# Drone-Based Phytoremediation Reconnaissance Using NDVI/NIR Multispectral Imagery at a Historical Waste Storage Landfill

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**Background/Objectives.** The health of approximately 500 hybrid poplar trees (*Populus deltoids x Populus nigra*) installed for leachate mitigation and water removal at a historical waste containment landfill was evaluated using a combination of drone aerial-reconnaissance and ground-based tree assessment techniques. Project objectives were to develop and implement a cost-effective approach to map the tree plot within approximately 2.5 acres (1 hectare) of land and to determine reasons for tree die-back and mortality.

**Approach/Activities.** The drone flight was accomplished on May 22, 2021, using a WingtraOne GEN II fixed wing VTOL aircraft. The drone payload consisted of a MicaSense RedEdge-M sensor array, equipped with red-edge/RGB/near-infrared (NIR) spectral sensitivity at 1280x960 sensor resolution. The red-edge spectral band was selected for its potential to resolve the sharp change in leaf reflectance between 680 and 750 nm and as a key wavelength in assessing leaf canopy health. The average density of data acquisition was approximately 0.01 points/US survey foot. Data were processed using Pix4D drone mapping software. Data were georeferenced to a local state plane coordinate system.

Reflectance maps of the terrain, trees and ground cover were generated for visual RGB, red-edge and NIR outputs. A Normalized Difference Vegetative Index (NDVI) map was also developed based on ratios of NIR to red wavelengths.

Based on a review of the drone mapping results, a field visit was performed focusing on individual tree health, including indicators for chlorosis, epinasty (leaf curling), twig dieback, bark sloughing, insect predation and bacterial and fungal lesions. Based up a combined review of drone imagery and field inspections, polygon classifications for tree health were assigned in a final tree health map.

**Results/Lessons Learned.** The visible RGB, NIR and red-edge drone-acquired imagery was helpful in quickly identifying healthy trees and canopy-chlorophyll signatures at sub-meter resolution. The NDVI data and resulting maps were less helpful in identifying stressed trees or evidence of tree morbidity and mortality. Ground-based reconnaissance is essential as a weight of evidence to confirm observations made from the aerial data acquisition.

Drone-based aerial reconnaissance is a cost-effective and alternative approach for quickly delineating and mapping stressed and damaged phytoremediation plots.