Project Report

UBC LiDAR Survey
Vancouver, BC, Canada

July 21, 2016

Submitted to:
University of British Columbia
2329 West Mall, Vancouver, BC V6T 1Z4

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Terra Project Manager: Taylor Davis

terra remote sensing

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EXECUTIVE SUMMARY

Terra Remote Sensing Inc. (Terra) is pleased to submit this project report to University of British Columbia for the UBC LiDAR Survey.

Contained within this report are the details regarding the data collection, data calibration and data processing pertaining to the UBC LiDAR Survey.

The survey commenced on May 20th, 2015 and finished on the same day. Terra acquired the data with operations primarily occurring from Helijet in Vancouver Harbour.

Calibration flights were conducted at the Helijet Vancouver Harbour located in Downtown Vancouver, BC, Canada. These flights were performed immediately after the completion of the project acquisition and consisted of two opposing flight lines along the runway and two perpendicular flight lines in relation to the runway. This pattern allows for system calibration and to solve for roll, pitch, and heading.

Temporary GPS base station points with aerial targets were placed at suitable locations near to or inside the project area, which were accessible either by helicopter or vehicle, as required to provide suitable baseline lengths for the aircraft data processing. Ground check-points to validate the airborne data were obtained at suitable access points such as highways and roads. Additional checks were done using the calibration flights.

DATA ACQUISITION SUMMARY

The general approach to the field portion of the project was to conduct the airborne data acquisition and ground control survey at the same time. As noted above, Helijet Vancouver Harbour located in Downtown Vancouver, BC, Canada served as the primary staging area for flight operations.

Project Specifications

Project Location:
Vancouver / BC / Canada

Projection/Datum:
UTM Zone 10 N / NAD83(CSRS)

Project Sites	Project Size (km^2)
Total Project Area	**8.91**

LiDAR Point Density

Ground surface modeling accuracy is subject to the density of ground points recovered below the vegetation canopy. Nominal point density for the UBC LiDAR Survey was calculated to be an average of ≥ 20 points per square meter (single flight line, open hard terrain).

Orthophoto Resolution

N/A

UBC LiDAR Survey Project Overview:

Location Map of the LiDAR survey project area and Static GPS control at the University of British Columbia, Vancouver, BC.

BELL 206 B3 JET RANGER FLIGHT PARAMETERS

Rotary Wing Data Acquisition Specifications

ACQUISITION DETAILS

Collection Platform	Bell 206B Jet Ranger B3
Flying Height (AGL) – Approx Average	400 m
Acquisition Speed – Approx Average	90 km/h
Flight Line Separation – Approx Average	175 m
Lateral Flight Line Overlap – Approx Average	30 %

SYSTEM AND DATA PARAMETERS

	LiDAR
Laser Type	Riegl VQ-480i
Average Point Density	≥ 20 points / m² (single pass, open hard surfaces)
Average Along Track Spacing	0.530 m
Average Cross Track Spacing	0.183 m
Laser PRF (outgoing)	300 kHz
Mirror Scan Rate	150 Hz
Max Scan Angle	±30˚
	DIGITAL IMAGERY
NADIR CAMERA	
Camera Type	N/A
CCD Array	N/A
Lens	N/A
Field of View	N/A
Ground Sampling Distance	N/A
OBLIQUE CAMERA	
Camera Type	N/A
CCD Array	N/A
	N/A
Lens	N/A
Field of View	N/A
	NEAR INFRARED IMAGERY
Camera Type	N/A
CCD Array	N/A
Lens	N/A
Field of View	N/A
Ground Sampling Distance	N/A
	HYPERSPECTRAL IMAGERY
Sensor Type	N/A
Spectral Range	N/A
Max Spectral Resolution	N/A
Spectral Binning	N/A
Field of View	N/A
Ground Sampling Distance	N/A
	THERMAL IMAGERY
Camera Type	N/A
Megapixels	N/A
Field of View	N/A
Ground Sampling Distance	N/A

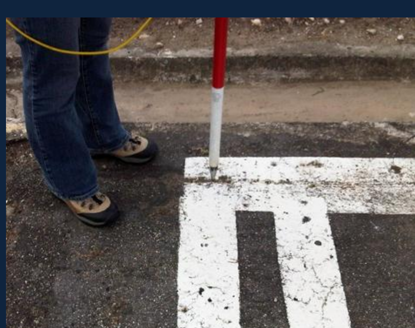
Ground Control Summary	

GPS BASE STATIONS

	GPS Base Stations: Base stations are used for positioning kinematic trajectory.
	• Baseline length: maximum 30 km.
	• Methodology:
	  ○ Set out by air-crew in the project area
	  ○ Data processed using Applanix POSPAC (v 7.0) software.

CONTROL STATIONS

	Control Stations: Targeted control monuments were established to aid in calibrating the airborne data.
	• Location: Coverage of project area
	• Geodetic Parameters:
	  ○ Horizontal Datum: NAD83 (CSRS)
	  ○ Projection: UTM Zone 10 N
	  ○ Vertical Datum: CGVD28
	  ○ Geoid: HTMVBC00_ABB
	  ○ Epoch: 2002
	  ○ Units: Metres
	• Methodology:
	  ○ All coordinates were established by static differential surveying methods and referenced to British Columbia Active Control System stations: BCVC and BCLI were held fixed for horizontal and vertical.
	  ○ Data processed using Waypoint GrafNet (v 8.5) software.

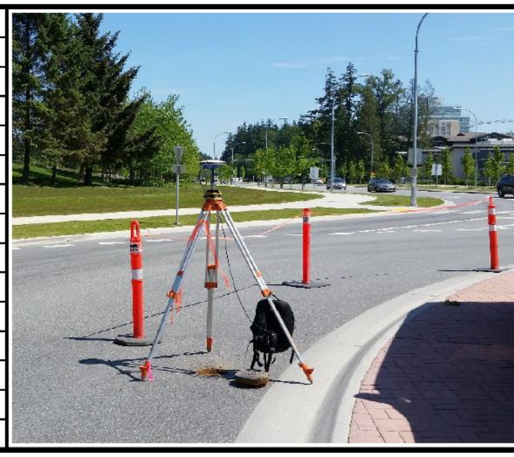
VALIDATION SITES

.
	Validation Sites: Used to validate the accuracy of the acquired data
	• Location: Coverage of project area with a general objective that no site is outside of 10 km distance from a checkpoint.
	• Methodology:
	  ○ Checkpoints collected using Post Processed Kinematic (PPK) methods.
	  ○ Checkpoints collected on open, hard-panned surfaces (e.g. Asphalt and Paint Lines).
	  ○ Data processed using Waypoint GrafNav (v. 8.5) software.

