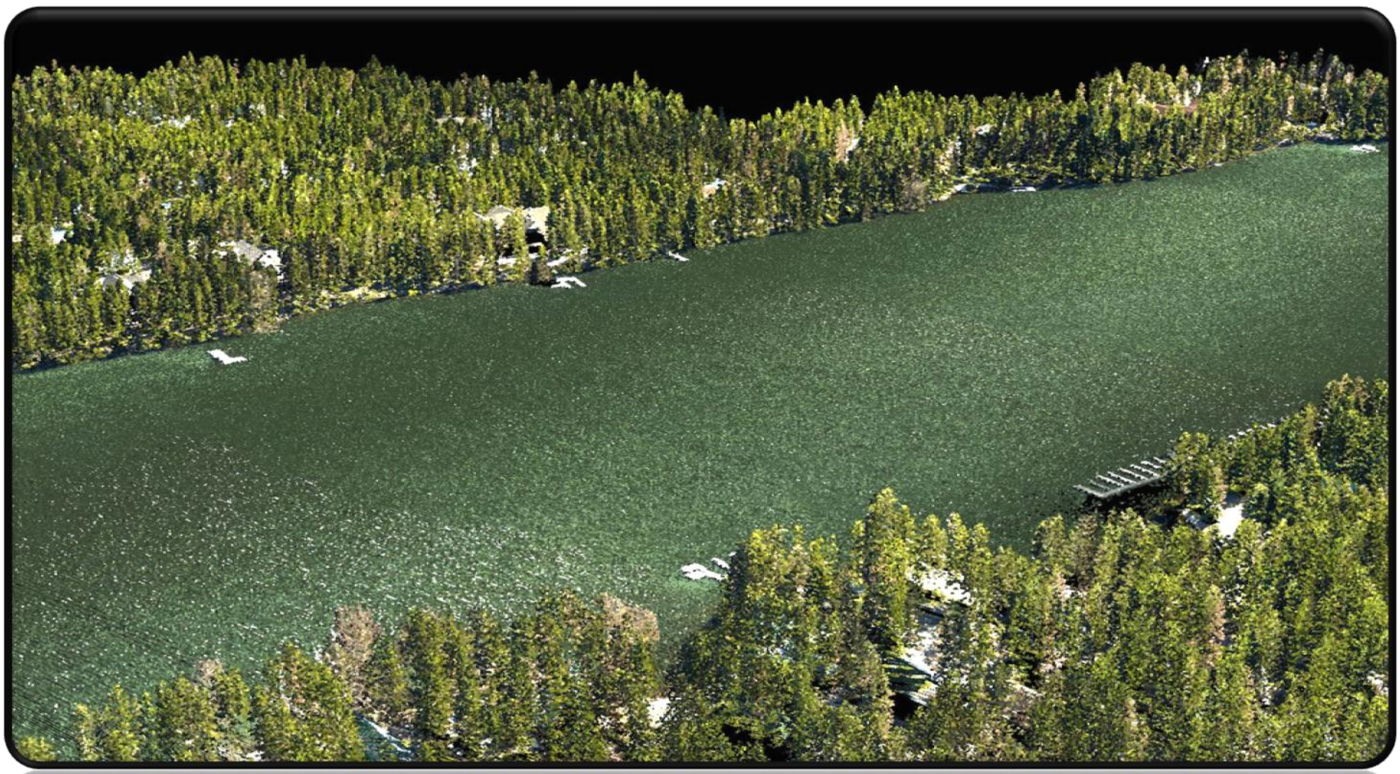
aero-graphics

TECHNICAL PROJECT REPORT

ISLAND PARK RESERVOIR AERIAL SURVEY

FREMONT COUNTY, IDAHO

May 2016



Submitted to:
Rick Collingwood
IDWR
322 East Front Street
Boise, ID 83720

Submitted by:
Aero-Graphics, Inc.
40 W. Oakland Avenue
Salt Lake City, UT 84115
www.aero-graphics.com

Technical Project Report
Island Park Reservoir Aerial Survey
Fremont County, Idaho

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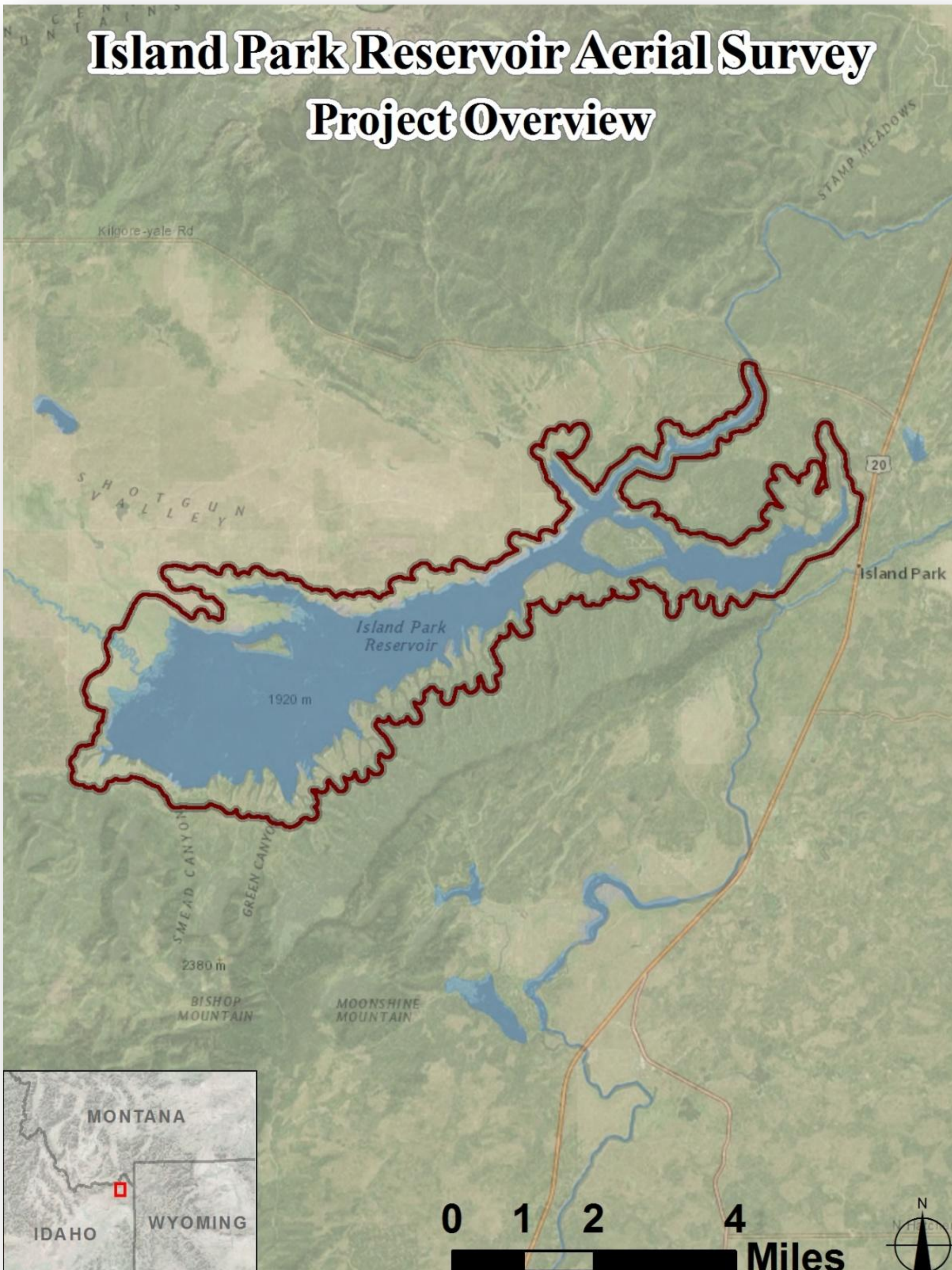
1. Overview

On May 3, 2016, Aero-Graphics acquired high resolution LiDAR data and digital 3-band stereo imagery over approximately 22 square miles located in Fremont County, Idaho. The LiDAR and orthoimagery deliverables will support the Island Park Reservoir Enlargement Assessment.

***Exhibit 1**:* *Island Park Reservoir project boundary*



2. Acquisition

2.1 LiDAR and Imagery Acquisition – Equipment and Methodology

LiDAR and imagery acquisition for the Island Park Reservoir project was performed simultaneously with an Optech ALTM Orion H300 LiDAR sensor and an Optech CS-10000 aerial camera system. The LiDAR sensor and the aerial camera were paired in a customized mount to minimize error and increase accuracy between datasets. Aero-Graphics flew at an average altitude of 2,625 ft AGL (above ground level) and made appropriate adjustments to compensate for topographic relief. The imagery was acquired at a 5.9 cm ground sampling distance with 60% forward and 50% side overlap, collecting 2,579 images over 48 flightlines. LiDAR acquisition was performed with 50% overlap and yielded an average 8.8 points per square meter throughout the project area. The PRF (pulse rate frequency) used for collection was 125 kHz, scan frequency 57.1 Hz, and scan angle +/- 15° from the nadir position (full scan angle 30°).

