CASE STUDY

Cold region clean-up – using UAVs to document contaminated sites in the High Arctic

When BluMetric Environmental was contracted to perform environmental assessments in the Canadian territory of Nunavut it faced a challenge in the form of low-quality topographic maps of the region. The solution: employ a senseFly eBee drone to produce the high-resolution, high-accuracy digital terrain models the team required.

Nunavut is Canada's most northern and least populated territory, comprising most of the Canadian Arctic Archipelago. It is also a region that includes industrial activity, resulting in areas of hydrocarbon contamination, many of which have long since ceased operations.

Looking to reduce the impact of this contamination on the region's ecosystem, in the summer of 2015 the federal government contracted consultants BluMetric Environmental Inc. to assess and document several sites of suspected contamination.

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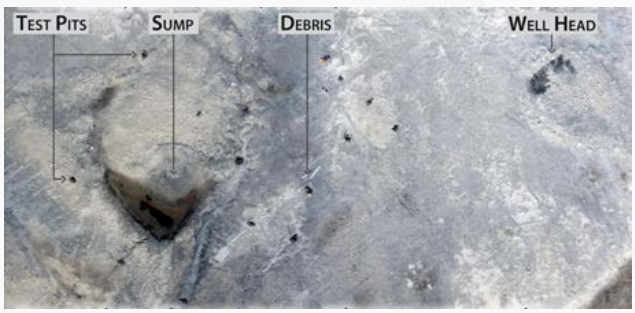
"The relevant federal department has released tenders for various levels of site inspection in Nunavut in recent years," explains BluMetric's geomatics manager Yannick Lanthier. "This project is currently in the advanced assessment phase three, focused specifically on six High Arctic sites."

These were sites of oil exploration sites back in the 1970s. "Most of the problem is hydrocarbon contamination, for example, from diesel storage at the exploration camps," Lanthier says.

Measuring the mess

The job of Lanthier's team, operating out of the Eureka Weather station and at Rae Point on Melville Island, was to spend a significant number of man hours sampling and fully characterising each site. "Our environmental engineers had to quantify what was contaminated and calculate the exact volumes of each contamination zone, before reporting back with estimates on how much it would cost to clean up these areas should the government choose to move to remediation," he says.



A drone-produced orthomosaic of an old exploration site, featuring a test pit, well head, sump and debris.

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Cost-effective data capture

Where BlueMetric's eBee mapping drone came into play was in aerially surveying the six sites.

"We have used the eBee since it was launched in 2012 when we were looking for a full, one-package deal that included a safe, easy-to-use UAV and software," Lanthier states. "We wanted a 99% automated tool to reduce the chance of user error. We have since purchased a second eBee due to demand from the aggregate sector continuing to increase."

In Nunavut the team used an eBee to capture the high-resolution, georeferenced images it required. These shots were then imported into Pix4Dmapper software for processing to generate high-accuracy, high resolution digital terrain models of the six sites. It was these models that BluMetric's team analysed to work out where to conduct its soil and ground water sampling.

> "Satellite images would have been significantly lower resolution than the drone's photos. Plus, they would have been very expensive."

Why use a UAV and not existing topographic maps or alternative data sources? "The topos available of the area, at 1:50,000, are not at all precise enough for the work required," Lanthier says. "Satellite imagery might have been an option for creating our models, but these images would still been significantly lower resolution than the drone's photos, maybe 50 centimetres per pixel compared to the four centimetres we achieved with the eBee. Plus, they would have been very expensive, at around 2,000 US dollars each and we still wouldn't have detailed topography. So it made more sense to check the drone with our luggage and collect our own aerial data, since we had to go on site to survey the sampled locations with the environmental team."

An additional factor that suited aerial photogrammetric surveying, as opposed to remote sensing with LIDAR say, was the terrain.

"In the High Arctic, while the weather can be challenging in terms of fog and wind, the topography itself is very open. You don't have trees or heavy vegetation, which means when you process your imagery you are creating a true terrain model, not merely a digital surface model," Lanthier adds.

Alongside its mapping drone, Lanthier's staff also used an RTK GPS to control the models it created, employing white reusable markers as ground control points to achieve an absolutely digital model accuracy of down to 1-2 cm.

"During our 6 week assessment trip, the biggest site we flew was Rae Point. This took three UAV flights to cover its eight square kilometres and over the six weeks we flew 12 flights in total," says Lanthier. In order to achieve the project's 4 cm/pixel GSD, Lanthier's geomatics team flew the eBee with its RGB payload at a height of 120 metres.

Yannick Lanthier of BluMetric Environmental Inc. with the project's two surveying instruments: a senseFly eBee drone and an RTK GPS.

Putting the data to work

Having created six drone-sourced digital terrain models, BluMetric then employed these outputs to guide its sampling.

"For example, we might use a DEM to perform a surface flow analysis, in order to model where diesel oil would have flowed had there had been spillage from a drum," Lanthier explains.

