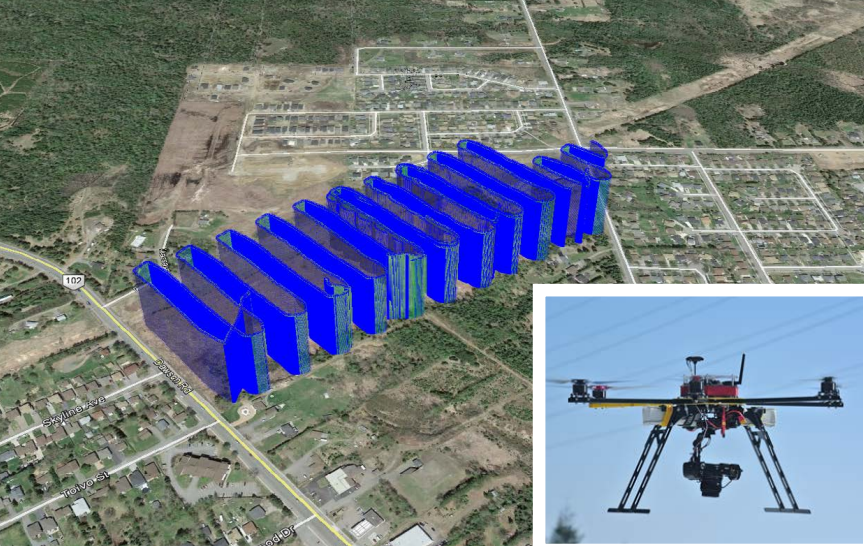

Sumac Geomatics Uncovers Deep Insights with Drones and ArcGIS

The Canadian Shield is truly unique. It's a geological wonder covering approximately 5 million km^2 that features the Earth's oldest rocks. The Shield is teeming with resources—beautiful waterways, sprawling coniferous forests, mineral treasures such as gold, silver and copper—to name but a few.

But if you've ever attempted to build anything ambitious on the Shield's thin soils and surface level rocks, you also know that it can make or break a planned development.

Wenscott Developments is currently developing 14 hectares of raw land in Thunder Bay—a northwestern Ontario city located on the Canadian Shield—into a residential neighbourhood. Before conducting a subsurface investigation, Wenscott knew they would encounter challenges based on site characteristics and prior experience building in the region. They just weren't sure exactly what to expect.

"We knew we had bedrock issues near the surface of the property, but we needed to determine the extent," said Mike Hannusch, Partner, Wenscott Developments. "We wanted to maximize our efficiencies in our approach to laying out the property and determining the best orientation of our infrastructure."

Developing land with bedrock near the soil surface meant that Wenscott would need to use techniques such as blasting or cut and fill, which would add time and costs to the project. Planners wanted to understand exactly where bedrock formations could be found underground to minimize the use of these techniques. This led Wenscott to reach out to Sumac Geomatics in the fall of 2014 to conduct a topographic survey that would complement a geotechnical investigation to determine subsurface soil and rock conditions.

Sumac, a local firm that specializes in geospatial data acquisition and solutions, recognized that Wenscott needed an in-depth analysis of the property that a traditional topographic survey simply couldn't provide.

"Normally they would carry out their own GPS survey that would involve a crew of two people picking up elevations on a 20 metre x 20 metre grid," said Adam Boczek, GIS/Geomatics Manager, Sumac Geomatics. "Using this methodology they would gather x, y, z coordinates but the resulting DEM (Digital Elevation Model) would be relatively coarse, missing variations in elevation between the sample points."

The timing was perfect for Sumac to apply the research and testing it had recently invested into Unmanned Aerial Vehicle (UAV) technology. Sumac had been planning to build on its solid reputation in photogrammetry—the science of making measurements from photographs—by expanding its capabilities to include topographic surveying using a combination of ArcGIS and UAV.

"Based on the R & D and testing we'd done already, we knew that a UAV remote sensing solution would be the best method to provide Wenscott with the 3D data they needed," said Mr. Boczek."Our goal was to create the most detailed, comprehensive dataset possible and integrate it into a suite of maps so they could address the development concerns."

To deliver this, Sumac wanted to ensure they collected as much data as possible. They approached the environmental services and engineering firm hired to conduct the geotechnical survey, LTL Group, with an idea that would improve imagery accuracy and save Wenscott costs.

