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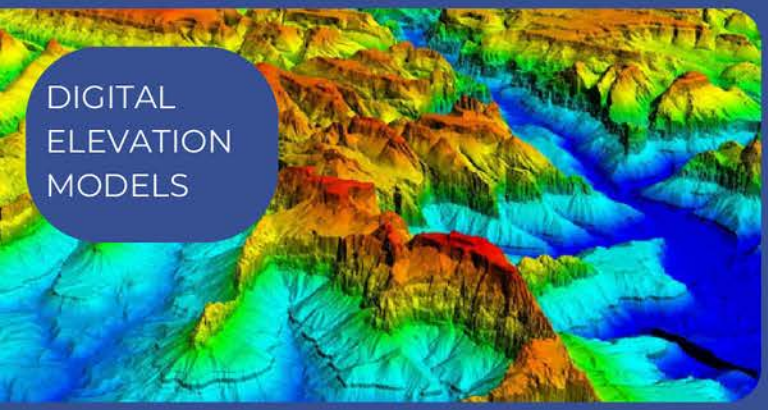
LiDAR in Horticulture

In horticulture, LiDAR is valuable for mapping landscape and topography, managing water catchment areas, and preventing soil erosion

what is LiDAR?

- Light detection and ranging (LiDAR) is a remote sensing method that uses lasers to measure distances and examine the earth's surface
- The reflections are recorded as millions of individual points that represent the 3D positions of objects including buildings, vegetation and ground
- The measurements are used to create 3D models and maps of objects and the environment
- Digital elevation models and digital surface models are the two main types of models used



Source: Ardavan Kamali, Precision Eco-Landscaping

digital representations of the earth's topographic surface

a 'bare earth' product because they do not include surface features such as buildings and vegetation

Source: Ralf Sembritzki, Hansa Luftbild

elevation models that capture the environment's natural and artificial features

they include the tops of buildings, trees, powerlines and other objects

types of LiDAR and their uses in horticulture

ON GROUND LiDAR

- leaf area index & canopy volume estimation
- weed, crop & soil estimation
- yield prediction

AERIAL LiDAR

- Landscape & topography
- Crop growth estimation
- Soil properties detection

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LiDAR in Horticulture

types of LiDAR and their uses in horticulture

ON GROUND LiDAR

- typically refers to LiDAR systems that are deployed on the ground
- these systems are stationary or mobile devices used to collect 3D data of the surrounding environment from a fixed or ground-based position

AERIAL LiDAR

- refers to LiDAR technology that is mounted on aerial platforms such as on planes, helicopters, drones or satellites
- these systems are used to capture high-resolution 3D data of large areas of the earth's surface

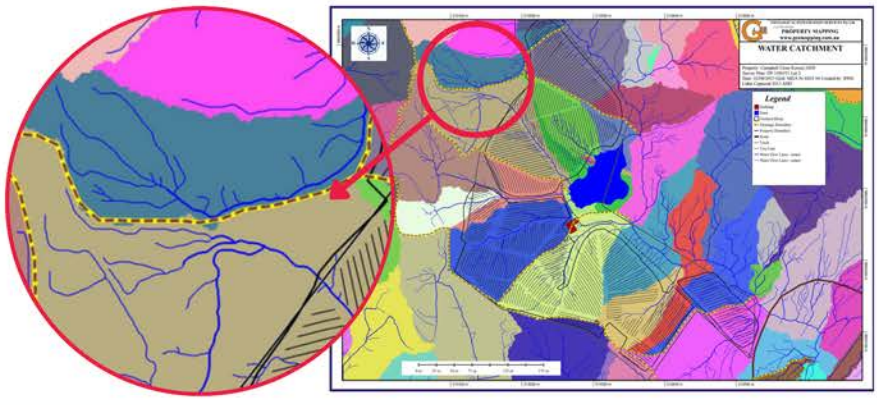
LiDAR's uses in horticulture: **landscape & topography**

