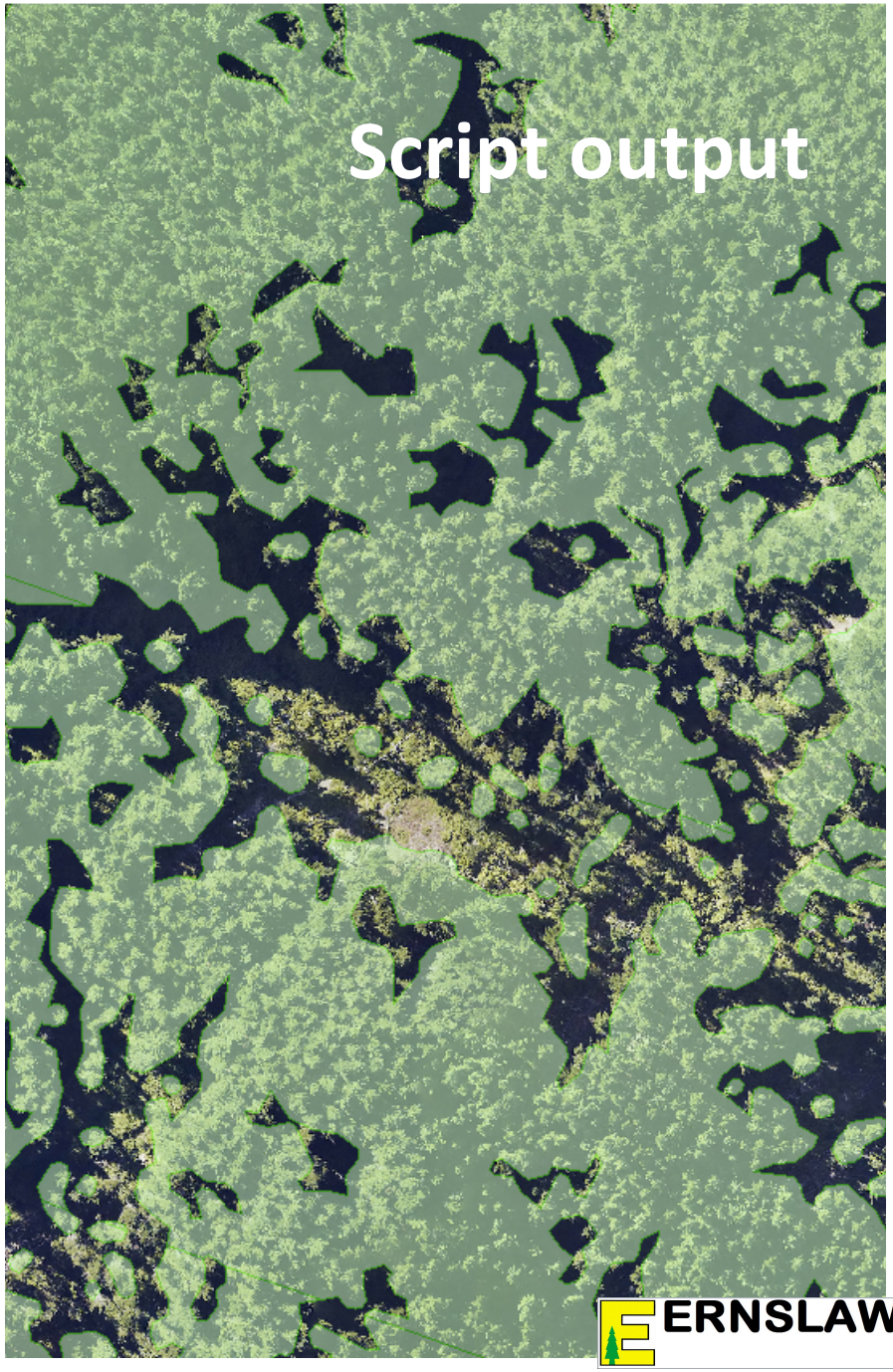
Remapping process

- nDSM
- extract raster of RGB values = likely tree crop
- Convert to polygon
- ‘tidy up’
- Integrate into GeoMaster