"We worked with LTL to distribute 14 ground targets—basically 11" x 17" markers with numbers and crosshairs—on the site while they were surveying," said Mr. Boczek. "This allowed us to incorporate our GCP targets into their existing survey plans, streamlining the process and saving them some budget."

Added to the geotechnical survey locations on the site, this gave Sumac a total of 56 targets. With the ground control in place, Sumac flew the site in December of 2014 using one of the company's in-house UAVs. The hexagon-shaped helicopter measuring 80 cm in diameter was chosen because it gives the operator finer control and handling than a fixed wing UAV—an important feature because the UAV was restricted to fly within the property boundaries.

In one day, Sumac collected over 2,000 GPS-tagged images, capturing a large degree of overlap between images to ensure accuracy and high resolution. With the data collected, the next step was processing the imagery and delivering it as information products that Wenscott could use for analysis and decision making.

"We find there are a lot of problems that businesses have that are best solved using a combination of remote sensing and a spatial solution such as ArcGIS."

Adam Boczek
Sumac Geomatics

Using a technique called pixel autocorrelation, Sumac leveraged photogrammetric software to create a point cloud density of 4 cm. The absolute accuracy of the dataset Sumac created was 5 - 10 cm in the x, y, z axis. This level of accuracy was due to Sumac's highly detailed ground control, which exceeded industry standards, as well as a combination of other factors, including the acquisition parameters and a rigorous aerial triangulation methodology. Sumac used 20 computers and a technique called cluster processing to efficiently process and turn around the data within a few days.

Next, Sumac conducted a point cloud classification to remove non-surface points (e.g. tree stumps and vehicles) and produced a Digital Terrain Model (DTM)—a topographic model of the bare earth. Sumac then brought the rasterized DTM based on the dense point cloud into ArcGIS for mapping and analysis. The go-to solution for Mr. Boczek and his team of 19 certified photogrammeterists to integrate imagery into a GIS is the raster mosaic dataset function available in **ArcGIS for Desktop**. The raster mosaic dataset allows you to store, manage, view and query small to vast collections of raster and image data, allowing you to perform tasks more efficiently.

"It's one of the best things that Esri has ever created," said Mr. Boczek. "14 hectares at 1 centimetre is a hefty dataset and to bring that in as a single layer isn't practical. Other solutions struggle to process it. But with the ArcGIS raster mosaic dataset, I can tile up the data so I have manageable images. It allows me to pan in and out live—there's no delay."

By harnessing these innovative tools, data processing techniques and streamlined workflows, Sumac created five maps that integrated imagery data and Wenscott's site plans in just one week. Three of the maps—orthographic, contour and an elevation/contour—comprised the original project deliverables. The two additional maps were provided as a value-add based on Wenscott's needs.