WATER CATCHMENT AREAS

- aerial LiDAR and digital elevation models can be used to map sub-catchment areas on farms
- can show whether a water sub-catchment is on one property or if it occurs on adjoining properties
- can help show where most of the surface water is coming from
- can help with deciding where to have diversion banks and other water management strategies

a digital elevation model with different colours indicating the various sub-catchment areas located on a farm

the red circle highlights where a sub-catchment occurs on adjoining properties, and as a result, water incursion on one property could flow onto the neighbouring property



Source: Bob Howard, GES mapping

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LiDAR in Horticulture

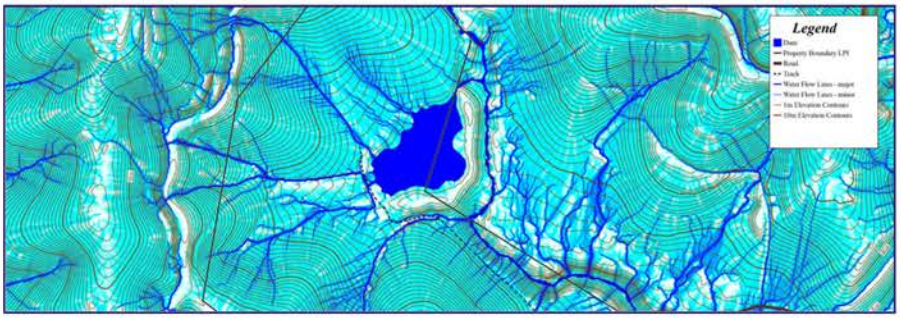
LiDAR's uses in horticulture: **landscape & topography**

SURFACE WATER FLOW

- aerial LiDAR and digital elevation models can be used to show areas of water flow throughout farms and orchards
- can be used to guide planting decisions to avoid planting in zones prone to water logging or high water flow

this digital elevation model shows water flow

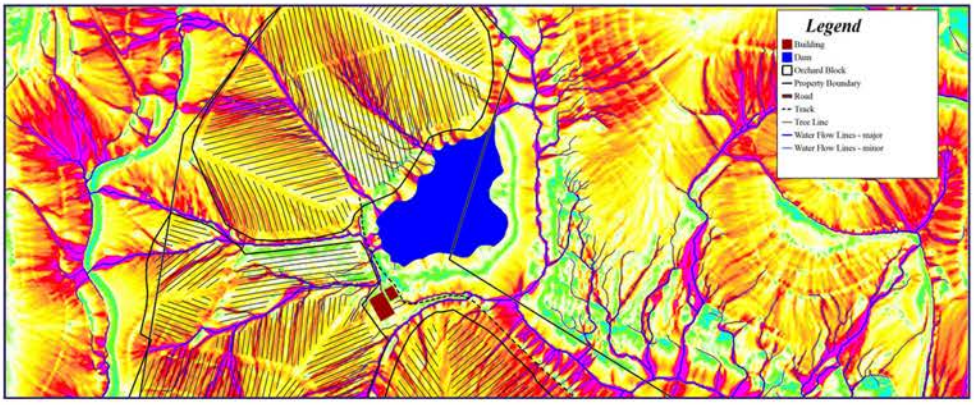
the dark blue lines indicate the areas of surface water flow on the property



Source: Bob Howard, GES mapping

EROSION POTENTIAL OF WATER FLOW

- the stream power index (SPI) is a measure of the erosive power of flowing water
- it is calculated based on the slope gradient and the contributing area
- SPI can be determined by digital elevation models and is used to help indicate where gullies might develop on farms



the red and deep pink areas are of concern because they highlight the areas of high risk