***Exhibit 2**:* *Summary of flight parameters*

Altitude (ft AGL)	Overlap (%)	Speed (kts)	PRF (kHz)	Scan Freq (Hz)	Scan Angle ° (full)
2,625	50	110	125	57.1	30

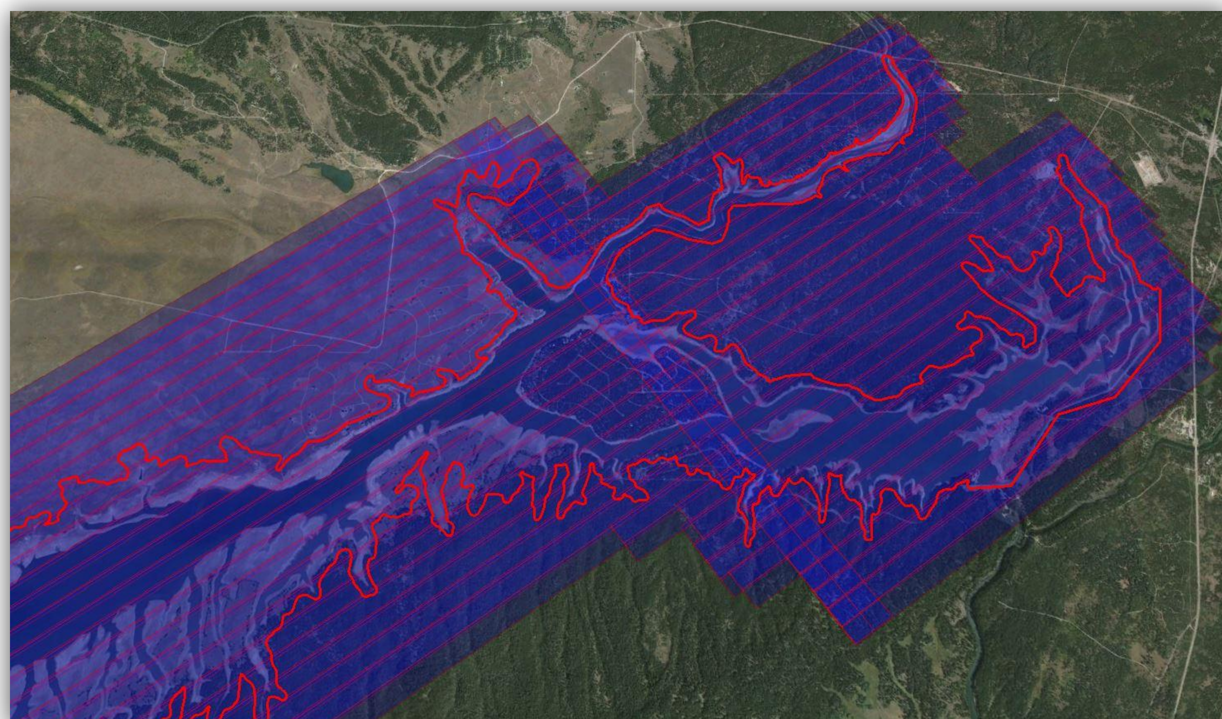
PPM^2 (mean)	Post spacing Cross Track (m)	Post Spacing Down Track (m)	Swath Width (m)	# Flightlines	# Images
5.15	0.4960	0.4955	429	48	2,579

The Orion H300 can send/receive up to 300,000 pulses per second and is capable of receiving up to four range measurements, including 1st, 2nd, 3rd, and last returns for every pulse sent from the system. The Orion H300 features roll compensation that adjusts the mirror to maintain the full scan angle integrity in relation to nadir, even when less than perfect weather conditions push the sensor off nadir. It is also equipped with a GPS/IMU unit that continually records the XYZ position and roll, pitch and yaw attitude of the plane throughout the flight. This information allows us to correct laser return data positions that may have been thrown off by the plane's natural movement.

***Exhibit 3**:* *The acquisition platform for the Island Park Reservoir project was a turbocharged Cessna 206. Our 206 has been customized for LiDAR and other airborne sensors with an upgraded power system and avionics. The stability of the Cessna 206 is ideal for LiDAR collection.*

The ALTM Orion H300 LiDAR sensor is equipped with FMS Planner Flight Management System Software, which is the latest release from Optech. Aero-Graphics utilizes FMS Planner to both plan the flight and guide the airborne mission while in flight. This smooth transition from flight planning to aerial operations eliminates discrepancies between the flight plan and the actual airborne mission. The use of FMS Planner helps ensure an accurate and consistent acquisition mission with real-time quality assurance while still airborne. The system operator can monitor the point density and swath during the mission to confirm adequate coverage within the area of interest, as shown in **Exhibit 4.**

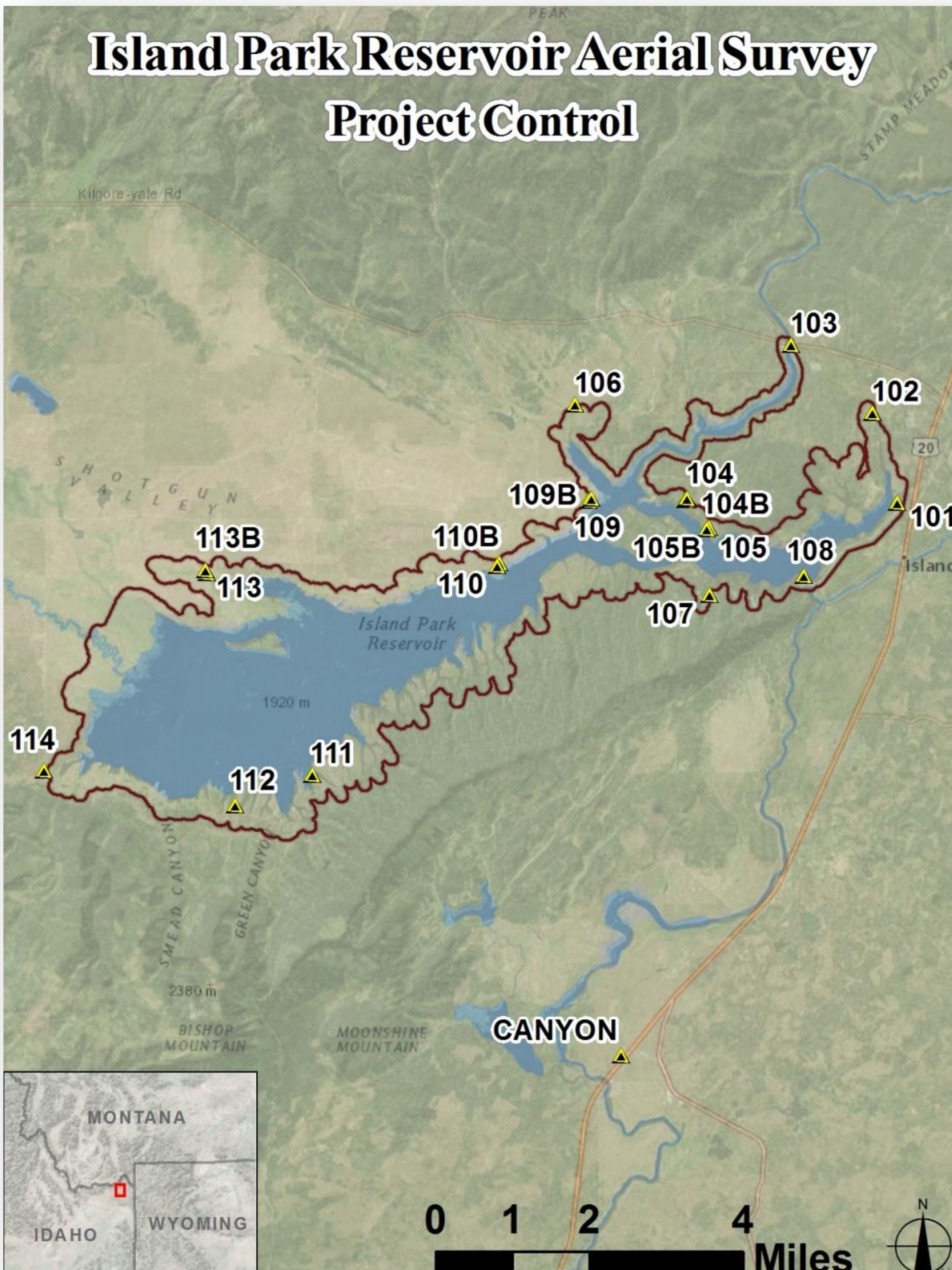
***Exhibit 4**: Swath data for the Island Park Reservoir project was recorded and viewed real-time by the operator*



2.2 Ground Survey – Equipment and Methodology

Aero-Graphics used CORS base stations and statically-collected survey data at strategic points throughout the project area to ensure that the LiDAR and image data maintained its true geographic integrity. A single-base solution was used to differentially correct the aircraft's trajectory data. Control point and base station coordinates can be found in Appendix A. LiDAR positional accuracy can be found in section 4.2.

***Exhibit 5**: Static ground control for the Island Park Reservoir project*



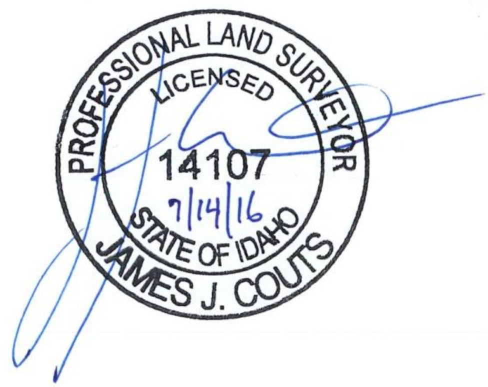
Project: ISLAND PARK RESERVOIR LIDAR DATA & ORTHOIMAGERY ACQUISITION

Dates Surveyed: May 2-4, 2016

Chief Surveyor: James Couts PLS (ID Lic #L-14107)

SURVEYOR'S CERTIFICATION:

I, James J. Couts, certify that I am a Professional Land Surveyor and hold License No. L-14107 in accordance with Title 54, Chapter 12, Idaho Engineers and Surveyors Code; that the control survey described in this report has been completed under my supervision; and that I have verified all measurements, calculations and conversions provided herein.



