



Yukon-2023 Poison Lake

LiDAR and Airphoto Data Capture and Processing

LiDAR and Air Photo Report

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1. Introduction

McElhanney Ltd (MCSL) performed a LiDAR and aerial photography acquisition for Poison Lake shown in Figure 1.

The site was flown on August 28th, 2023. This report describes the acquisition, post-processing and quality control methodology used to produce the final elevation models.

2. Mission Plan

Project: Poison Lake

Date: 2023-08-28

Location: Poison Lake, YT

Topography: low relief

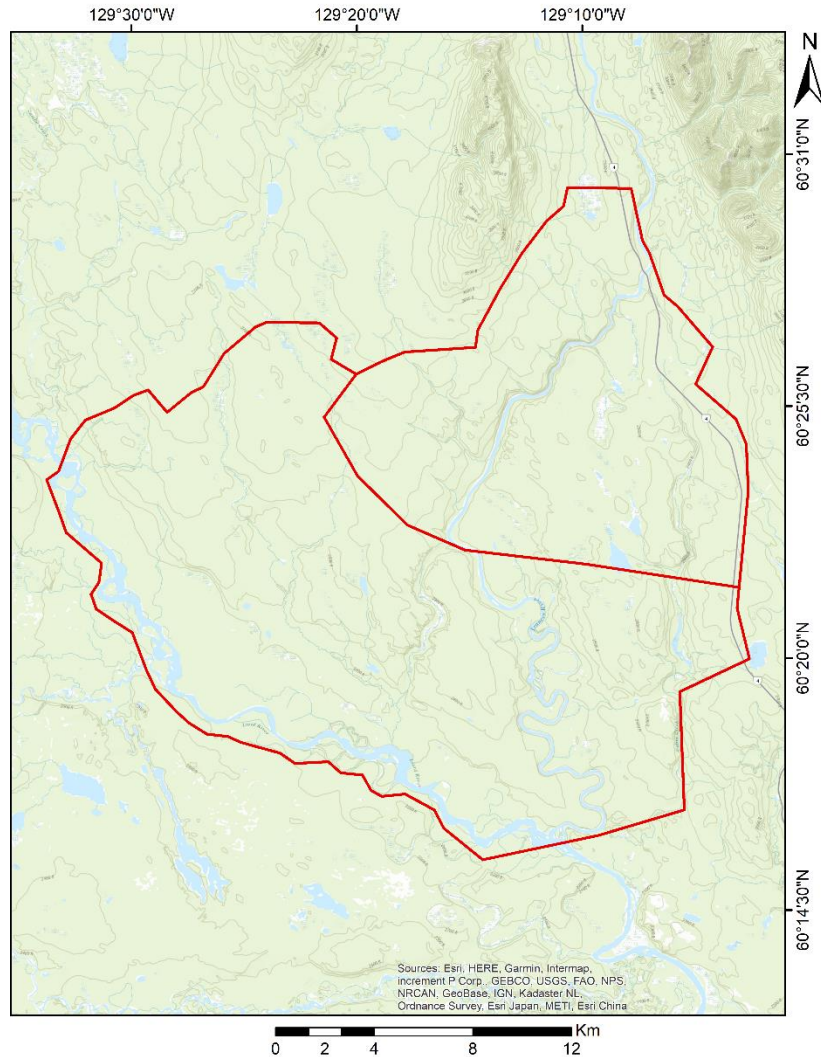


Figure 1 - LiDAR Survey Site

3. Equipment

McElhanney utilized the Galaxy Optech T2000 system for LiDAR Capture (Figure 2).

For Product Specifications please see

<https://www.teledyneoptech.com/en/products/airborne-survey/galaxy/>

The LiDAR system is mounted on Piper Navajo fixed wing aircraft.



Figure 2 – Optech Galaxy T2000 Components

4. Flight Plan

Table 1 - Flight Parameters 2023-08-28

Strip ID	Start [s]	Stop [s]	Durati on [s]	PRF [kHz]	Scan Frequency [Hz]	Scanner Half Angle [deg]	Speed Avg [m/s]	Height Avg [m]
2	15113 6.1645	15157 1.155	435	1300	102	19.5	68	2307.5
3	15175 7.1291	15180 9.9116	52.8	1300	102	19.5	68	2340.7
4	15195 4.0334	15202 3.5208	69.5	1300	102	19.5	73	2341.4
5	15215 6.3026	15224 0.4903	84.2	1300	102	19.5	67	2350.6
6	15235 3.2368	15244 6.7793	93.5	1300	102	19.5	74	2365.7
7	15258 7.5046	15269 5.0792	107.6	1300	102	19.5	69	2366.4
8	15282 4.6023	15294 0.1953	115.6	1300	102	19.5	74	2376.2
9	15307 2.5751	15320 4.2048	131.6	1300	102	19.5	70	2361.3
10	15331 2.0698	15347 0.4273	158.4	1300	102	19.5	71	2381.4
11	15362 0.4744	15392 3.1623	302.7	1300	102	19.5	67	2396.8