GROUND SURVEY INSTRUMENTATION	Ashtech Z-Extreme and Magellan ProFlex 500/800 dual (L1/L2) frequency receivers.

SURVEY MONUMENT DATA SHEETS

Monument Name: 2464

STATION COORDINATE SHEET	2464
AGENCY	TRSI
DATE OF SURVEY	May 20, 2015
SURVEYOR	M. Demidow
HORIZONTAL DATUM	NAD83 (CSRS)
VERTICAL DATUM	CGVD28
GEOID	(HTMVBC00_Abb)
PROJECTION	UTM Zone 10
LINEAR UNIT	Metres
EPOCH	2002.0
LATITUDE (d m s)	49 15 15.60950
LONGITUDE (d m s)	-123 14 28.05989
ELLIPSOIDAL HEIGHT	66.638
EASTING	482453.291
NORTHING	5455757.704
ELEVATION	85.588

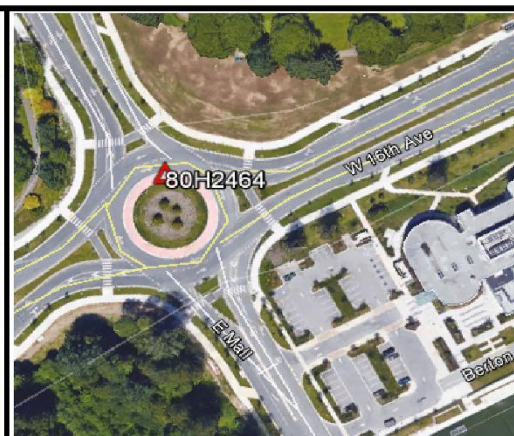


MONUMENTATION	ADJUSTMENT
TYPE 1 STANDARD CONCRETE POST WITH VALVE COVER	NONE, BCACS (BCLI & BCVC) HELD FIXED HORIZONTALLY AND VERTICALLY FOR CHECK

DESCRIPTION

GENERAL LOCATION:	VANCOUVER, BC

TABLET MARKER 80H2464; GCM#523704;
LOCATED IN THE CAMPUS OF THE UNIVERSITY OF BC
SET IN THE MEDIAN OF EAST MALL ON THE N SIDE OF 16TH AVE.
GVRD SURVEY 2002



Monument Name: PP01

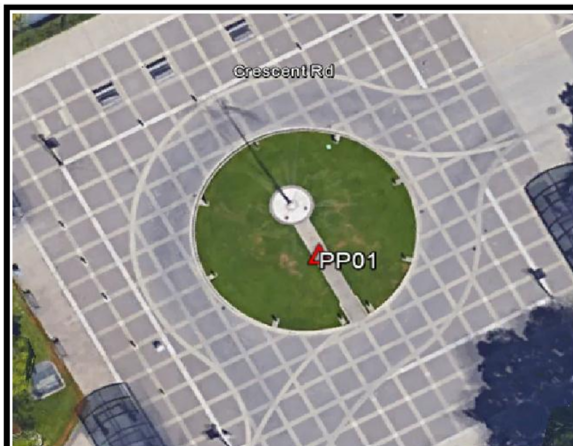
STATION COORDINATE SHEET	PP01
AGENCY	TRSI
DATE OF SURVEY	May 20, 2015
SURVEYOR	M. Demidow
HORIZONTAL DATUM	NAD83 (CSRS)
VERTICAL DATUM	CGVD28
GEOID	(HTMVBC00_Abb)
PROJECTION	UTM Zone 10
LINEAR UNIT	Metres
EPOCH	2002.0
LATITUDE (d m s)	49 16 07.99508
LONGITUDE (d m s)	-123 15 22.16875
ELLIPSOIDAL HEIGHT	68.256
EASTING	481365.032
NORTHING	5457378.998
ELEVATION	87.129

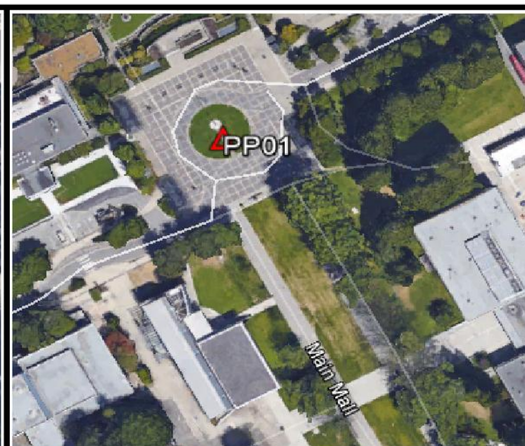
MONUMENTATION	ADJUSTMENT
STANDARD CONCRETE POST (PCON)	NONE, BCACS (BCLI & BCVC) HELD FIXED HORIZ. & VERT. CHECKED WITH UBC PP01 COORDINATES & PUBLISHED MASCOT COORDINATES ARE BETTER

DESCRIPTION

GENERAL LOCATION:	VANCOUVER, BC

TABLET MARKER "PP" GCM#521617;
LOCATED IN THE CAMPUS OF THE UNIVERSITY OF BC
NEAR THE FLAGPOLE AT THE MAIN MALL @ CRESCENT RD.
GVRD SURVEY 2002





DATA PROCESSING

The following section outlines the data processing sequence implemented for the project.

LiDAR Data

LiDAR Calibration

Once the final aircraft trajectory positions were obtained from the GPS and INS processing, the LiDAR data was calibrated to obtain the parameters necessary to apply to the system installation for the project.

External Calibration (System) - External calibration of the data involved the use of the runway calibration flights and a selection of the ground control points. These data were used to establish system offsets and nominal roll, pitch, and heading values. The position of the target features were compared with their corresponding known positions obtained through the independent GPS survey.

Internal Calibration (LiDAR) - Project area flight lines were then compared to one another (along with control) to make any necessary final adjustments to the applied values within individual flight lines. The objective is to achieve overall data accuracies that meets or exceeds the project accuracy requirements.

Following field operations, final data checks and adjustments were made during the calibration / pre-processing phase in the office. This stage of data processing yields the final geo-referencing of the data from which all checks to the data accuracy specifications are made. These checks included internal and external accuracy checks.

Ground Accuracy Testing

1. Internal Accuracy Checks

Internal checks were made on flight-line overlap areas

Comparison of overlap areas for the vertical component will utilize range data and grid interpolation. Planar areas were used to minimize the effects of artifacts at feature discontinuities:

- Intra flight - minimum of one overlap area
- Inter flight / day to day – two overlap areas (where overlap exists)

Comparison of overlap areas for the horizontal component using intensity data and extraction of conjugate features such as road or building edges:

- Intra flight - minimum of one overlap area
- Inter flight / day to day – two overlap areas

TerraMatch software was also used in the internal accuracy checks. TerraMatch software produces a report listing the apparent offsets in range, roll, pitch, and heading for each flight line. The listing includes both the offset values and standard deviations. Once saved, these values were opened in Excel and sorted to determine outliers. Any offending flight lines were flagged and returned to calibration for review.