On-Site Surveyor: John R Francis PLS (UT Lic #368357-2201, NV Lic #17370)

ON-SITE SURVEYOR'S NARRATIVE:

On Monday, May 2, 2016, I began the ground control survey for the Island Park Reservoir Enlargement Land Assessment project. I set up five (5) base station aerial targets with 8 inch mag spikes/washers/white vinyl (1 ft x 7 ft legs) at ground control positions 104, 105, 109, 110 and 113. At each of these five (5) positions, a GNSS dual constellation receiver recorded data at a one (1) second interval for a minimum of seven (7) hours. Another GNSS receiver was also set up at a 1946 NGS Benchmark "Canyon" and also recording data for just short of seven (7) hours to serve as a vertical check for this project. Another GNSS receiver was then set up at ground control positions 111 (w/12 ft square black LiDAR-specific target), 112 (w/white vinyl target – 1 ft x 7 ft legs), and 114 (w/white vinyl target – 1 ft x 7 ft legs) and each recording data for a minimum of one (1) hour. These three (3) southwestern control positions were tied to Canyon Benchmark and control position 113 in the final solution.

On Tuesday, May 3, 2016, I set up three (3) base stations at ground control positions 106 (w/mag spike/washer/12 ft square black LiDAR-specific target) and 108 (w/mag spike/washer/white vinyl target – 1 ft x 7 ft legs) and Canyon Benchmark. Again, all three (3) of these GNSS base station receivers recorded data for a minimum of seven (7) hours. I then set up GNSS receivers at control positions 101 (w/mag spike/washer/white vinyl target – 1 ft x 7 ft legs), 102 (w/mag spike/washer/white vinyl target – 1 ft x 7 ft legs), 103 (w/mag spike/washer/white vinyl target – 1 ft x 7 ft legs), and 107 (w/mag spike/washer/12 ft square black LiDAR-specific target). Again, all GNSS receivers recorded data at a one (1) second interval. All base station ground control positions were verified by an NGS OPUS solution.

On Wednesday, May 4, 2016, I set up a Spectra Precision Focus 35 Robotic Total Station on control positions 104, 105, 109, and 110 and collected 40 ground check points around each position. These check points were used as a quality check on the LiDAR sensor data.

Topcon GNSS dual-frequency dual constellation receivers (HiperSR, HiperGa, and GB1000) were exclusively utilized for this ground control survey. NovAtel/Waypoint software was used to check the accuracy of every baseline/vector generated by the ground position tie data.

All work on this project was performed under the direction of the Idaho Water Resource Board.

<u>Exhibit 6</u>: *Base station aerial target at ground control position 109*

3. LiDAR Processing Workflow

a. **Absolute Sensor Calibration.** Our absolute sensor calibration adjusted for the difference in roll, pitch, heading, and scale between the raw laser point cloud from the sensor and surveyed control points on the ground.

b. **Kinematic Air Point Processing.** Differentially corrected the 1-second airborne GPS positions with ground base station; combined and refined the GPS positions with 1/200-second IMU (roll-pitch-yaw) data through development of a smoothed best estimate of trajectory (SBET).

c. **Raw LiDAR Point Processing (Calibration).** Combined SBET with raw LiDAR range data; solved real-world position for each laser point; produced point cloud data by flight strip in ASPRS v1.2 .LAS format; output in NAD 83 UTM Zone 12.

d. **Relative Calibration.** Performed relative calibration by correcting for roll, pitch, heading, and scale discrepancies between adjacent flightlines; tested resulting relative accuracy. Results presented in Section 4.1.

e. **Absolute Accuracy Assessment.** Performed comparative tests that showed Z-differences between each static survey point and the laser point surface. Results presented in Section 4.2. LiDAR checkpoints can be found in Appendix B.

f. **Tiling & Long/Short Filtering.** Cut data into project-specified tiles and filtered out grossly long and short returns.

g. **Classification & QA/QC.** Ran classification algorithms on points in each tile; separated into (1) processed, unclassified (2) bare-earth (6) buildings and other manmade structures (7) noise (8) Model Keypoints (Ground) (9) water (10) ignored ground (proximity to breakline) (11) unusable/withheld; revisited areas not completely classified automatically and manually corrected them.

h. **Contour Generation.** Bare-earth DEMs at a cell size of 0.3 meters were mosaicked into one file using ArcGIS. The resulting cell values were converted from meters to feet using the Map Algebra tool and a factor of 3.2808. The mosaicked DEM, in feet, was then used as an input for the Focal Statistics tool where cell values were averaged with a radius of 2 cells. Running Focal Statistics on the DEM allows for contours to be generated with a somewhat smoother appearance while still maintaining accuracy. This new DEM was then used as an input into Golden Software's Surfer program to generate 1' contours. The contours were then exported to shapefile format and used as an input in ArcGIS where processes were ran to properly classify contours, fix any errors and finally be cut into tiles that correspond to the LiDAR tiling scheme. A single shapefile of all contours was also supplied.

i. **DEM Creation.** Generated hydro-flattened bare-earth DEMS at a 1 meter resolution in 32-bit ERDAS .IMG format, tiled according to project specifications.

j. **Intensity Image Creation.** Generated 0.5 meter pixel intensity images in GeoTIFF format, tiled according to project specifications.

4. Results

4.1 Relative Calibration Accuracy Results

Between-swath relative accuracy is defined as the elevation difference in overlapping areas between a given set of two adjacent flightlines. The statistics are based on the comparison of the flightlines and points listed below.

Island Park Reservoir project area: (47 flightlines, > 738 million points)

- Between-swath relative accuracy **average** of 0.03 meter

Within-swath relative accuracy is the amount of vertical separation, or "noise," among a set of points on open, paved ground that should have the same elevation. The within-swath relative accuracy average is less than **0.026 foot.**

4.2 Absolute Accuracy

4.2.1 NVA/VVA Results

The following exhibits display the Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA) results for the Island Park Reservoir project. NVA is defined as the elevation difference between the LiDAR surface and ground surveyed static points collected in open terrain (bare soil, sand, rocks, and short grass) as well as urban terrain (asphalt and concrete surfaces). VVA is defined as the elevation difference between the LiDAR surface and ground surveyed static points collected in all vegetated land cover categories combined, including tall weeds and crops, brush lands, and lightly- to fully-forested land cover categories.

Exhibit 7: *Non-vegetated Vertical Accuracy (NVA) of the Island Park Reservoir project*

Accuracy$_z$: Tested 0.149 meters Non-vegetated Vertical Accuracy (NVA) at 95 percent confidence level in all open and non-vegetated land cover categories combined using RMSEz x 1.96.	
Average Error = 0.019 m	**RMSE = 0.076 m**
Minimum Error = -0.268 m	**σ = 0.074 m**
Maximum Error = 0.235 m	**2σ = 0.148 m**
Survey Sample Size: n = 84	

Exhibit 8: *Distribution of the errors between the LiDAR surface and NVA surveyed points. Demonstrates the percentage of compared points within a given accuracy range.*