"The key benefit of the UAV was definitely the ability to capture high-resolution imagery over the vast site area and to be able to carefully review the resulting orthomosaic on the screen to find extended contaminated zones," Lanthier concludes. "Being in the Arctic, even some impacted soil from the 1970's will still show a scar, such as weak or no vegetation and/or disturbed native materials. We can't walk the entire eight square kilometres to find every source of contamination, nor fly the crew over the area in a helicopter as this would be more expensive on fuel. Using the ortho, we were successfully able to locate other minor impacted soil and could concentrate our efforts on investigating these areas very cost effectively."

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At the request of the Eureka station's researchers, BluMetric also flew that site, providing staff there with an A0-sized orthophoto of the site and a second same-sized contour version. These maps will be displayed on-site and used for future PR and publicity purposes.

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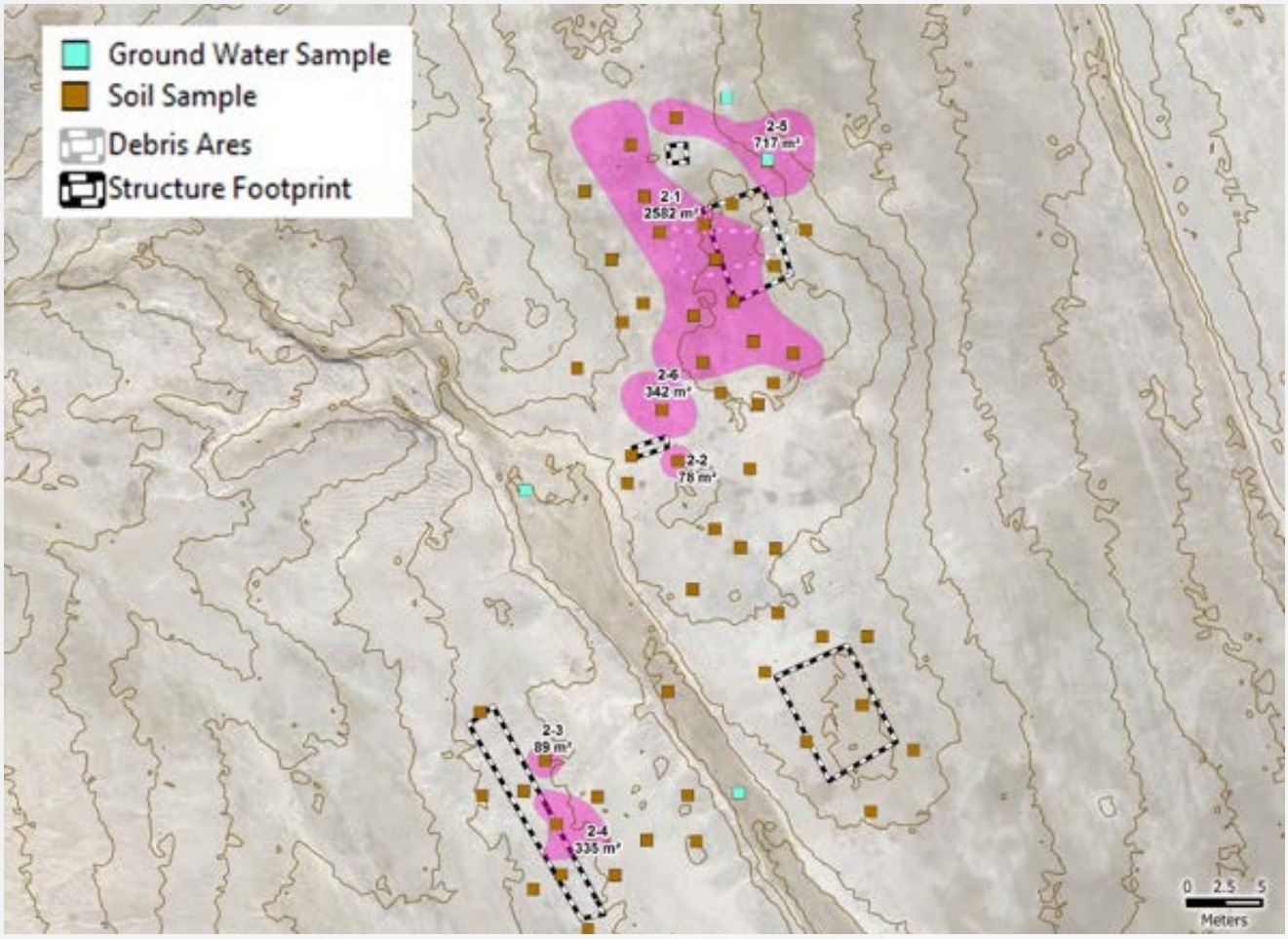
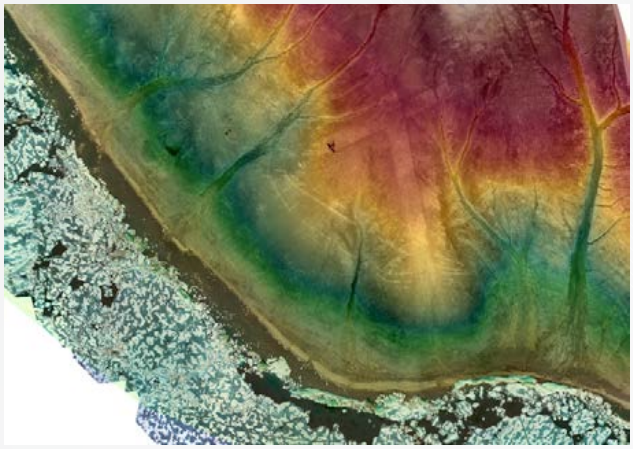