Once all of the flight lines were reviewed in TerraMatch and approved, they were released into production. This final TerraMatch report is used for verification purposes only, and therefore the flight lines are not shifted by the suggested offsets. In order for the LiDAR data to be approved and released, all of the offsets listed in the TerraMatch report will lie within established accuracy limits.

2. External Accuracy Checks

External checks consisted of two components; checks performed on control stations and validation survey results using the GPS PPK points.

The checks consisted of horizontal and vertical comparisons of the data from the following;

- Base station over-flights
- Over-flights of standard photo type targets placed throughout or near to the project area

Using the ground control points that were not included in the calibration process, the LiDAR data accuracy test consisted of a three-dimensional coordinate difference comparison between control point coordinates and a linear interpolated mapping coordinate derived from the surface of a triangular irregular network (TIN). The coordinate difference results were analyzed to obtain the RMSE values included in this report, which are contained in the Accuracy Reporting section further in this report.

GPS PPK points were also collected on a series of identifiable features throughout the project area or calibration sites. These features, such as edge of pavement, paint lines on parking lots or roads, top of bridge deck, top of culverts etc. are identifiable in the LiDAR and digital imagery data thus ensuring a high level of confidence in the LiDAR and digital image data. Monument sheets have not been provided for the individual PPK measurements as has been provided for the static control stations.

Digital Imagery

Digital Image Calibration

Calibration of the digital camera consisted of two parts. First the internal camera calibration, which defines the individual camera parameters such as focal length, principle point, offset and lens distortion. These are typically initially determined using a test array of photo targets located at the Terra hanger. A process is also undertaken as required during field operations using images flown an area with natural targets which can be positively identified in each of the separate image.

Both methods use a reverse bundle adjustment strategy to extract the parameters. The derived camera model will be used from project to project but is checked at the beginning of each project using field measurements to ensure that the cameras are performing properly.

The second part of the calibration is project specific, which involves determining the boresite angles of the camera with respect the Inertial Measuring Units (IMU) frame of reference. The differences are small and cannot be measured directly but are easily determined through the calibration process. Once sufficient calibration points are collected, Terrasolid software solves for the boresite angles in a process similar the photogrammetric bundle block adjustment.

Digital Imagery / Orthomosaic Processing

When the raw imagery was initially mosaicked together, colour differences can be evident at seams throughout the dataset. The seams themselves are perfectly straight lines that stand out in areas of trees or buildings. The next step was a preliminary colour balance that involved two steps: a global Intensity, saturation and contrast adjustment, followed by automated colour point routine. Colour points are sample sites in common areas of the raw imagery. A triangulated colour corrective scheme is created, which can be edited. This is a powerful tool for removing seams due to colour differences.

Once the above steps are completed, the next step is to perform a seam line improvement. The seam line improvement transformed the straight seam lines into broken irregular lines following lines of contrast. This helps hide the photo seams lines through forest areas. The product at this point is visually correct.

The final step involves going through each block looking for defects and correcting features such as bridges and buildings, which may be distorted. Since orthorectification occurs to ground level, above-ground features are not in their true orthographic position. These above-ground features were edited to achieve a visually acceptable product.

QUALITY CONTROL REPORT

Terra is committed to ensure that the quality of our services and products at every level are continually monitored. We have recently implemented a Quality Management System based on the international QMS standard ISO9001:2008.

Terra's QC department assures that all deliveries meet or exceed the specifications and formats stated in the contract for this project.

Summary of quality plan

The Terra quality plan for the project may be summarized as follows:

A. Field and Pre-processing
- Field QC of acquired data
- QA of acquired data upon return from field by calibration department
- Data calibration followed by QC of results vs. ground checks

B. Data Processing
- Internal QC (IQC) is conducted within processing department following initial data processing. Identified corrections then go through a first-edit process.
- Edited data then goes through a QC conducted by the independent QA/QC department.

C. Data Delivery
- QA of final deliverable products by the independent QA/QC department

Field QC / QA Processes

1. LiDAR and Image Data Verification — The primary concerns with respect to quality for airborne LiDAR survey programs are data integrity, completeness, and coverage. The following QC procedures are undertaken in the field during the data acquisition process to address these concerns.

Data integrity refers to the data files being uncorrupted and able to be processed. Field procedures undertaken to ensure data integrity:

- Daily download from airborne system
- Checks that all files can be opened and contain the correct content
- Checks for corrupted files
- Create backup files of all data

Data completeness involves:

- Checks to ensure that there is a full set of files for each mission
- Checks to ensure there are no gaps in the data

- Data coverage checks are performed to determine that there is a match between each type of data to be collected and each area that is to be covered by that data type (e.g. if there are variations in the required coverage for LiDAR and digital image data).

2. Geo-Referencing Verification—The basic accuracy of the data is achieved primarily through a combination of the system specifications and actual operational performance and the flight procedures.

Flight procedures are subject to weather and other conditions in the air such as air traffic that may affect the way in which the project is actually flown.

While final accuracy results won't be known until the data are processed, two processes will be conducted to ensure that the data returned from the field will meet the project accuracy specifications. These processes are checks on flight data to ensure operational adherence to project specifications.

Flight data checks:

- Review of system calibration flight following installation
- Checks on actual system setting to match project specifications
- Checks on flight overlap and aircraft speed
- Checks on maximum baseline distances from aerial base stations
- Review of GPS data acquired on the base stations through network ties and redundant base station operation for checks on airborne data

Accuracy checks:

- Vertical and horizontal checks on LiDAR and image data obtained on flights over base stations and other placed targets
- Vertical and horizontal checks on additional GPS PPK data obtained throughout the project area on identifiable ground features such as road paint markings

Calibration and Data Pre-processing QC / QA Processes

Following field operations, final data checks and adjustments are made during the calibration / pre-processing phase in the office. As this stage of data processing yields the final geo-referencing of the data all checks to the accuracy specifications are made. They include internal and external accuracy checks.

1. **Internal Accuracy Checks**—Internal checks will be made on flight-line overlap areas and on the overlaps between datasets acquired on different days.
2. **External Accuracy Checks**—The external checks made by Terra consist of comparison of the LiDAR data to ties to any client supplied control and to any additional control placed by Terra in the project area.

Quality Control Methodology for Data Processing QC / QA Processes

Individual departments processing various aspects of the data conduct internal QC procedures appropriate to the type of data processing being undertaken. The following are examples of QC procedures.