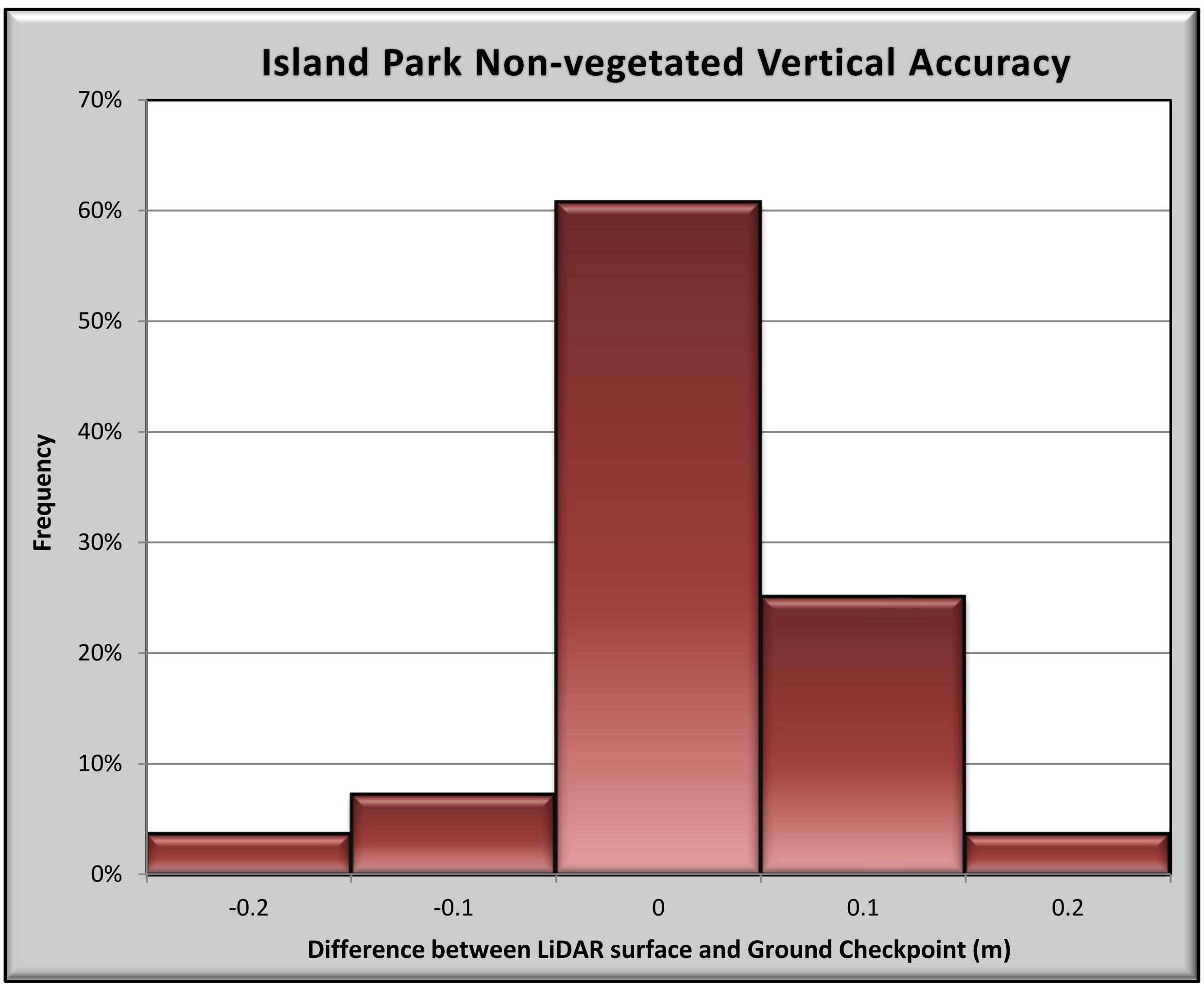


Exhibit 9: *Vegetated Vertical Accuracy (VVA) of the Island Park Reservoir project*

Accuracy$_z$: Tested 0.870 meters Vegetated Vertical Accuracy (VVA) at 95th percentile in all vegetated land cover categories combined using the absolute value 95th percentile error.	
Average Error = -0.218	RMSE = 0.358
Minimum Error = -1.145	σ = 0.285
Maximum Error = 0.371	2σ = 0.570
Survey Sample Size: n = 84	

Exhibit 10: *Distribution of the errors between the LiDAR surface and VVA Surveyed points. Demonstrates the percentage of compared points within a given accuracy range.*

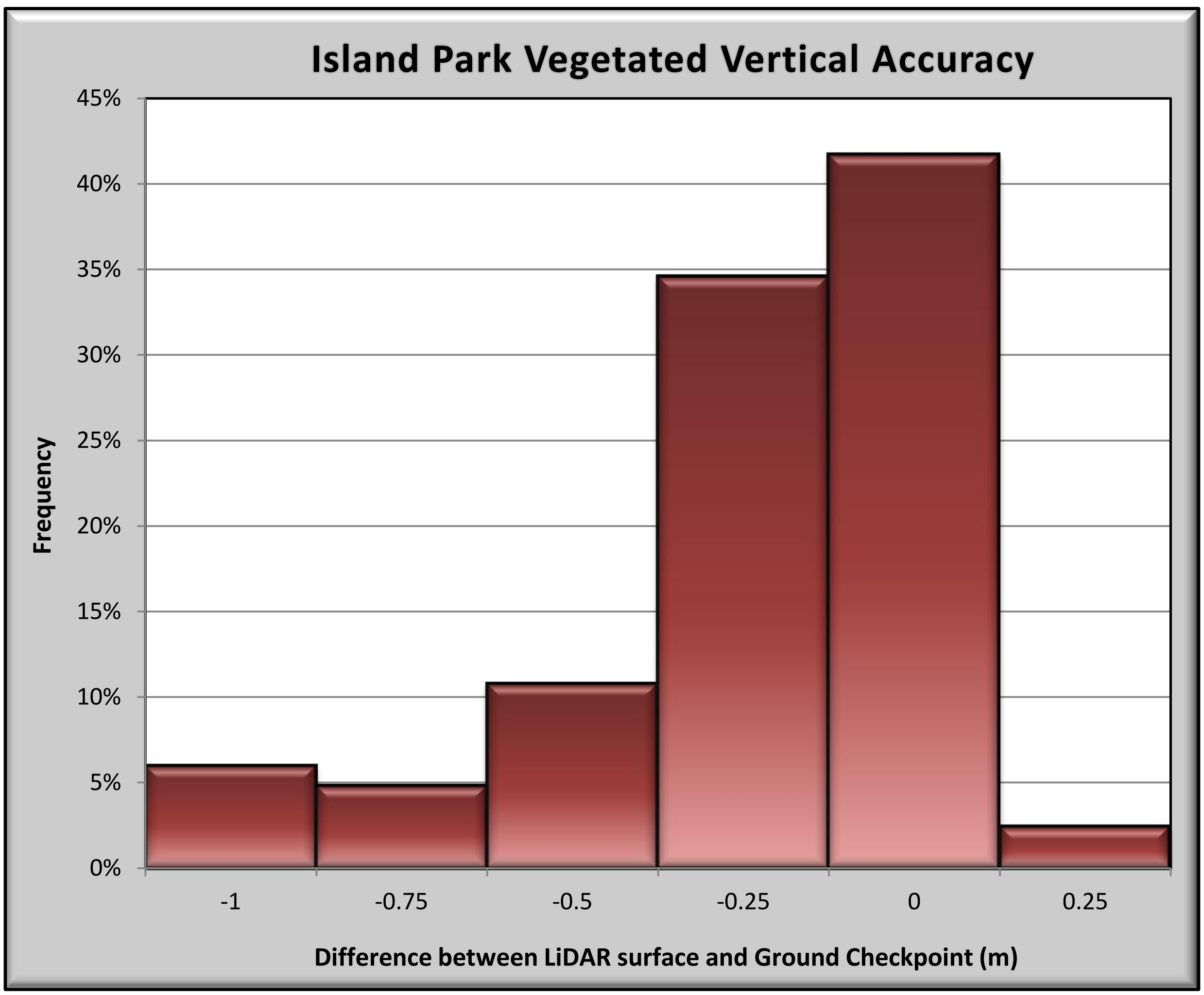
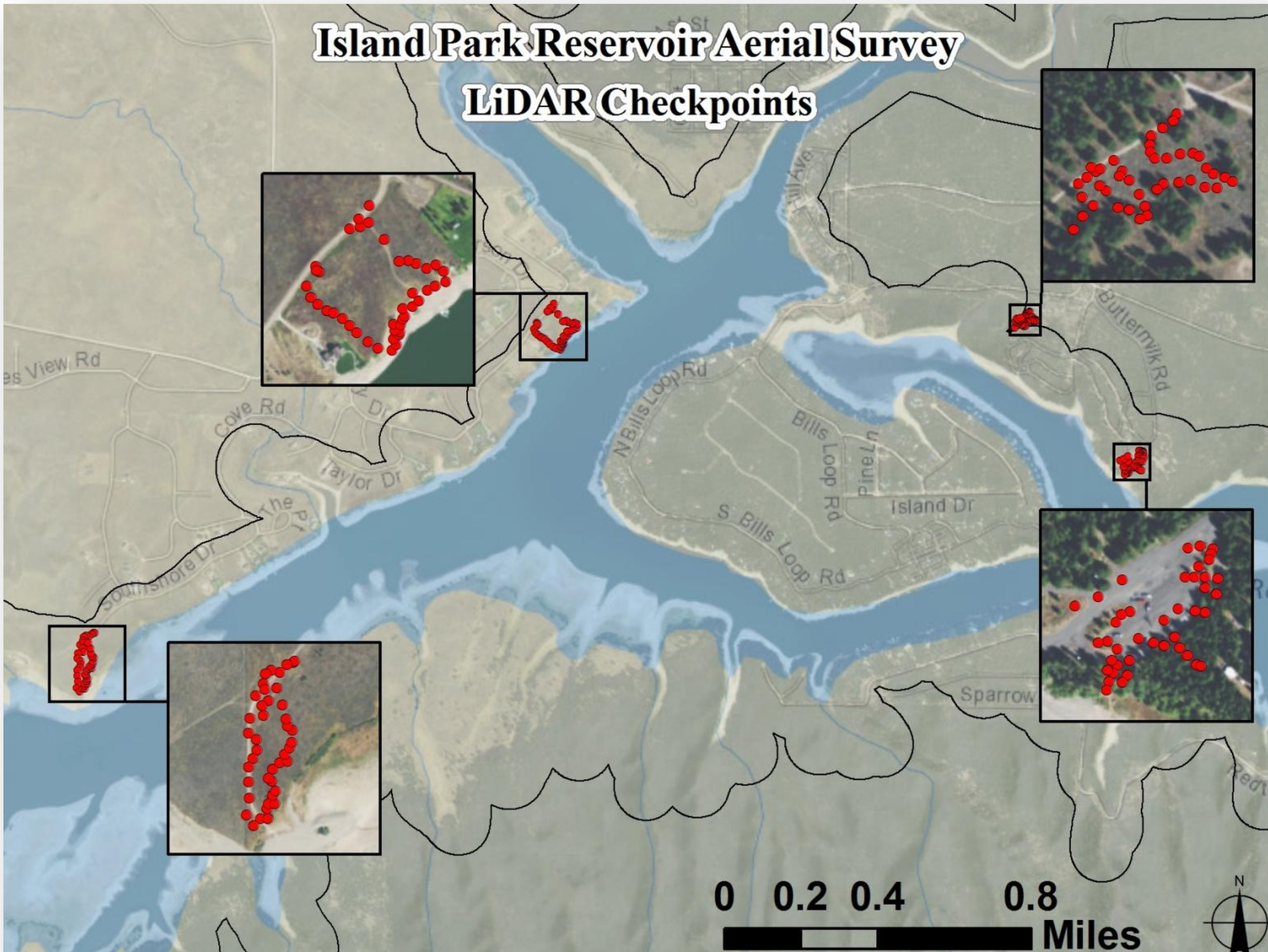