Remapping example





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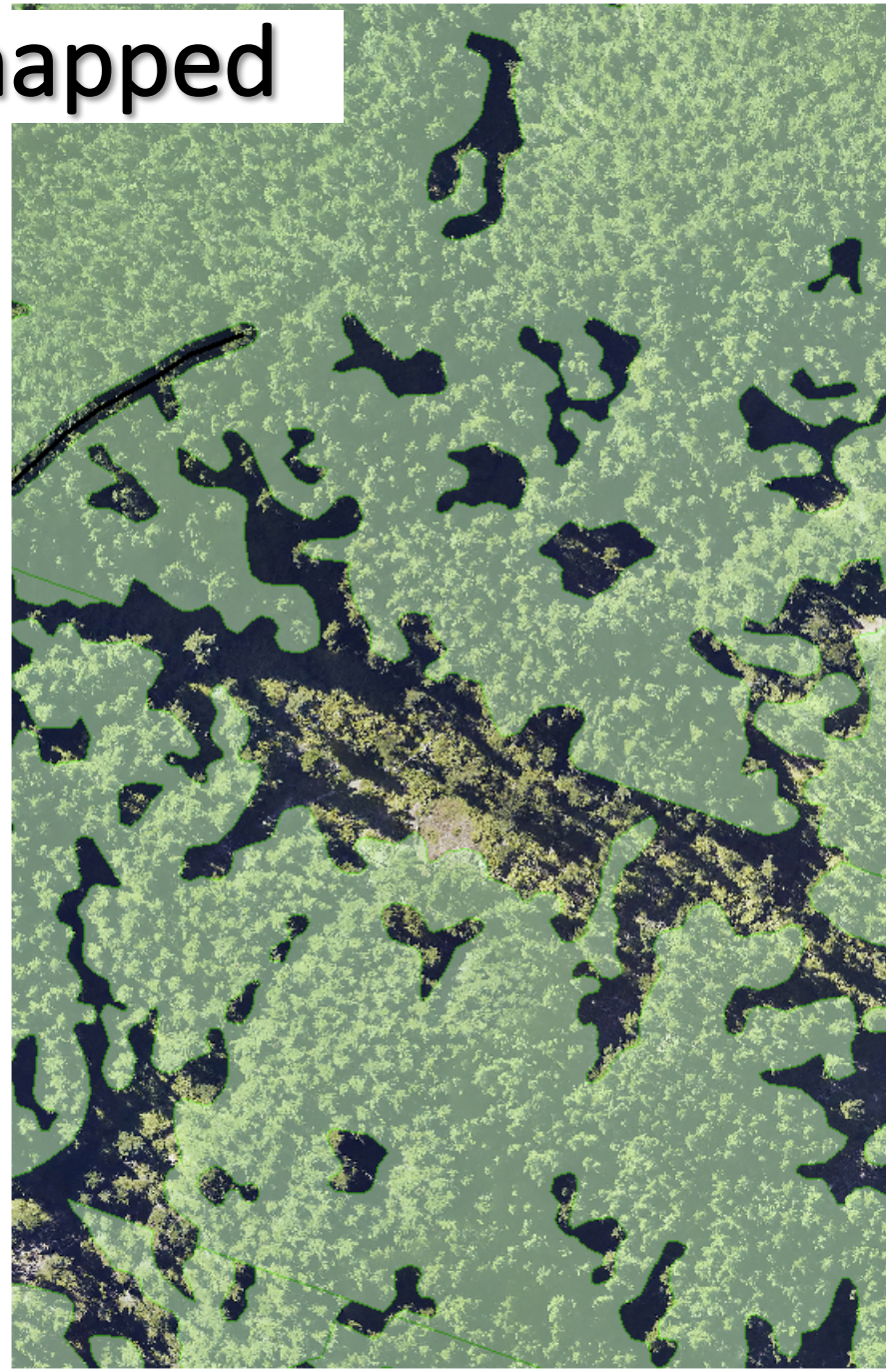
Remapped



CPT	Old area	Script area	New area	Change
275	41.46	35.52	37.17	-4.29
522	19.78	17.92	18.22	-1.56