- Digital Image Processing
- Checks on the consistency of the image tonal quality across the project area, particularly in areas where image boundaries occur due to different flying days or different missions
- Checks on seams where individual images are mosaicked to ensure that there are no mismatches, especially as evidenced along linear features, for example, roadways

- LiDAR Processing
- Checks on ground classification through the use of shaded relief models to ensure ground is accurately defined
- Checks on the feature classes by comparing to the digital imagery to ensure all required classes are identified within the LiDAR data

Final Quality Assurance Procedures

Terra maintains a separate QA division that reviews all data prior to delivery. Specific QA processes will be implemented for each type of data to be delivered. Checks will include the following:

- Data format
- Map projection and datum
- File name and content matching conventions adopted for the project
- Data completeness
- Consistency of data between different types, e.g. classified LiDAR points match the features in the digital image
- Review of checks on external control
- Review of bare earth classification
- Review of above ground points to ensure noise removal

ACCURACY REPORTING

The following table outlines the final accuracies obtained in the project through the comparison of the known static GPS survey locations (as described in the Survey Monuments section), as well as PPK observations (if in project scope) in comparison with the bare earth LiDAR data obtained in the survey. Individual datasheets for PPK sites have not been included as have been provided for the static GPS control.

Final Coordinates

UTM Zone 10	TRSI Final Coordinates			NAD83 (CSRS)	CGVD28	(HTMVBC00_Abb)
STATION NAME	LATITUDE (d m s)	LONGITUDE (d m s)	HEIGHT (Ellipsoidal) Metres	EASTING Metres	NORTHING Metres	ELEVATION (Orthometric) Metres
2464	49 15 15.60950	-123 14 28.05989	66.638	482453.291	5455757.704	85.588
PP01	49 16 07.99508	-123 15 22.16875	68.256	481365.032	5457378.998	87.129

Vertical Accuracy Report - Static

Control Point	CGVD28 (HTMVBC00_Abb) Elevations (Metres)		
	Known Z	Laser Z	dZ
2464	85.588	85.590	0.002
PP01	87.129	87.130	0.001

Number	2
Average dZ	0.002
Minimum dZ	0.001
Maximum dZ	0.002
Average Magnitude	0.002
Root Mean Square	0.002
Std Deviation	0.001

Vertical Accuracy Report - PPK

UTM Zone 10	TRSI Final PPK Coordinates			NAD83 (CSRS)	CGVD28	(HTMVBC00_Abb)
STATION NAME	EASTING Metres	NORTHING Metres	ELEVATION (Orthometric) Metres	ELEVATION (Laser) Metres	dZ Metres	DESCRIPTION
1003	482427.626	5455733.275	85.340	85.360	0.020	PAINT
1004	482425.65	5455730.972	85.302	85.300	-0.002	PAINT
1005	482425.225	5455731.374	85.294	85.290	-0.004	PAINT
1006	482427.167	5455733.647	85.339	85.360	0.021	PAINT
1007	482433.973	5455722.255	85.351	85.350	-0.001	PAINT
1008	482431.432	5455723.454	85.328	85.310	-0.018	PAINT
1009	482430.862	5455721.522	85.279	85.280	0.001	PAINT
1010	482433.995	5455721.673	85.343	85.340	-0.003	PAINT
1011	482493.923	5455666.5	85.408	85.380	-0.028	PAINT
1012	482495.022	5455665.647	85.370	85.370	0.000	PAINT
1013	482494.607	5455664.694	85.290	85.320	0.030	PAINT
1014	482543.409	5455642.425	83.992	83.980	-0.012	PAINT
1015	482550.473	5455629.214	83.946	83.980	0.034	PAINT
1016	482564.97	5455636.938	83.954	83.980	0.026	PAINT
1017	482630.53	5455809.119	86.899	86.890	-0.009	PAINT
1018	482634.685	5455811.26	86.869	86.870	0.001	PAINT
1019	482634.416	5455811.791	86.899	86.880	-0.019	PAINT
1020	482630.274	5455809.63	86.899	86.890	-0.009	PAINT
1021	482764.964	5455904.649	87.749	87.740	-0.009	PAINT
1022	482762.64	5455902.723	87.705	87.710	0.005	PAINT

Residual	N	Mean	Minimum	Maximum	Average Magnitude	RMS	SD
dZ	20	0.001	-0.028	0.034	0.013	0.017	0.017

DELIVERABLES SUMMARY

Deliverable Product Summary

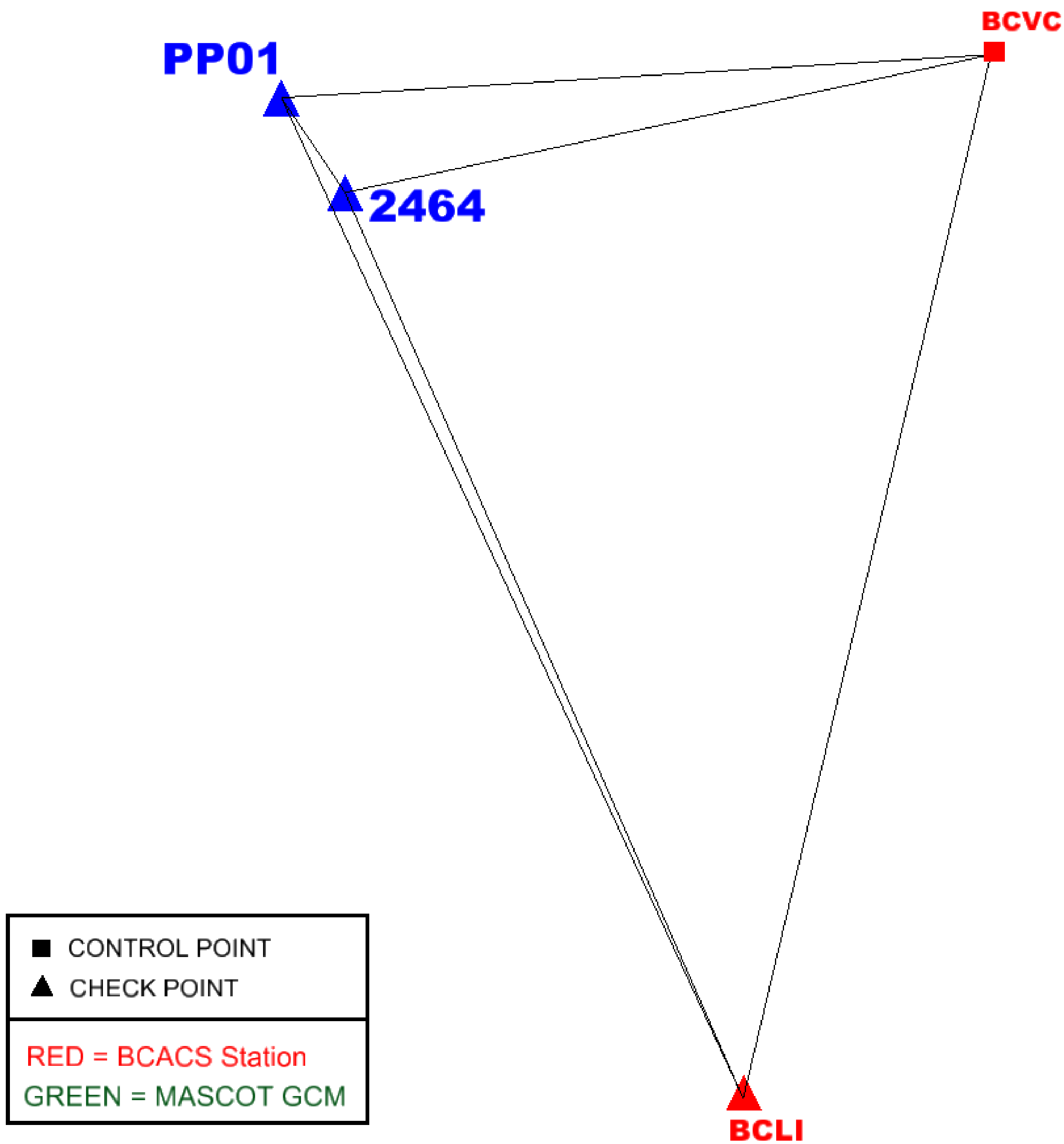
Final Deliverable Coordinates	**Projection:**	UTM Zone 10 N		
	Datum:	NAD83(CSRS)		
Delivery Medium	**Hard Drive**	☐	**FTP**	☑