Exhibit 11: *LiDAR checkpoints used for the NVA and VVA assessments*



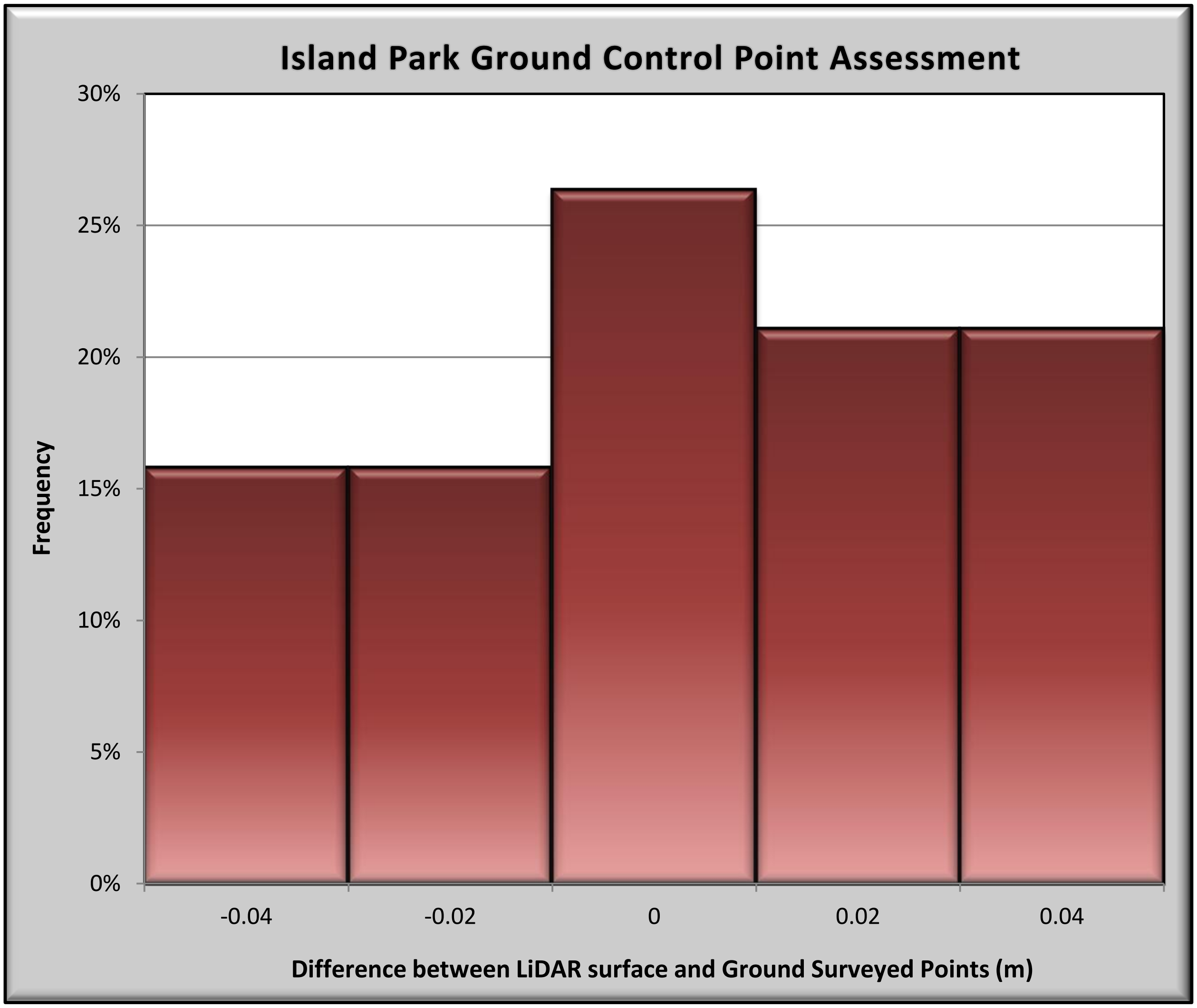
4.2.2 Ground Control Point Assessment

Absolute accuracy was also assessed using ground control point data. These results can also be a good indication of the overall accuracy of the LiDAR dataset.

Exhibit 12: *Ground control point assessment results for the Island Park Reservoir project*

Difference between LiDAR surface and Ground Surveyed Points	
Average Error = 0.004 m	RMSE = 0.029 m
Minimum Error = -0.061 m	σ = 0.029 m
Maximum Error = 0.046 m	2σ = 0.058 m
Survey Sample Size: n = 19	

Exhibit 13: *Distribution of the errors between the LiDAR surface and surveyed ground control points. Demonstrates the percentage of compared points within a given accuracy range.*



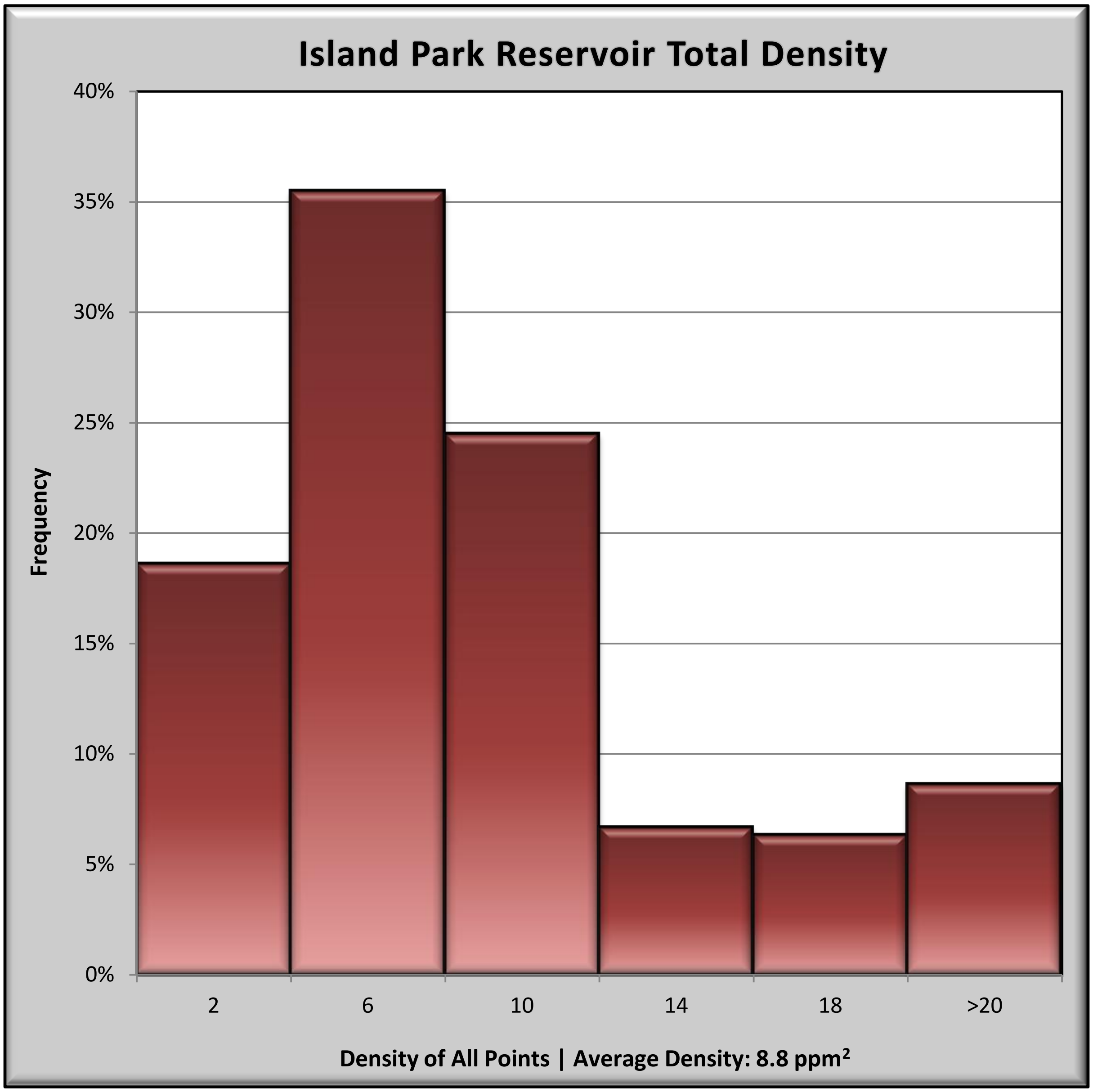
4.3 Orthophoto Accuracy

Horizontal accuracy of the orthophoto is dependent upon the quality of the aerotriangulation solution and the resulting ortho surface creation. Each bundle-adjusted AT solution is checked visually with the stereoimagery to ensure the surveyed control point falls directly on the center of the target and within a specified vertical tolerance (one-quarter the equivalent contour interval). If these tolerances are met, horizontal accuracy is always acceptable. In addition, Aero-Graphics utilized the project's survey grade control throughout the block to verify the integrity of the ortho's positional accuracy. Control and check points yielded a 0.12m RMSE XY.