12	15410 4.1786	15439 8.18	294	1300	102	19.5	71	2394.6
13	15454 3.1425	15487 3.8947	330.8	1300	102	19.5	63	2380.9
14	15503 8.45	15538 8.5799	350.1	1300	102	19.5	76	2378
15	15554 8.0525	15595 0.3018	402.2	1300	102	19.5	68	2373.5
16	15609 4.0852	15649 2.9286	398.8	1300	102	19.5	71	2385.5
2	16435 5.2724	16464 7.9382	292.7	1300	102	19.5	72	2308.3
3	16490 2.2087	16530 5.1269	402.9	1300	102	19.5	74	2355
4	16545 0.0783	16585 3.666	403.6	1300	102	19.5	66	2360
5	16596 9.6527	16638 6.6029	417	1300	102	19.5	74	2340.6
6	16649 7.254	16691 4.2041	417	1300	102	19.5	63	2344.5
7	16703 4.6217	16743 9.5442	404.9	1300	102	19.5	73	2340.6
8	16755 2.5945	16796 2.1944	409.6	1300	102	19.5	68	2322.7
9	16806 6.2256	16842 4.3743	358.1	1300	102	19.5	79	2324.3
10	16859 6.0667	16899 8.3164	402.2	1300	102	19.5	67	2344.9
11	16928 3.2987	16934 5.3812	62.1	1300	102	19.5	74	2252
12	16949 3.2649	16961 8.2178	125	1300	102	19.5	69	2229.3
13	16971 9.1378	16987 8.1636	159	1300	102	19.5	74	2259.3
14	16999 4.2074	17018 6.6431	192.4	1300	102	19.5	70	2251.7
15	17028 2.6089	17049 2.4177	209.8	1300	102	19.5	76	2258.4
16	17059 8.0772	17085 7.3326	259.3	1300	102	19.5	66	2270.1
17	17098 3.5758	17126 8.2226	284.6	1300	102	19.5	70	2281.8
18	17137 8.0828	17168 0.1027	302	1300	102	19.5	69	2267.8
19	17177 9.0151	17208 5.7124	306.7	1300	102	19.5	69	2286.5

20	17221 1.1806	17255 1.2877	340.1	1300	102	19.5	67	2294.8
21	17264 6.1161	17299 4.2423	348.1	1300	102	19.5	74	2301.3
22	17309 8.52	17346 5.355	366.8	1300	102	19.5	63	2314.7
23	17356 6.1224	17394 0.3075	374.2	1300	102	19.5	77	2304.2
24	17406 6.3916	17444 5.2541	378.9	1300	102	19.5	65	2327.8
25	17453 4.2292	17490 8.4144	374.2	1300	102	19.5	78	2320.4
26	17502 9.5666	17540 7.7609	378.2	1300	102	19.5	68	2338.7

5. Data Processing

All GPS and IMU data was processed using POS Pac v8.7 software. The laser data was extracted using Optech LMS v4.6.1 software. The GPS antenna position in the airplane was calculated by post-processing the raw data at one (1) second intervals for the entire flight. We have used Precise Point Position (PPP) to process the trajectories, and the coordinates were calculated in NAD83(CSRS).

6. Point Density

Bare earth point density varies with canopy closure, understory density and topographic features. Mean density of the point cloud was measured at nominal 31.57 pts/m² and the bare-earth point density was measured at nominal 12.72 pts/m².

7. Calibration

System: Leica TM-2

LiDAR Calibration flight:

Calibration Date: August 01, 2023 Location: Red Deer, AB

Base station used for calibration (in NAD83(CSRS) v4e2002):

- ABRD N 52° 16' 16.381569" W 113° 49' 01.47521278" 848.5524m epoch 2010

The LiDAR system calibration was flown over calibration site. The lever arms (offset between GPS antenna IMU and Laser Mirror), were calibrated based on 31 ground survey points.

Lever Arms

GPS Lever arms in (m):

X = 0.266 m Y = -0.449 m Z = -1.176 m

IMU Lever arms in (m):

x: 0 y: 0 z: 0

8. Quality Control

The LiDAR data consistencies have been checked between the flight lines using Terrascan software.

Comparison of Bare Earth LiDAR data with Existing LiDAR Ground Points

According to ASPRS guidelines, the vertical accuracy of LiDAR is as follows:

$$RMSE_z = Sqrt \left[\sum (Z_{Lidar(i)} - Z_{check(i)})^2 / n \right] = 0.029m$$

Where the "Check" refers to the ground truth (in this project, we used existing LiDAR ground points) and n is the number of check points. A total of 187 check points were used for this analysis.

n=187

Average dz	-0.006 m
Minimum dz	-0.071 m
Maximum dz	+0.086 m
Average magnitude	0.023 m
Root mean square	0.029 m
Std deviation	0.028 m

9. Deliverables

Final output data is provided in NAD83CSRS UTM Zone 09 and the elevations are based on CGVD28 HT2 and CGVD13 geoid models. The deliverables include:

- Bare Earth & Thinned model key points in las, xyz
- Non Bare Earth in las format
- Index map
- 20 cm Orthophoto