Delivery Products	**Description**	**Resolution**	**Format**	**In Scope**	
				YES	**NO**
LiDAR	Ground	n/a	.las v1.2	☑	☐
	Non-Ground	n/a	.las v1.2	☑	☐
	Detailed Classification (pre-determined feature code)	n/a	.las v1.2	☐	☒
	Filtered ground LiDAR points (MKP)	n/a	.las v1.2	☐	☒
DEM		m	.img	☑	☐
DSM		m	.img	☐	☒
CHM		m	.img	☐	☒
TIN		m	.img	☑	☒
3D Mesh		m	.dxf	☐	☒
Contours	not cartographically enhanced	25 cm	.shp	☑	☐
Hillshade Models		m	.tiff	☐	☒
Slope / Aspect Maps		m	.tiff	☐	☒
PLS-CADD®	Compiled .bak model	n/a	.bak	☐	☒
	In-flight MET data	n/a	.csv	☐	☒
Planimetry	2D - pre-determined feature code	n/a	.shp	☐	☒
	3D - pre-determined feature code	n/a	.shp	☐	☒
3D Buildings	3D wireframe buildings	n/a	.shp	☐	☒
Tree crown polygons	Max-diameter	n/a	.shp	☐	☒
Tree-top points	Max height point	n/a	.shp	☐	☒
RGB Imagery	Orthophoto mosaics	cm	.ecw	☐	☒
	Oblique imagery	cm	.jpg	☐	☒
NIR Imagery	Orthophoto mosaics	cm	.tiff	☐	☒
Hyperspectral Imagery	VNIR Bands - Radiometrically calibrated mosaics	m	.tiff	☐	☒
	SWIR Bands - Raidometrically calibrated mosaics	m	.tiff	☐	☒
TIR Imagery	Calibrated mosaics	cm	.tiff	☐	☒
Video	Nadir and Oblique digital video	n/a	.mp4	☐	☒
Plots		scale	.pdf	☐	☒
Project Index	Key map containing all relevant project information	n/a	.dwg	☑	☐
Project Report	Accuracy and general project reporting	n/a	.pdf	☑	☐
Other				☐	☒

Comments

APPENDIX A – NETWORK ADJUSTMENT:

Network Adjustment Diagram



BCACS (BCLI & BCVC) stations were held fixed in the horizontal and vertical. Checked with published MASCOT coordinates