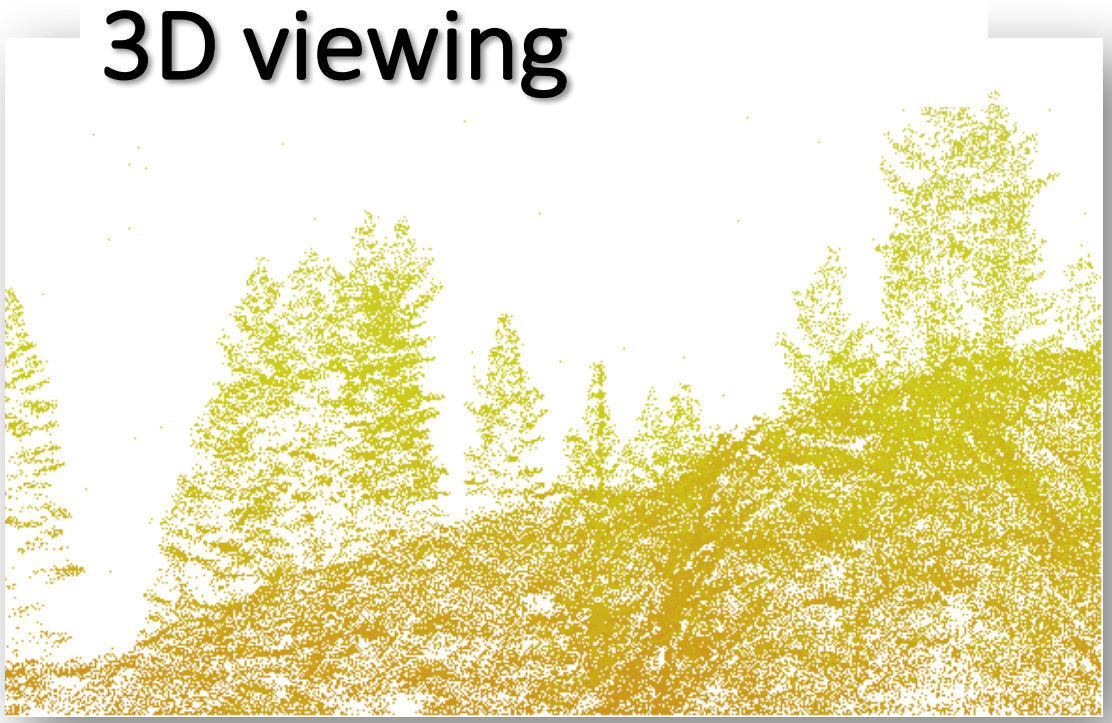
Improved stand boundaries

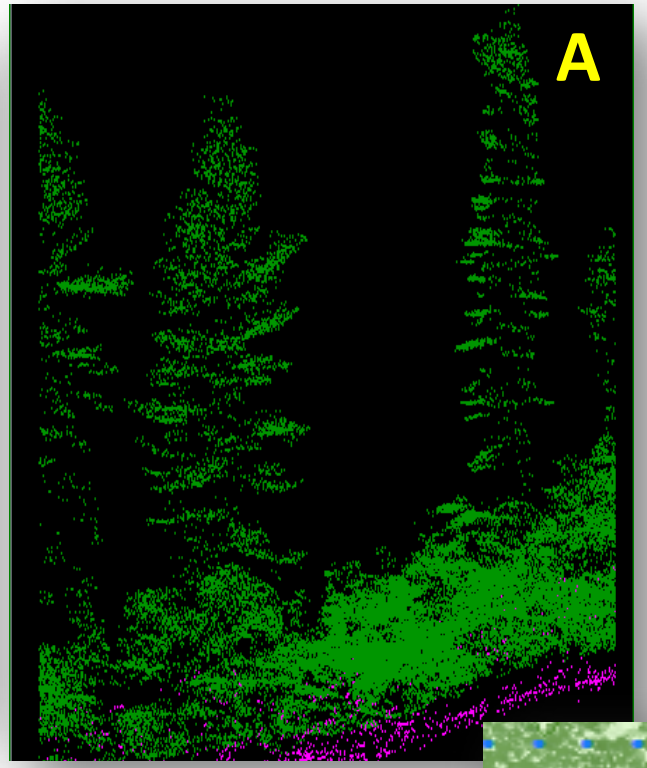
40hrs reduced to 12-14hrs

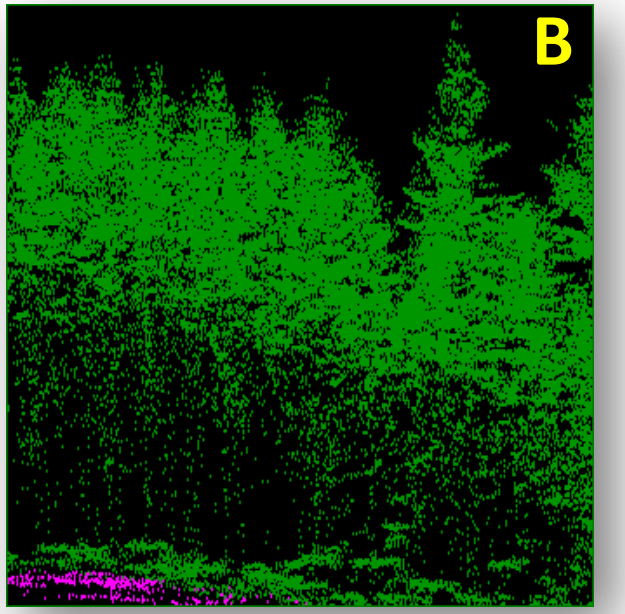
Less digitising

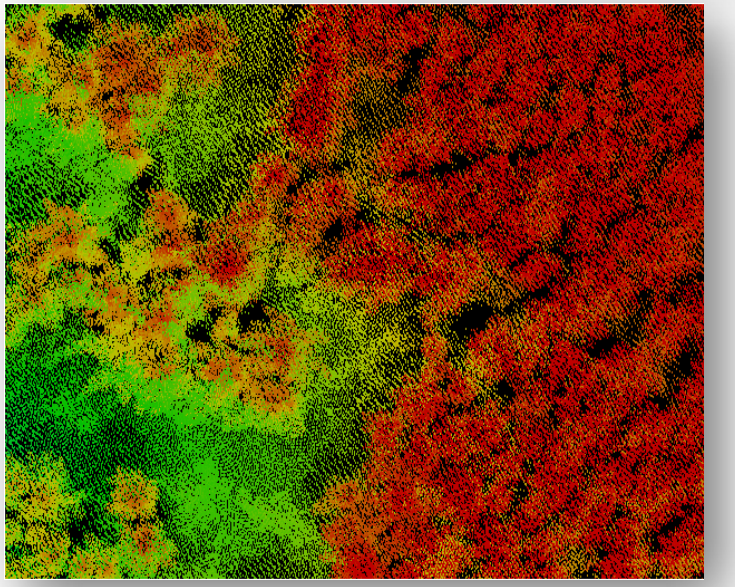
Happy GA

3D viewing

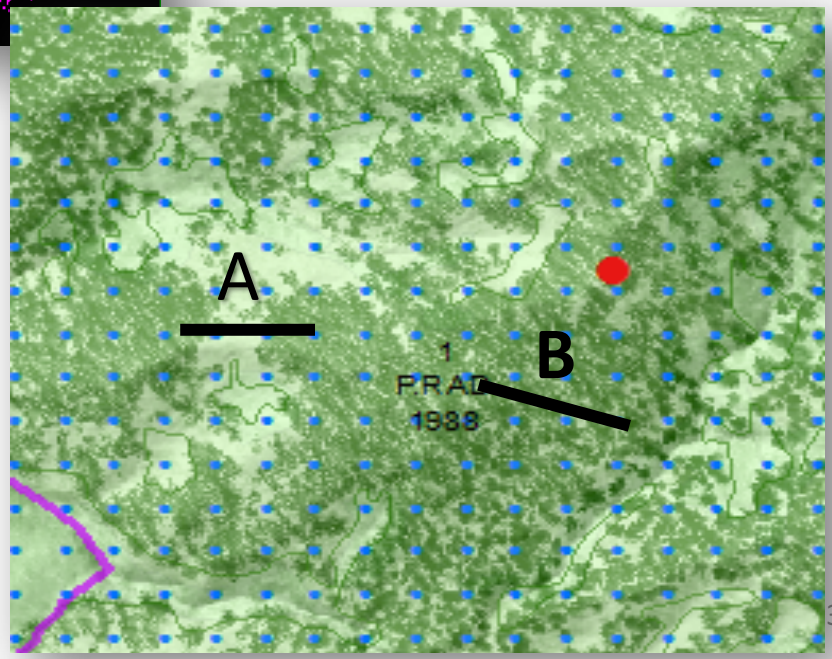