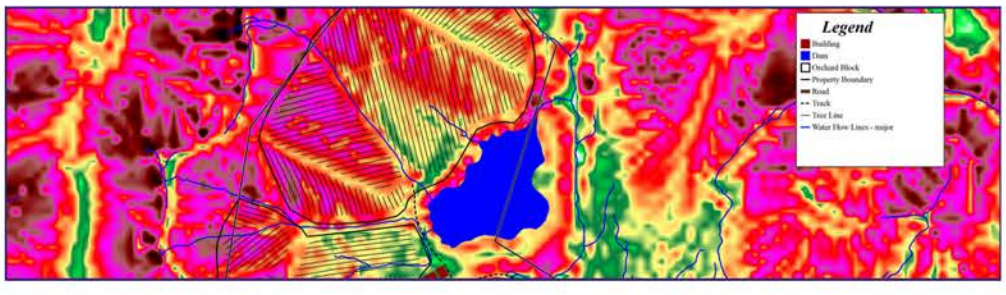
extra effort should be focused to avoid erosion, such as ensuring good ground coverage and, in certain cases, avoiding planting altogether

Source: Bob Howard, GES mapping

SOIL LOSS RISK

- can be used to measure the potential erosion of a site, taking into consideration both the slope length and steepness
- the model can determine which areas within blocks are a significant concern for erosion

the areas with pink and darkish red–brown indicate where there is high soil loss potential on the property



Source: Bob Howard, GES mapping

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LiDAR in Horticulture

LiDAR's uses in horticulture: **crop growth estimation**

CROP GROWTH ESTIMATION

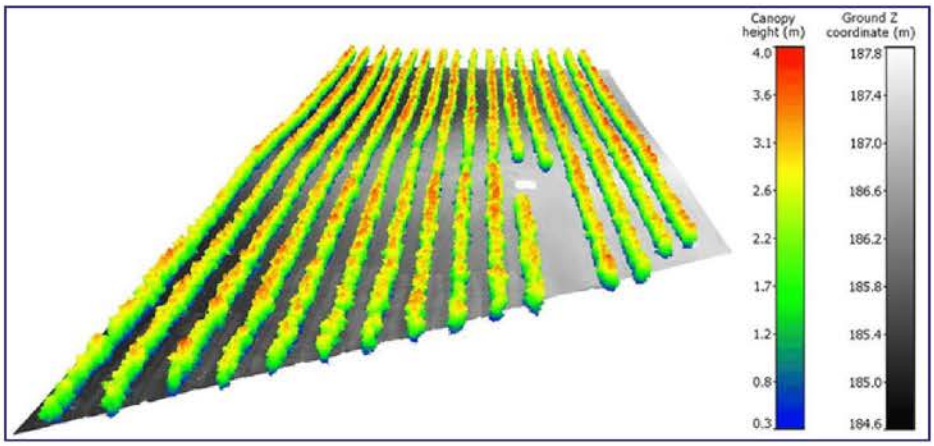
- depending on the chlorophyll content and amount of biomass a plant population reflects light to varying degrees
- in this way LiDAR enables crop height monitoring by providing detailed 3D maps of blocks or orchard
- it can help assess crop health, detect areas of stress or disease, and optimise irrigation and fertilisation strategies based on accurate data about plant height, density, and canopy structure

three-dimensional georeferenced point cloud of 1 ha olive orchard scanned in March 2014

colours in tree rows represent tree height

ground points are represented in grey scale according to their Z coordinate

Source: Escola et al. 2017



summary

- LiDAR (Light Detection and Ranging) is a remote sensing technology that uses laser light to measure distances and map the earth's surface in 3D
- this technology captures millions of individual reflection points to represent objects like buildings, vegetation, and the ground
- these measurements create two main types of models: digital elevation models (DEMs), which represent the earth's bare topographic surface, and digital surface models (DSMs), which include natural and artificial features
- aerial LiDAR is mounted on planes, drones, and satellites to capture large areas, while on-ground LiDAR systems collect detailed data from fixed or mobile ground-based positions
- in horticulture, LiDAR is valuable for mapping landscape and topography, managing water catchment areas, and preventing erosion
- DEMs can show sub-catchment areas and water flow on farms, aiding in the placement of diversion banks and other water management strategies
- LiDAR also calculates the Stream Power Index (SPI) to identify erosion-prone areas and assesses soil loss risk based on slope characteristics
- additionally, LiDAR enables crop growth estimation by providing detailed 3D maps of plant height, density, and canopy structure, which helps optimise irrigation, fertilisation, and detect areas of stress or disease

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NSW GOVERNMENT

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