Network Adjustment Residuals

```
              * NETWORK - WEIGHTED GPS NETWORK ADJUSTMENT      *
              *                                                *
              * (c) Copyright NovAtel Inc., (2014)             *
              *                                                *
              * Version: 8.40.5121                             *
              *                                                *
              * FILE: D:\2015019\000-2595-01\D140\control\static\proc\000-2595-
01_D140_UBC_Static.net
              **************************************************

DATE(m/d/y): Wed.   5/20/15   TIME: 22:04:20

***************************************************************

  DATUM:             'NAD83'
  SCALE_FACTOR:      2.9696
  CONFIDENCE LEVEL: 95.00 %   (Scale factor is 2.4479)

****************************************************************
    INPUT CONTROL/CHECK POINTS
****************************************************************

STA_ID     TYPE    -- LATITUDE --  -- LONGITUDE --  ELLHGT -   HZ-SD   V-SD
2464       CHK-3D  49 15 15.60872 -123 14 28.06042     66.645
BCLI       CHK-3D  49 06 54.40474 -123 08 49.61827     -4.645
BCVC       GCP-3D  49 16 32.73535 -123 05 21.58021     11.439 0.00500 0.00500
PP01       CHK-3D  49 16 07.99424 -123 15 22.16827     68.283

***************************************************************
    INPUT VECTORS
****************************************************************

SESSION NAME           VECTOR(m)   ------ Covariance (m) [unscaled] ------
                        DX/DY/DZ          standard deviations in brackets
2464 to BCLI (1)       -654.7709  3.5411e-006 (0.0019)
                     -13519.2645  2.6165e-006 6.1759e-006 (0.0025)
                     -10174.3985  -2.1230e-006 -5.1709e-006 1.2026e-005 (0.0035)

2464 to PP01 (1)       -243.2030  4.6657e-007 (0.0007)
                       1624.4307  3.0615e-007 9.4051e-007 (0.0010)
                       1057.3872  -2.8675e-007 -7.1027e-007 1.6967e-006 (0.0013)

BCLI to PP01 (1)        411.5696  3.6194e-006 (0.0019)
                      15143.7040  2.0231e-006 5.9172e-006 (0.0024)
                      11231.7708  -4.6039e-007 -2.1420e-006 7.5007e-006 (0.0027)

BCVC to 2464 (1)     -10256.0176  1.6136e-006 (0.0013)
                       4502.6560  1.1283e-006 3.9206e-006 (0.0020)
                     -1513.0071   -8.9795e-007 -2.9559e-006 6.9604e-006 (0.0026)

BCVC to BCLI (1)     -10910.7960  4.9832e-006 (0.0022)
```

```
                       -9016.6134  2.3556e-006 4.5881e-006 (0.0021)
                       -11687.3896  -1.8873e-006 -8.7554e-007 6.8246e-006 (0.0026)

BCVC to PP01 (1)       -10499.2228  1.3625e-006 (0.0012)
                        6127.0963  9.1276e-007 2.1584e-006 (0.0015)
                        -455.6264  -1.0441e-006 -1.7535e-006 4.4259e-006 (0.0021)

****************************************************************
    OUTPUT VECTOR RESIDUALS (East, North, Height - Local Level)
****************************************************************

SESSION NAME               -- RE --    -- RN --    -- RH --     - PPM -   DIST - STD -
                             (m)         (m)         (m)                  (km)    (m)
2464 to BCLI (1)           0.0014      0.0025      0.0136       0.818   16.9  0.0080
2464 to PP01 (1)          -0.0012     -0.0001     -0.0023       1.336    2.0  0.0030
BCLI to PP01 (1)           0.0008      0.0008      0.0008       0.075   18.9  0.0071
BCVC to 2464 (1)          -0.0036      0.0011     -0.0027       0.412   11.3  0.0061
BCVC to BCLI (1)           0.0013     -0.0006     -0.0065       0.365   18.4  0.0070
BCVC to PP01 (1)           0.0022     -0.0000      0.0044       0.406   12.2  0.0049
                         --------------------------------
               RMS         0.0020      0.0012      0.0066

 $ - This session is flagged as a 3-sigma outlier

****************************************************************
    CHECK POINT RESIDUALS (East, North, Height - Local Level)
****************************************************************

STA. NAME    -- RE --    -- RN --    -- RH --
               (m)         (m)         (m)
2464         0.0071      0.0251     -0.0092
BCLI         0.0171      0.0066     -0.0350
PP01        -0.0076      0.0261     -0.0226
            --------------------------------
RMS          0.0115      0.0212      0.0246

****************************************************************
    CONTROL POINT RESIDUALS (ADJUSTMENT MADE)
****************************************************************

STA. NAME    -- RE --    -- RN --    -- RH --
               (m)         (m)         (m)
BCVC        -0.0000     -0.0000      0.0000
            --------------------------------
RMS          0.0000      0.0000      0.0000

****************************************************************
    OUTPUT STATION COORDINATES (LAT/LONG/HT)
****************************************************************

STA_ID      -- LATITUDE --  -- LONGITUDE -- - ELLHGT -
2464        49 15 15.60953 -123 14 28.06007    66.6358
BCLI        49 06 54.40495 -123 08 49.61743    -4.6800
BCVC        49 16 32.73535 -123 05 21.58021    11.4390
```

```
PP01         49 16 07.99508 -123 15 22.16865    68.2604



*****************************************************************
    OUTPUT VARIANCE/COVARIANCE
*****************************************************************
                                              2
STA_ID       SE/SN/SUP  --------- CX matrix (m )-----------
             (95.00 %)  (not scaled by confidence level)
                (m)          (ECEF, XYZ cartesian)
2464            0.0126  2.7288e-005
                0.0129  1.4990e-006 2.9266e-005
                0.0145  -1.3790e-006 -3.0818e-006 3.2863e-005

BCLI            0.0129  2.9896e-005
                0.0136  2.7519e-006 3.1247e-005
                0.0150  -1.8368e-006 -2.6014e-006 3.4781e-005

BCVC            0.0122  2.5000e-005
                0.0122  3.6401e-020 2.5000e-005
                0.0122  -5.2804e-022 -3.7249e-020 2.5000e-005

PP01            0.0126  2.7192e-005
                0.0129  1.4064e-006 2.8688e-005
                0.0142  -1.3836e-006 -2.6390e-006 3.1943e-005




*****************************************************************
    VARIANCE FACTOR = 1.0000

    Note: Values < 1.0 indicate statistics are pessimistic, while
          values > 1.0 indicate optimistic statistics. Entering this
          value as the network adjustment scale factor will bring
          variance factor to one.
*****************************************************************
```

APPENDIX B – ACTIVE CONTROL STATION REPORT:

BCACS Station: BCLI

GeoBC

BRITISH COLUMBIA ACTIVE CONTROL SYSTEM

GPS ACTIVE CONTROL POINT as of 2012/01/27

STATION: BCLI
GEODETIC MARK: 869792
FULL NAME: BCACS - Lulu Island ACP
CLASS: BCACS Primary
LOCATION: Richmond, B.C., Canada

- 2005/04/05

MARKER COORDINATES: Latitude n49 6 54.40474
Longitude w123 8 49.61827
Ellipsoid Height - 4.645
Orthometric Height 14.895

GEODETIC ATTRIBUTES: Datum/Ellipsoid = NAD83(CSRS) 4.0.0.BC.1.GVRD
Geoid Model = HTGVRDBC00
N = -19.54m xi = -
4.68s
eta = 2.53s

REFERENCE NETWORKS:
Inner: nil

Outer:

COLLOCATION TIES:
- nil

ANTENNA HEIGHT: > vertical distance measured to antenna reference point

– 2004/09/04 00:00UT 0.000m

GPS RECEIVER:
– 2011/09/27 19:00UT Leica GR10 s/n 1700656
(used for RINEX as of 2012/01/27)
– 2004/09/30 15:00UT Trimble NetRS s/n#4432236955

FIRMWARE:

- 2011/09/27 19:00UT Firmware ver. 1.1
- 2011/01/28 01:00UT Firmware ver. 1.3.0
- 2005/04/28 00:00UT Firmware ver. 1.13

– 2004/09/30 15:00UT Firmware ver. 1.03

ANTENNA (diagram below):
– 2011/09/27 19:30UT LEIAR25 LEIT s/n 725136
– 2004/09/04 20:35UT Trimble Zephyr Geodetic with GP (NGS TRM41249.00) sn# 12379381
– 2004/09/30 15:00UT Trimble Choke Ring w/radome (TRM29659.00) sn# 0220335638

ANTENNA CABLE:
- 2004/09/30 00:00UT

CLOCK:

- 2004/09/30 00:00UT GPS Receiver Internal Clock

MODEMS:
- N/A

UNINTERUPTABLE POWER SUPPLY:

- 2004/09/30

STATUS:
- 2004/09/30 00:00UT Operational

AGENCY: GeoBC
Prince of British Columbia

CONTACT: Vern Vogt P. Eng.
Province of British Columbia
GeoBC
3400 Davidson Ave.
Victoria, BC, Canada V8Z 3P8
Tel: (250) 952-6571 Fax: (250) 952-4188 email: vern.vogt@gov.bc.ca

