



Celebrating excellence in the field of geomatics in Canada



CELEBRATING EXCELLENCE IN SURVEYING

The David Thompson National Geomatics Awards

Why National Awards?

1. Promote excellence in Geomatics
2. Promote unique cadastral and non cadastral applications
3. Raise public awareness of Geomatics

Deadline for submission: March 1st, 2023.

All 2023 submissions were challenging non-cadastral survey projects.

Candidates this year consisted of:

- Dan Boyle, Underhill
- Jeff Adair, GeoVerra
- Rob Yates, McElhanney
- Ryan Schuler, Underhill
- Sandy Cooke, Underhill

The 2023 David Thompson Award was granted to **Rob Yates**, Congratulations Rob!

Mapping the Unknown: Autonomous LiDAR Drone Tunnel Inspection of the Rio Tinto Tailrace

Deep inside the base of Mt Dubose, in the giant Kitimat Ranges of BC's northwest coast, is the Kemano hydroelectric generation station. Since 1954, this facility has been producing power 24/7 for the Rio Tinto aluminium smelter, and today is the fifth largest power producer in BC. In the cavern are eight massive, high-voltage generators and turbines from which a 475m-long, 8m-wide, "tailrace" tunnel carries the station's outflow water to the Kemano River. This tunnel has also been in operation for 24/7 for 70 years, always half-full of rapidly moving water, and it required a detailed condition assessment. Rio Tinto had long waited for a tailrace assessment for pre-emptive maintenance. They were concerned about rock fall, erosion, and other issues that could affect the water flow. In 2022, Rio Tinto hired McElhanney to assist with the assessment. They needed a full picture of the interior and shutting down the tunnel to do the survey was not an option.

McElhanney's Rob Yates, BCLS, and Marcell Iseli, BTech, discussed manned and remote bathymetric options, but the tunnel shape (with a bend), length, water velocity, and turbulences made surface and underwater inspections unsafe and difficult to plan. They assessed aerial options; a drone could be attached with a LiDAR sensor and thermal camera, but the long, cavernous path made GPS and radio communication impossible. With Rio Tinto's support, the remaining and selected option would be an autonomous drone to fly out of sight, on its own, into the dark, half-kilometre-long tunnel of rushing water to collect the data.

The team chose a DJI Matrice 300 unmanned aerial vehicle (UAV) with Hovermap, a high-resolution light detection and ranging (LiDAR), video, and motion unit with an autonomous navigation system that uses



simultaneous localisation and mapping (SLAM) technology. The unit was equipped with Autonomy Level 2 (AL2) software so it could fly beyond line-of-sight and communication range within GPS-denied environments.

The team planned meticulously for the risks, including curious local bears, spraying water that could damage the electronics and spoil the dataset, the only viable pilot position being 200m downstream, low-hanging trees covering the entrance, and, over the flight path, a 300KV transmission line whose electromagnetic output could interfere with the drone's internal compass. The mitigation plan included: a lockable bear-proof footbridge for the operator; retrieval nets; careful flight planning to avoid all obstacles; and disabling the global navigation satellite system (GNSS) to avoid powerline interference on the approach.

The team set up the \$200K system with floats and sent it on short test flights into the tunnel, increasing the distance each flight. The unit returned safe and dry each time. They switched on AL2 mode and sent it on its mission. Using SLAM to guide itself while capturing data, the drone made many flights, returning each time with new datasets, and reached the generators at the far end, returning more data than planned. Using precise control points and proprietary software, our team created a point cloud, 3D model, and video fly-through for Rio Tinto to experience a full picture assessment of the interior. (Watch video: <https://vimeo.com/802077359>.)

The project was a success. The client touted on their intranet that the team's pre-planning and expertise, along with Rio Tinto's operations, contributed to the successful outcome. Andrew Czornohalan, Director – Power & Projects, BC Works from Rio Tinto said, "This is a good example of mitigating critical risk using latest technology, and not putting our people in harm's way." Rio Tinto and McElhanney are ecstatic to have used this environmentally friendly and advanced technology to collect crucial data. The project did not negatively impact the provincial and local economies (which would have happened if there was shutdown) and the safety of the team was not put at risk (if a manned option was used for the inspection).

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Mapping the Unknown: Autonomous LIDAR Drone Tunnel Inspection of the Rio Tinto Tailrace

- 1 DJI Matrice 300 Unmanned Aerial Vehicle (UAV) with Hovermap technology.
- 2 Flight path to the tunnel entrance.
- 3 UAV entering the tailrace tunnel after successfully navigating approach obstacles.
- 4 UAV's pointcloud of tailrace entrance.
- 5 3D model showing condition of extruded rock and concrete support.
- 6 3D model of the tailrace tunnel showing the exposed rock and concrete sections.

 Follow this link to to experience the technology for yourself.
<https://vimeo.com/802077359>

 **McElhanney**