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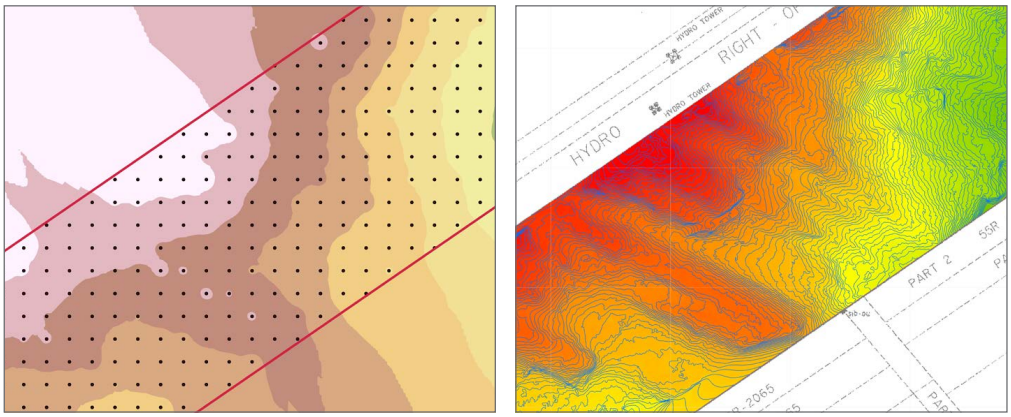
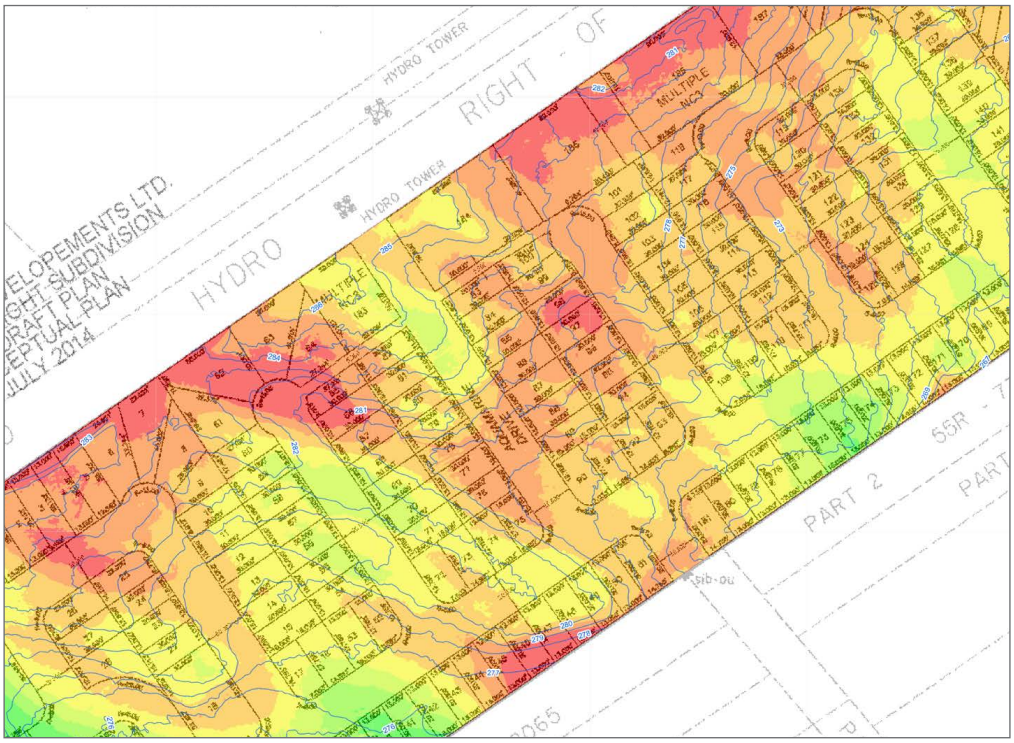
Integrating the imagery data with the rich geotechnical data LTL Group collected, Sumac used **ArcGIS Spatial Analyst** to create a predictive depth to bedrock layer that was overlaid with Wenscott's site plans (lots, legal survey, roads, storm water basins, etc.). Sumac also ran the surface model through the hydrological tools in ArcGIS for Desktop, allowing them to delineate the watersheds on the site and show how water was flowing.



A traditional topographic survey (left) compared to Sumac's enhanced topographic survey (right), which combined the use of UAV aerial imagery acquisition and ArcGIS to provide greater detail and accuracy.



Combining aerial imagery, geotechnical survey data and site pans, Sumac leveraged tools in ArcGIS for Desktop to create a predictive bedrock map that gave Wenscott the necessary insights for site planning.

Mr. Boczek delivered the maps and datasets to Wenscott's offices in person, where something unexpected happened.

"The initial meeting quickly grew from one person to a half a dozen," recalled Mr. Boczek. "It triggered this spontaneous, organic brainstorming session. The maps helped them realize that they didn't have the road and infrastructure going through the best areas. As a result, they changed the main access point of the entire site to the south boundary. On top of that, the hydrological analysis identified where the water was flowing, so they decided to realign the main infrastructure for their storm water along the south boundary, too."

In the end, the way that Sumac mashed up the information in maps made it possible for Wenscott to make the data actionable.

"The information obtained and integrated into maps by Sumac was invaluable as we were able to identify surficial bedrock topography, which allowed us to develop our subdivision around the bedrock," said Mr. Hannusch.

In essence, UAV and ArcGIS visualized the unexpected so Wenscott could plan now, rather than be surprised later. And, if you're developing on the Canadian Shield, that's a very good thing.