## From Exploration to Closure

Remote sensing tools and techniques are ideally suited for mining's early target generation since they produce accurate and detailed datasets, while reducing the need to deploy field personnel. Woolpert collects advanced thermal imagery, multispectral and hyperspectral data to support cost-effective techniques for ore mineral exploration. Woolpert Program Director Cecilia Hattingh said innovative image processing algorithms are integrated into these datasets to detect key materials associated with a variety of ore deposits, subsequent to acquisition of the data.

"The analysis of these deposits can be used for large-scale geological interpretation, leading not only to target generation but assisting in the discovery of additional resource leads," she said.

To accurately plan, design and construct a mine, precise baseline information must be acquired for the initial feasibility study. This information should include topographic elevation data, environmental factors, human settlements and activity, floodplain modeling and existing infrastructure. Woolpert employs satellite data, collects and processes topographic and bathymetric lidar data, and conducts terrestrial laser scanning. These are used to produce elevation models and mapping solutions with the needed survey-grade accuracy and assist in identifying access and infrastructure routes to pinpoint optimal mining locations.

"This data analysis can be exported into a georeferenced format that can not only be shared for easy dissemination of information," Unamaca said, "but can provide an environmental snapshot and eventual management plan for future rehabilitation and closure."

Once a mine is established and operations are underway, Woolpert uses periodic satellite-based imagery and radar as well as airborne lidar and thermal data for change detection, monitoring for environmental impact, tailings dam stability, security, construction progress, revegetation and infrastructure mapping. Unamaca added that the firm is currently developing a method for the condition monitoring of drainage pipes within the tailings.

When it comes time to rehabilitate and close a mine, remote sensing helps monitor the decommissioning of that site, reducing environmental damage while maximizing security. The continued imagery and data acquisitions build on the historical data collected throughout the life of the mine, enabling officials to view and compare the original site to the rehabilitated site and to outline the success of the environmental management plan and the stability of the environment moving forward. This analysis can also be utilized for subsistence monitoring.

"There is no question that geospatial technologies vastly improve the quality and effectiveness of planning, designing and constructing mines, and these tools and techniques are still evolving," Hattingh said. "Because of this, I am excited to see what the future holds for the mining industry in Zambia, in Africa and around the world."

# Woolpert, a 'One-Stop Geospatial Shop,' Comprehensively Supports Mining Industry

Geospatial technologies have become integral to the mining industry, improving accuracy, accelerating productivity, reducing operating costs and expanding location-based opportunities. Woolpert, a geospatial leader for more than 50 years, has accrued a portfolio of capabilities that supports mining around the world—with a laser focus on Africa.

Woolpert was founded in as an engineering and survey company in the U.S. in 1911. It has evolved to become an architecture, engineering, geospatial and strategic consulting firm, with more than 1,300 experts across multiple markets at 42 offices in three countries. The firm works with partners that include Esri, Planet, Airbus and Google.

In 2019, Woolpert acquired Southern Mapping, an international aerial survey and mapping company based in Johannesburg, South Africa, that specializes in lidar, hyperspectral imagery and remote sensing technologies. The firm has provided geospatial services in more than 40 countries in Africa, including Zambia, where it has provided lidar and imagery solutions since 2000.

Most recently, Woolpert has surveyed multiple mines along the Copperbelt that include the Kinsenda Copper Mine, owned by Metorex; the Kamoa Mine, owned by Ivanhoe; and Glencore's Mopani Mine. The firm utilizes high-resolution imagery, which is crucial for the full development cycle of the mineral resource industry, and satellite and lidar-derived elevation models that support the accurate planning, design and construction of mines.

"Woolpert is a one-stop geospatial shop, and this means we're able to provide the full range of data and technology solutions for mining around the world, from exploration to closure," Woolpert Program Director Credo Unamaca said.

"We support multiple markets and services, as well—from water to power to transportation to elevation mapping—which enables us to devise and leverage additional, supportive solutions from industries like engineering and survey to provide added value to our mining clients."