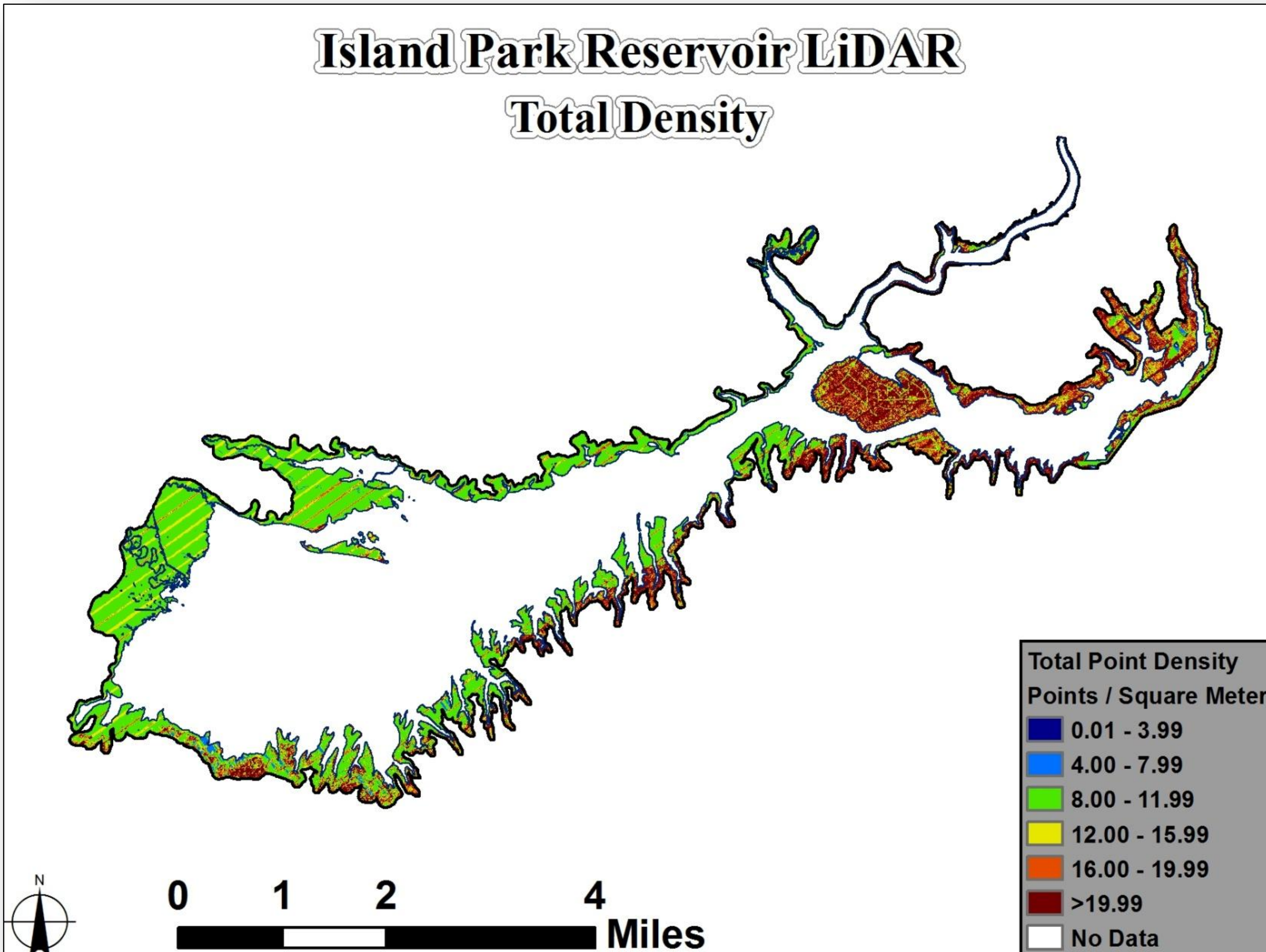
4.4 Data Density

The goal for this project was to achieve a LiDAR point density of **5.1** points per square meter. The acquisition mission achieved an actual average of **8.8** points per square meter. The following two exhibits show the density of **all collected points.**

<u>Exhibit 14</u>*: *Island Park Reservoir – All returns *Laser Point Density by Frequency, points/m^2.*
Demonstrates the percentage of project tiles with points in a given density range



<u>Exhibit 15</u>: *Laser Point Density of All Returns by Tile, points/m²*



The following two exhibits show the density of **ground classified points**. Factors such as vegetation, water, and buildings will reduce the density of points classified to the ground. For the Island Park Reservoir project, an average of **4.5** ground classified points per square meter was achieved.

<u>Exhibit 16</u>*: *Island Park Reservoir - Ground Classified *Laser Point Density by Frequency, points/m^2. Demonstrates the percentage of project tiles with points in a given density range*

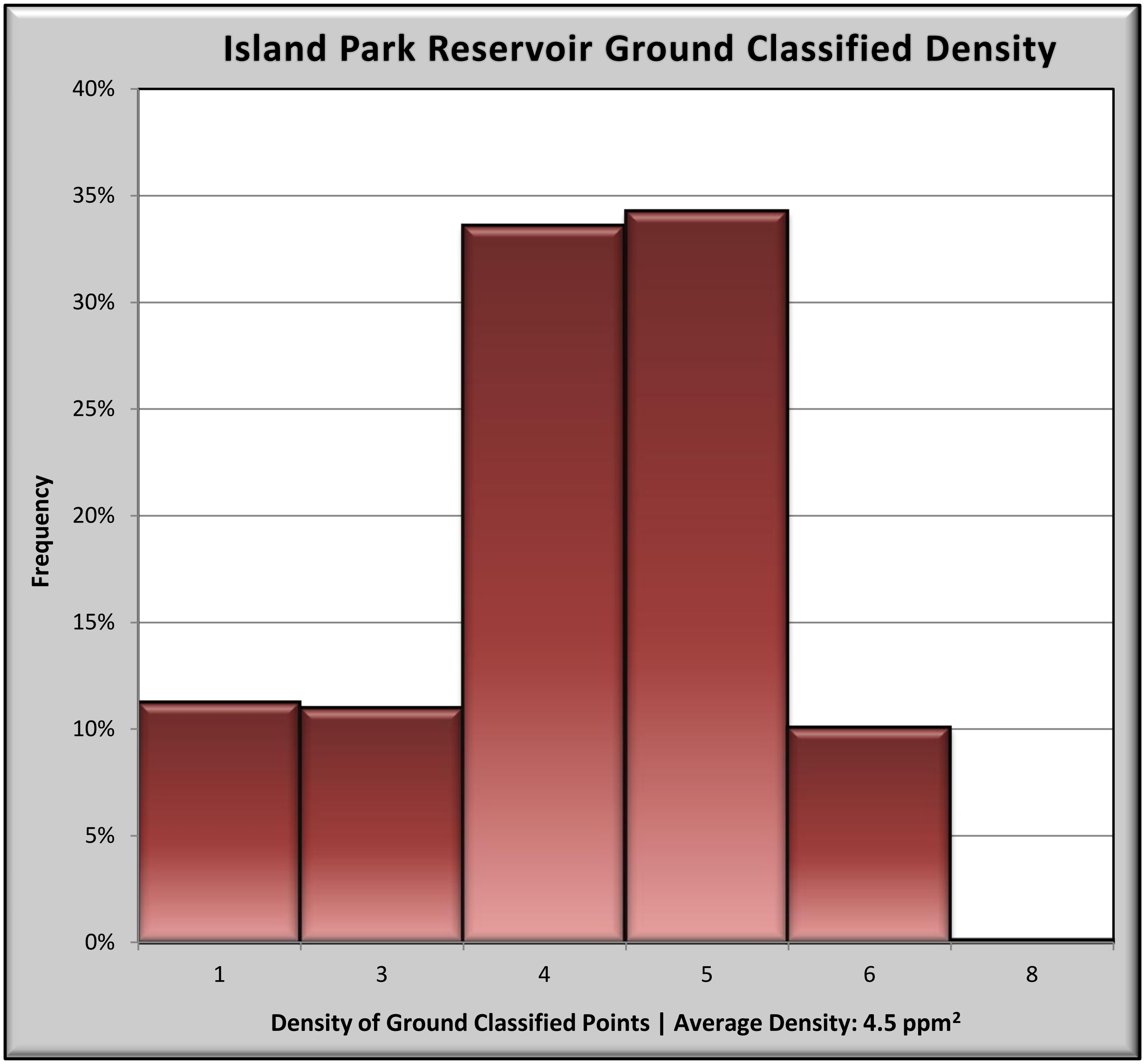
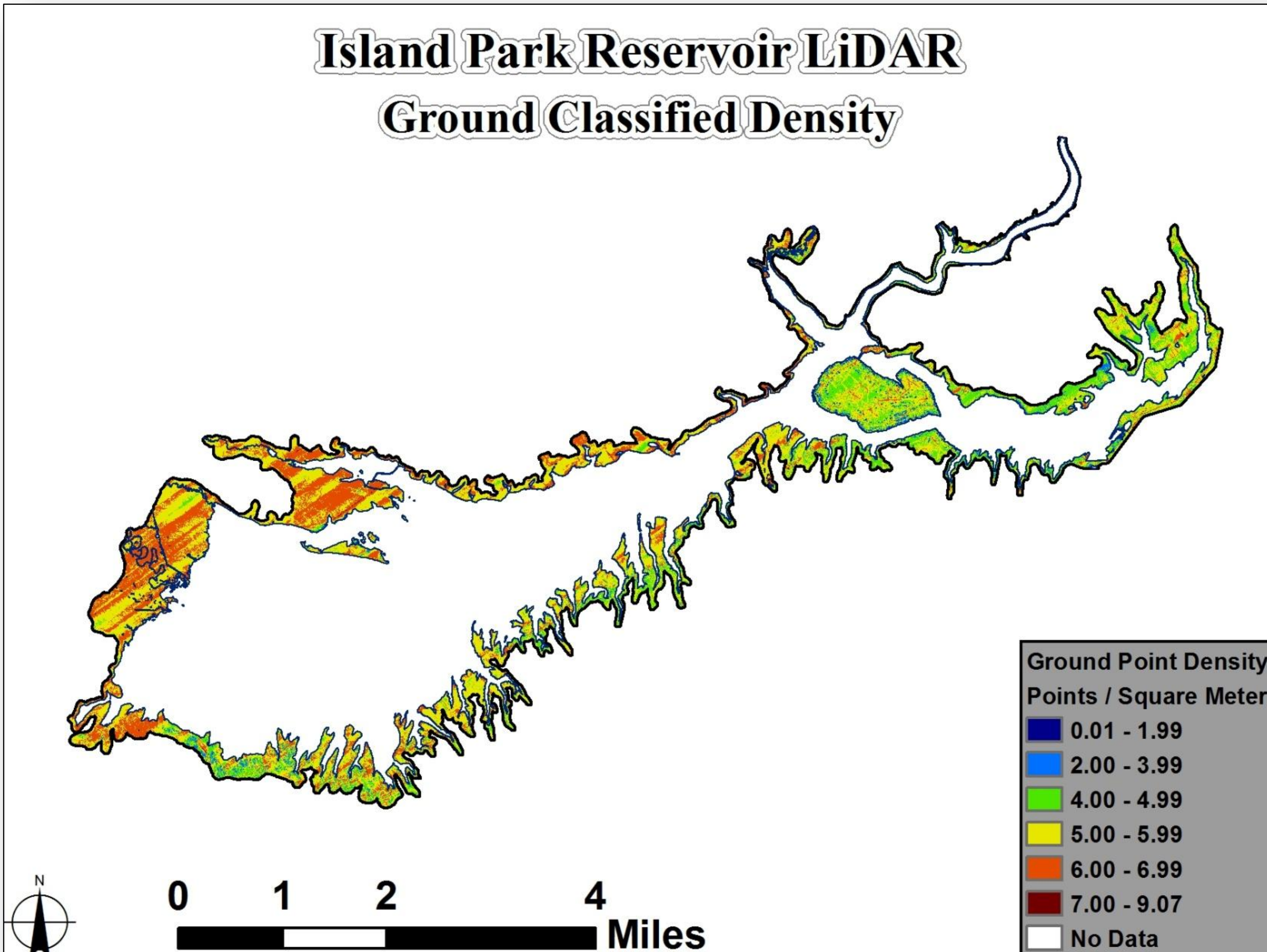