ANTENNA DIAGRAM:

2011/09/27 Leica AR25 w/ Leica dome (LEIAR25 LEIT)

```
 <--                                   -->
     _______________________________________________
    /                              \
   /                                \
  /                                  \
 /                                    \
/                                      \
/                                       \
|                                       |
|             ------------                | <--  0.1540 L2
|       Phase Center  +     \                 | <--  0.1583 L1
|            |          |             |
+-------------------------------------------------------+
|               Antenna                      |
|                                       |
+-----------------+---------------+---------------------+
             |          |
```

```
              |          |                                                <-- -0.0000  ARP
            +--+======|X|======+--+                  <-- Marker
            |              |
            |    Aluminum      |
            |     Mast       |
```

- 2006/11/26 Dorne Margolin Trimble Choke Ring w/radome (NGS TRM29659.00 UNAV)

```
 <--               0.3810               -->

                ------------                    <--  0.1273  L2
          Phase Center  +      \                    <--  0.1077  L1
               |          |
 +-------------------------------------------------------+
 |                  Antenna                       |
 |                                          |
 +-----------------+---------------+---------------------+
              |          |
              |          |                                                <-- -0.0000  ARP
            +--+======|X|======+--+                  <-- Marker
            |              |
            |    Aluminum      |
            |     Mast       |
```

- 2006/09/04 Trimble Zephyr Geodetic with GP (NGS TRM41249.00)

```
 <--               0.3810               -->

               ------------
         Phase Center  +      \                    <--  0.0714 / 0.0682  L1/L2
              |          |
 +-------------------------------------------------------+
 |                  Antenna                       |
 |                                          |
 +-----------------+---------------+---------------------+
              |          |
              |          |                                                <-- -0.0000  ARP
            +--+======|X|======+--+                  <-- Marker
            |              |
            |    Aluminum      |
            |     Mast       |
```

- 2004/09/30 Dorne Margolin Trimble Choke Ring w/radome (NGS TRM29659.00 UNAV)

```
 <--                 0.3810                  -->

                  ------------
          Phase Center  +       \                <--  0.110  L1/L2
                |            |
 +--------------------------------------------------------+
 |                  Antenna                      |
 |                                         |
  +------------------+---------------+---------------------+
                |            |
                |            |                                          <-- -0.0000  ARP
             +--+======|X|======+--+              <-- Marker
             |                 |
             |    Aluminum       |
             |      Mast         |
```

Marker - X

ACRONYMS:

ARP ... Antenna Reference Point

BCACS ... British Columbia Active Control System

NAD83 ... North American Datum 1983

SRMB ... Surveys and Resource Mapping Branch

WGS84 ... World Geodetic System 1984

Reference*:*
http://geobc.gov.bc.ca/base-mapping/atlas/gsr/products/bcacs/bcacsinfo/bcli_site.pdf

BCACS Station: BCVC

GeoBC
BRITISH COLUMBIA ACTIVE CONTROL SYSTEM

GPS ACTIVE CONTROL POINT as of 2012/01/27

STATION: BCVC
GEODETIC MARK: 875864
FULL NAME: BCACS - Vancouver City Firehall #1 ACP
CLASS: BCACS Primary
LOCATION: Vancouver, B.C., Canada

- 2005/06/17

MARKER COORDINATES: Latitude n 49 16 32.73535
Longitude w123 5 21.58021
Ellipsoid Height 11.439
Orthometric Height 30.229

GEODETIC ATTRIBUTES: Datum/Ellipsoid = NAD83(CSRS) 4.0.0.BC.1.GVRD
Geoid Model = GVRD00
N = -18.79 xi = -12.76s
eta = -0.58s

REFERENCE NETWORKS:
Inner: nil

Outer:

COLLOCATION TIES:
- nil

ANTENNA HEIGHT: > vertical distance measured to antenna reference point

- 2004/09/28 00:00UT 0.000m

GPS RECEIVER:

- 2011/09/28 15:00UT Leica GR10 s/n 1700619
  (used for RINEX as of 2012/01/27)
- 2004/09/28 11:00UT Trimble NetRS s/n#4432236954

FIRMWARE:

- 2011/09/28 15:00UT Firmware ver. 1.1
- 2011/01/21 01:00UT Firmware ver. 1.3.0
- 2005/04/28 00:00UT Firmware ver. 1.13
- 2004/09/28 11:00UT Firmware ver. 1.03

ANTENNA (diagram below):

- 2011/09/28 15:00UT LEIAR25 LEIT s/n 10231039
- 2004/09/28 11:00UT Trimble Choke Ring w/Radome (TRM29659.00) sn#0220335632

ANTENNA CABLE:
- 2004/09/28 00:00UT

CLOCK:

- 2004/09/28 00:00UT GPS Receiver Internal Clock

MODEMS:
- N/A

UNINTERRUPTABLE POWER SUPPLY:

- 2004/09/28

STATUS:
- 2004/09/28 00:00UT Operational

AGENCY: GeoBC
Prince of British Columbia

CONTACT: Vern Vogt P. Eng.
Province of British Columbia
GeoBC
3400 Davidson Ave.
Victoria, BC, Canada V8Z 3P8
Tel: (250) 952-6571 Fax: (250) 952-4188
email: vern.vogt@gov.bc.ca

ANTENNA DIAGRAM:

2011/09/28 Leica AR25 w/ Leica dome (LEIAR25 LEIT)

```
 <--                                        -->
     ____________________________________________
     /                                \
    /                                  \
   /                                    \
  /                                      \
 /                                        \
/                                          \
|                                          |
|           ------------                   |<--  0.1540 L2
|     Phase Center +      \                 |<--  0.1583 L1
|            |          |                  |
+-------------------------------------------------------+
|                Antenna                        |
|                                          |
```

```
 +-----------------+---------------+--------------------+
              |           |
              |           |                                                                  <-- -0.0000  ARP
          +--+======|X|======+--+               <-- Marker
          |                 |
          |    Aluminum       |
          |      Mast         |
```

- 2004/09/28 Dorne Margolin Trimble Choke Ring w/radome (NGS TRM29659.00 UNAV)

```
 <--                  0.3810                  -->

                ------------                   <--  0.1273  L2
          Phase Center  +      \                  <--  0.1077  L1
               |           |
 +------------------------------------------------------+
 |                   Antenna                      |
 |                                            |
 +-----------------+---------------+--------------------+
              |           |
              |           |                                                                  <-- -0.0000  ARP
          +--+======|X|======+--+               <-- Marker
          |                 |
          |    Aluminum       |
          |      Mast         |
```