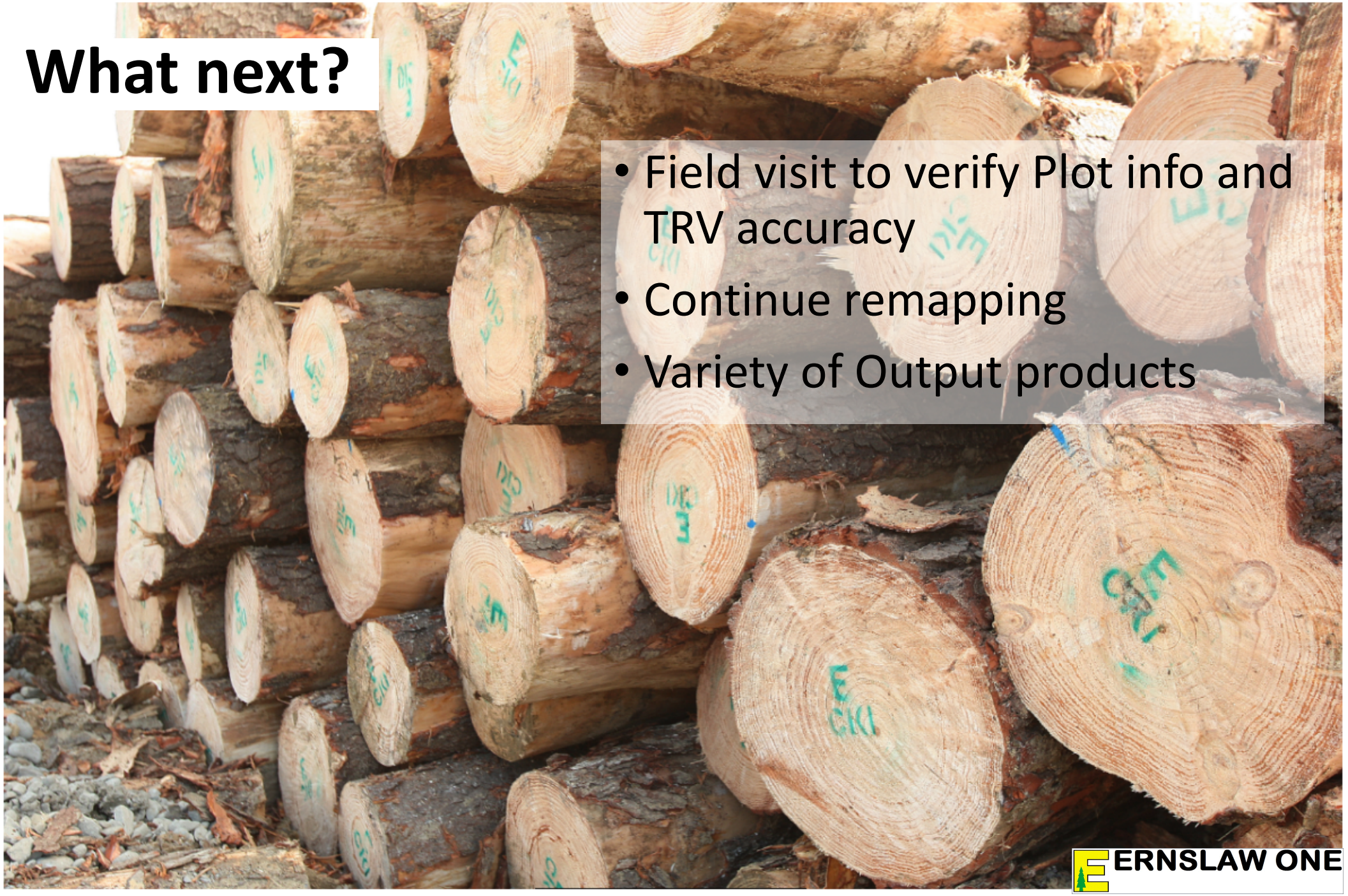




- Profiles, Variations in canopy
- LasTools, FugroView
- ArcPRO



What next?



- Field visit to verify Plot info and TRV accuracy
- Continue remapping
- Variety of Output products

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Acknowledgements

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QUESTIONS
Bev Taylor
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SITODEC
ON BOARD WEIGH SYSTEMS
PATCHELL TRAILERS
SITODEC
ON BOARD WEIGH SYSTEMS
PATCHELL TRAILERS

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