Exhibit 17: *Ground Classified Laser Point Density by Tile, points/m²*



4.5 Data Density Summary

Island Park Reservoir	Goal	Actual (mean)
Total Point Density:	5.1 points/m^2	8.8 points/m^2
Ground Classified Point Density:	-------	4.5 points/m^2

4.6 Projection, Datum, and Units

Projection:		UTM Zone 12
Datum	Vertical:	NAVD 88 (U.S. Survey Feet)
	Horizontal:	NAD 83
Units:		Meters (Horizontal)

5. Deliverables

LiDAR Point Data:	• Classified LiDAR data and raw point cloud swaths in .LAS v1.2 format
Raster Data:	• 3-band orthorectified imagery in .TIF format at a 0.06 meter pixel resolution • Intensity Imagery in GeoTIFF format at a 0.5 meter pixel resolution • Hydro-flattened Bare-Earth DEMS at a 1 meter resolution in 32-bit ERDAS .IMG format
Vector Data:	• 1' contours and 3-D Hydro-lines in .SHP format
Report of Survey:	• Technical Project Report including methodology, accuracy, and results

6. Highlighted Images

Exhibit 18: *LiDAR point cloud looking northwest, colored by orthophoto RGB values*

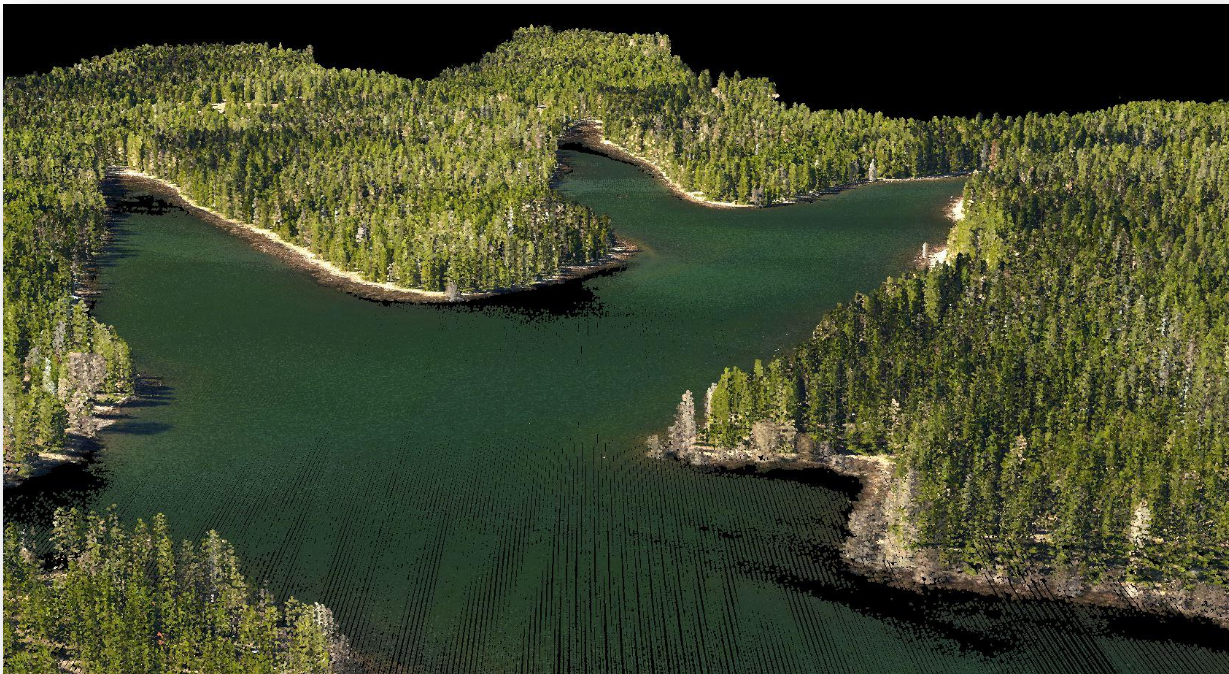
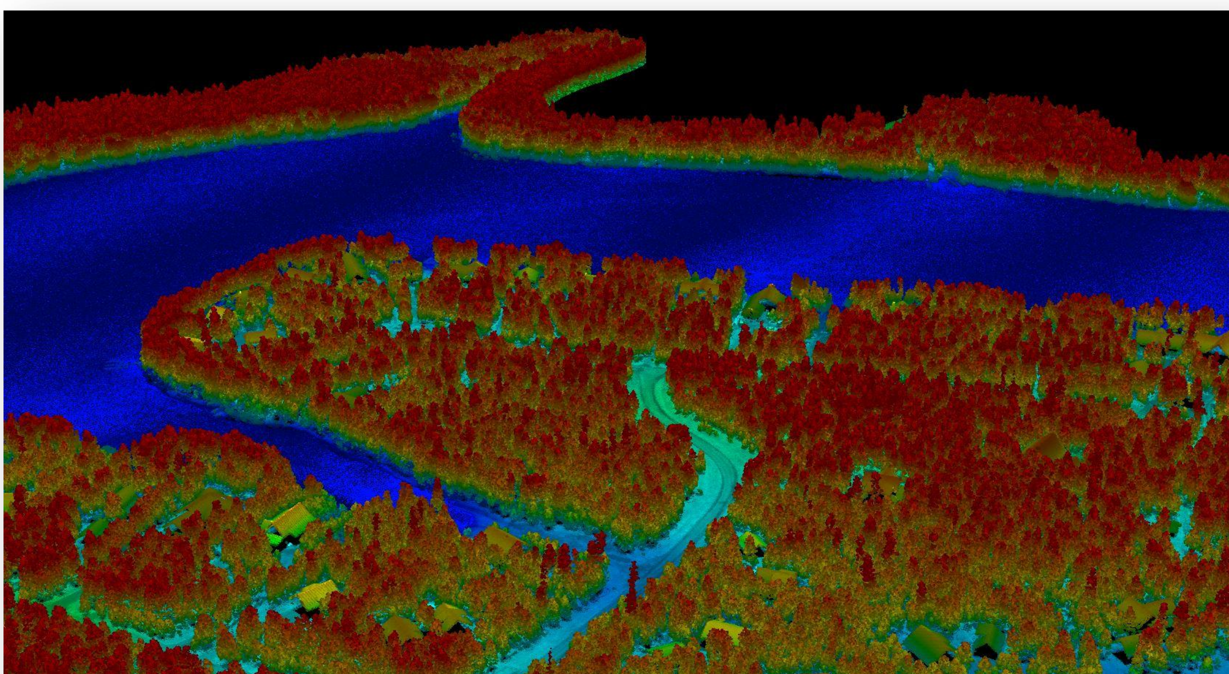