A BluMetric map of one small part of a site showing contaminated zones in pink, with sampling points, structures and a debris zone also notated.



A digital elevation model of a contaminated exploration site on a Nunavut island, layered on top of the team's orthophoto of the site. "We can see the site features old runways that were used by the exploration companies back in the 1970's, major drainage paths/ rivers, the contaminated site to the West and the impressive ice barrier along the coast," Lanthier explains.

The contoured orthomosaic that BluMetric supplied to staff at the Eureka Weather station.

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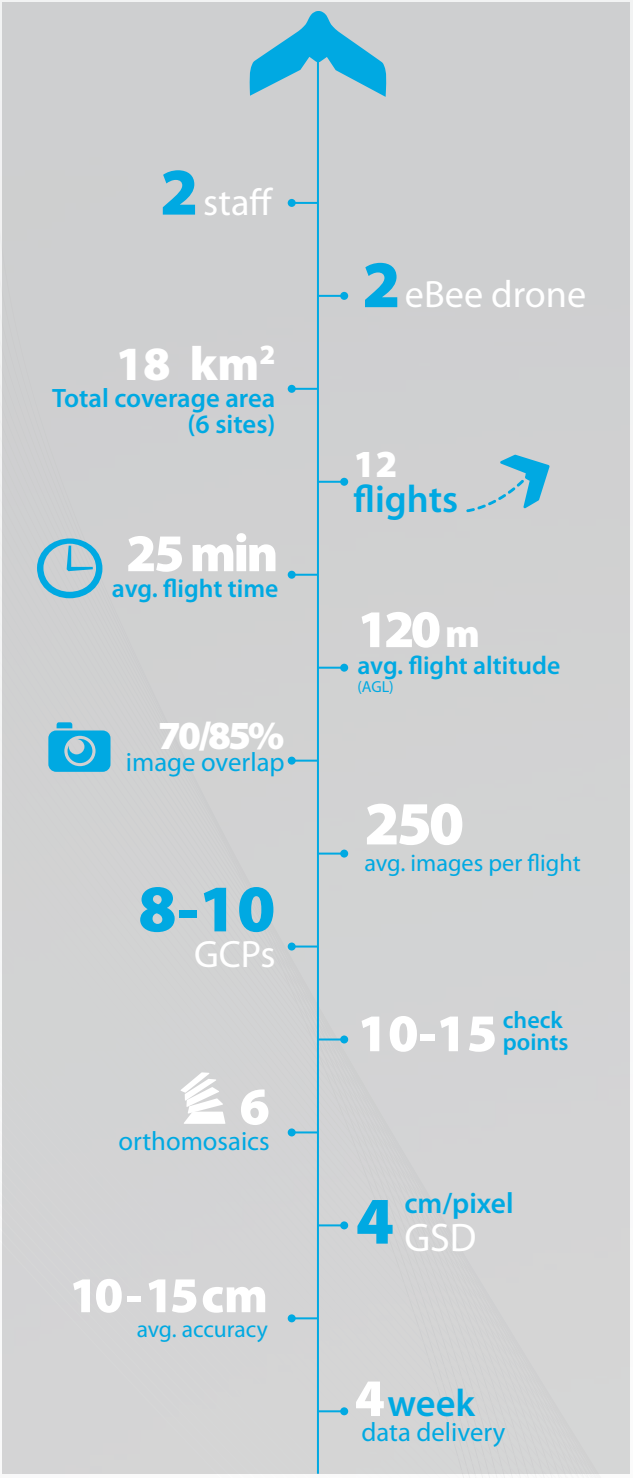
About BluMetric Environmental Inc.

BluMetric Environmental Inc. is a diverse water, earth, and energy company providing solution-oriented consultation, design, products, and construction services to clients with complex environmental issues in more than 60 countries. With its award-winning team of industry experts and technology, BluMetric provides the finest effective and sustainable solutions to environmental challenges. BluMetric is a publicly traded Canadian company (TSX-V: BLM), headquartered in Ottawa, Ontario.

PROJECT STATISTICS



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