Exhibit 19: *LiDAR point cloud looking north over Bill's Island, colored by elevation and intensity values*



Appendix A – Surveyed Ground Control

Survey Point	NAD 83 UTM Zone 12		NAVD 88
	Northing (m)	Easting (m)	Elevation (m)
101	4920107.347	470308.739	1924.741
102	4921995.419	469788.532	1929.180
103	4923417.351	468083.194	1930.324
104	4920160.293	465874.596	1930.539
104B	4920194.412	465907.549	1930.039
105	4919563.509	466325.334	1924.333
105B	4919588.164	466364.254	1924.136
106	4922163.279	463568.431	1929.152
107	4918181.228	466381.817	1933.711
108	4918581.734	468355.934	1923.251
109	4920197.675	463900.142	1924.678
109B	4920145.879	463841.964	1927.294
110	4918793.207	461928.172	1929.766
110B	4918843.379	461984.671	1930.129
111	4914419.367	458069.220	1923.534
112	4913777.979	456454.118	1923.673
113	4918697.674	455826.035	1924.610
113B	4918640.655	455857.415	1923.912
114	4914503.633	452451.422	1933.367
CANYON	4908549.441	464531.504	1868.875

Base Stations

Base Station	WGS84		
	Latitude	Longitude	Ellipsoid Height
P360	44° 19' 04.26160"	-111° 27' 02.44593"	1857.821

Appendix B – LiDAR Checkpoints

Survey Point	NAD 83 UTM Zone 12		NAVD 88
	Northing (m)	Easting (m)	Elevation (m)
104	4920160.293	465874.596	1930.539
104B	4920194.412	465907.549	1930.039
1001	4920190.523	465905.450	1930.003
1002	4920185.994	465898.853	1929.800
1003	4920181.354	465892.169	1929.704
1004	4920176.050	465891.384	1929.892
1005	4920171.572	465891.560	1930.086
1006	4920167.721	465894.227	1930.331
1007	4920167.914	465901.401	1930.399
1008	4920170.552	465909.511	1930.460
1009	4920170.684	465916.974	1930.496
1010	4920169.003	465921.103	1930.603
1011	4920161.964	465925.003	1930.734
1012	4920158.561	465929.467	1930.821
1013	4920156.312	465936.028	1930.849
1014	4920154.110	465940.818	1930.802
1015	4920150.291	465931.524	1930.894
1016	4920150.719	465924.199	1930.870
1017	4920154.680	465915.948	1930.800
1018	4920153.450	465908.512	1930.798
1019	4920152.718	465899.308	1930.784
1020	4920149.234	465895.649	1930.840
1021	4920154.946	465879.006	1930.761
1022	4920146.533	465884.917	1930.825
1023	4920139.309	465888.275	1930.785
1024	4920133.465	465889.685	1930.770
1025	4920131.535	465885.417	1930.636
1026	4920137.009	465879.135	1930.849
1027	4920138.094	465872.024	1930.778
1028	4920157.343	465873.228	1930.661
1029	4920148.384	465864.925	1930.728
1030	4920139.535	465857.399	1930.737
1031	4920133.331	465850.913	1930.740
1032	4920125.325	465845.556	1930.749
1033	4920151.292	465861.023	1930.617
1034	4920144.539	465850.824	1930.752
1035	4920152.530	465848.405	1930.527
1036	4920156.373	465853.770	1930.458
1037	4920159.833	465858.908	1930.374

1038	4920162.452	465856.210	1930.416
1039	4920161.530	465861.542	1930.336
1040	4920166.604	465869.730	1930.160
105	4919563.509	466325.334	1924.333
105B	4919588.164	466364.254	1924.136
2001	4919608.306	466366.324	1924.077
2002	4919609.822	466374.477	1924.480
2003	4919607.827	466383.540	1924.268
2004	4919604.570	466382.011	1924.246
2005	4919600.644	466381.117	1924.105
2006	4919595.564	466373.890	1924.137
2007	4919587.964	466370.604	1924.025
2008	4919587.813	466378.222	1924.215
2009	4919587.027	466387.358	1923.810
2010	4919580.446	466378.343	1923.802
2011	4919576.129	466385.940	1923.308
2012	4919563.029	466378.045	1923.700
2013	4919563.975	466371.379	1923.744
2014	4919565.577	466359.287	1923.770
2015	4919557.411	466349.229	1923.768
2016	4919545.578	466356.559	1923.714
2017	4919539.531	466349.203	1923.690
2018	4919537.955	466360.186	1923.321
2019	4919532.538	466365.600	1923.032
2020	4919525.962	466372.381	1922.882
2021	4919525.155	466375.213	1922.897
2022	4919541.474	466341.707	1923.703
2023	4919544.379	466331.010	1923.751
2024	4919528.804	466324.837	1923.714
2025	4919518.672	466322.936	1923.494
2026	4919513.713	466319.821	1922.422
2027	4919525.396	466316.196	1923.575
2028	4919520.042	466312.979	1922.720
2029	4919514.022	466310.013	1922.450
2030	4919507.846	466308.871	1922.244
2031	4919521.958	466309.302	1922.926
2032	4919528.911	466312.288	1923.663
2033	4919537.052	466316.314	1923.987
2034	4919542.715	466308.969	1923.773
2035	4919541.341	466302.411	1923.920
2036	4919555.823	466315.121	1923.871
2037	4919561.497	466319.252	1924.349
2038	4919567.562	466286.141	1924.122
2039	4919573.868	466302.474	1923.917

2040	4919586.211	466319.604	1923.923
109	4920197.690	463900.139	1924.678
109B	4920145.894	463841.961	1927.294
3001	4920137.567	463845.834	1927.296
3002	4920139.566	463842.226	1927.387
3003	4920118.972	463829.604	1927.532
3004	4920104.016	463835.229	1927.055
3005	4920094.829	463844.268	1926.770
3006	4920086.939	463856.172	1926.821
3007	4920084.356	463864.831	1926.743
3008	4920076.415	463876.492	1926.449
3009	4920067.128	463886.680	1926.048
3010	4920057.559	463895.087	1925.588
3011	4920046.025	463910.348	1924.485
3012	4920037.621	463923.104	1923.869
3013	4920034.170	463941.693	1922.974
3014	4920041.654	463947.369	1922.644
3015	4920049.360	463943.563	1923.135
3016	4920055.280	463951.641	1922.072
3017	4920058.536	463952.714	1922.087
3018	4920060.229	463946.044	1922.695
3019	4920069.282	463944.005	1922.905
3020	4920068.392	463953.348	1922.226
3021	4920075.138	463955.955	1922.251
3022	4920079.486	463958.717	1922.166
3023	4920089.669	463956.371	1922.255
3024	4920091.894	463969.139	1922.271
3025	4920099.942	463977.243	1922.326
3026	4920110.255	463969.537	1922.614
3027	4920113.865	463988.246	1922.254
3028	4920119.496	463998.516	1922.259
3029	4920125.236	464012.771	1922.506
3030	4920138.473	464010.317	1922.367
3031	4920146.967	463999.645	1922.775
3032	4920142.550	463987.490	1923.161
3033	4920149.055	463973.896	1923.362
3034	4920153.258	463963.651	1923.376
3035	4920151.945	463951.859	1923.452
3036	4920181.266	463931.471	1923.936
3037	4920203.527	463911.082	1924.389
3038	4920225.568	463912.577	1924.768
3039	4920208.298	463898.244	1924.904
3040	4920194.388	463886.224	1925.317
110	4918793.213	461928.174	1929.766

110B	4918843.385	461984.673	1930.129
4001	4918845.396	461986.938	1930.128
4002	4918840.361	461975.311	1929.965
4003	4918828.554	461964.509	1929.870
4004	4918831.906	461951.449	1929.568
4005	4918825.969	461942.997	1929.550
4006	4918811.504	461940.298	1929.940
4007	4918803.347	461942.358	1929.946
4008	4918785.804	461947.759	1930.483
4009	4918778.213	461938.133	1929.485
4010	4918764.069	461939.428	1928.969
4011	4918759.391	461919.562	1928.767
4012	4918737.042	461917.902	1928.261
4013	4918727.750	461928.980	1927.941
4014	4918712.532	461930.372	1927.498
4015	4918698.924	461924.406	1927.273
4016	4918686.707	461917.638	1927.288
4017	4918664.639	461917.516	1926.831
4018	4918640.169	461918.313	1926.215
4019	4918615.009	461914.404	1925.447
4020	4918599.193	461924.975	1924.161
4021	4918609.766	461936.085	1924.197
4022	4918609.804	461946.778	1923.666
4023	4918624.042	461945.422	1924.648
4024	4918631.298	461946.968	1924.887
4025	4918632.036	461956.744	1924.197
4026	4918644.266	461953.901	1924.735
4027	4918651.159	461958.255	1924.557
4028	4918665.434	461952.557	1925.091
4029	4918670.057	461947.610	1925.468
4030	4918683.367	461954.105	1925.839
4031	4918693.167	461964.586	1925.939
4032	4918695.397	461975.435	1925.534
4033	4918706.042	461971.242	1926.271
4034	4918715.205	461978.851	1926.460
4035	4918723.753	461982.655	1926.691
4036	4918741.264	461983.575	1927.425
4037	4918747.874	461975.577	1928.029
4038	4918758.661	461973.387	1928.335
4039	4918780.291	461968.911	1928.935
4040	4918804.774	461960.325	1930.242