Marker - X

-- ACRONYMS:

ARP ... Antenna Reference Point

BCACS ... British Columbia Active Control System

NAD83 ... North American Datum 1983 WGS84 ... World Geodetic System 1984

Reference: *http://geobc.gov.bc.ca/base-mapping/atlas/gsr/products/bcacs/bcacsinfo/bcvc_site.pdf*

APPENDIX C – DELIVERABLE DATA INVENTORY:

Delivery Details – June 30th ,2015

```
FreeCommander - Contents of folder:  T:\Projects\Aerial\000-2595 UBC - Vancouver
BC\Deliveries 30/06/2015 1:47 PM

Date       Time    Attrib       Bytes          File name
---------- -------- ------   ----------------  --------

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries
30/06/2015 1:45:38 PM AD----                     CONTOURS
30/06/2015 1:45:49 PM AD----                     DEM
30/06/2015 1:45:21 PM AD----                     INDEX
30/06/2015 1:44:46 PM AD----                     LAS
30/06/2015 1:45:29 PM AD----                     TIN
                          -------------------
                                          256  1 Files

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries\CONTOURS
30/06/2015 9:00:54 AM A-----          5,108,960
UBC_480_5456_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:00:36 AM A-----         12,224,896
UBC_480_5457_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:01:28 AM A-----         16,435,552
UBC_481_5455_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:00:16 AM A-----         23,357,184
UBC_481_5456_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:56:14 AM A-----         21,297,504
UBC_481_5457_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:56:35 AM A-----         10,873,440
UBC_481_5458_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:02:51 AM A-----         10,267,104
UBC_482_5454_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:02:14 AM A-----         16,267,072
UBC_482_5455_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:59:25 AM A-----          7,909,760
UBC_482_5456_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:58:10 AM A-----         10,773,632
UBC_482_5457_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:57:10 AM A-----         21,106,176
UBC_482_5458_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:03:10 AM A-----          8,818,720
UBC_483_5454_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 9:02:27 AM A-----          4,871,968
UBC_483_5455_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:59:08 AM A-----          2,883,264
UBC_483_5456_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:58:50 AM A-----         18,359,520
UBC_483_5457_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:57:31 AM A-----         12,852,864
UBC_483_5458_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:58:58 AM A-----            479,008
UBC_484_5456_UTM10_25cmContours_SP000-2595_v1.dwg
30/06/2015 8:58:56 AM A-----            219,328
UBC_484_5457_UTM10_25cmContours_SP000-2595_v1.dwg
```

```
                          -------------------
                                204,105,952  18 Files

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries\DEM
30/06/2015 12:21:12 PM A-----          2,688,720  UBC_480_5456_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:13 PM A-----          4,589,907  UBC_480_5457_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:16 PM A-----         12,679,788  UBC_481_5455_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:26 PM A-----         28,099,790  UBC_481_5456_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:31 PM A-----         28,431,957  UBC_481_5457_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:20:48 PM A-----          6,474,519  UBC_481_5458_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:20:48 PM A-----          6,864,841  UBC_482_5454_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:20:53 PM A-----         30,684,503  UBC_482_5455_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:20:56 PM A-----         29,795,172  UBC_482_5456_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:20:59 PM A-----         30,895,845  UBC_482_5457_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:01 PM A-----         19,171,042  UBC_482_5458_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:02 PM A-----         10,254,786  UBC_483_5454_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:03 PM A-----         10,364,261  UBC_483_5455_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:04 PM A-----         11,145,168  UBC_483_5456_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:08 PM A-----         26,556,150  UBC_483_5457_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:11 PM A-----         10,694,957  UBC_483_5458_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:11 PM A-----          2,223,227  UBC_484_5456_UTM10_DEM_SP000-
2595_v1.xyz
30/06/2015 12:21:11 PM A-----            840,875  UBC_484_5457_UTM10_DEM_SP000-
2595_v1.xyz
                          -------------------
                                272,455,508  18 Files

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries\INDEX
29/06/2015 9:04:46 AM A-----            334,169  000-
2595_PointGrey_ClientIndex_UTM10_v1.dwg
                          -------------------
                                    334,169  1 Files

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries\LAS
30/06/2015 12:24:41 PM A-----        167,022,637  UBC_480_5456_UTM10_SP000-
2595_v1.las
30/06/2015 12:24:47 PM A-----        402,104,009  UBC_480_5457_UTM10_SP000-
2595_v1.las
```

```
30/06/2015 12:25:00 PM A-----       888,424,539  UBC_481_5455_UTM10_SP000-
2595_v1.las
30/06/2015 12:25:20 PM A-----     1,185,169,331  UBC_481_5456_UTM10_SP000-
2595_v1.las
30/06/2015 12:25:46 PM A-----     1,351,086,339  UBC_481_5457_UTM10_SP000-
2595_v1.las
30/06/2015 12:25:53 PM A-----       413,578,329  UBC_481_5458_UTM10_SP000-
2595_v1.las
30/06/2015 12:21:19 PM A-----       488,647,983  UBC_482_5454_UTM10_SP000-
2595_v1.las
30/06/2015 12:21:50 PM A-----     1,247,999,631  UBC_482_5455_UTM10_SP000-
2595_v1.las
30/06/2015 12:22:14 PM A-----     1,028,203,299  UBC_482_5456_UTM10_SP000-
2595_v1.las
30/06/2015 12:22:39 PM A-----     1,342,546,287  UBC_482_5457_UTM10_SP000-
2595_v1.las
30/06/2015 12:23:04 PM A-----     1,388,213,829  UBC_482_5458_UTM10_SP000-
2595_v1.las
30/06/2015 12:23:15 PM A-----       576,580,585  UBC_483_5454_UTM10_SP000-
2595_v1.las
30/06/2015 12:23:24 PM A-----       435,751,463  UBC_483_5455_UTM10_SP000-
2595_v1.las
30/06/2015 12:23:33 PM A-----       561,422,433  UBC_483_5456_UTM10_SP000-
2595_v1.las
30/06/2015 12:24:10 PM A-----     1,655,583,641  UBC_483_5457_UTM10_SP000-
2595_v1.las
30/06/2015 12:24:35 PM A-----       959,786,017  UBC_483_5458_UTM10_SP000-
2595_v1.las
30/06/2015 12:24:39 PM A-----        89,910,025  UBC_484_5456_UTM10_SP000-
2595_v1.las
30/06/2015 12:24:40 PM A-----        43,820,951  UBC_484_5457_UTM10_SP000-
2595_v1.las
                          -------------------
                               14,225,851,328  18 Files

T:\Projects\Aerial\000-2595 UBC - Vancouver BC\Deliveries\TIN
30/06/2015 10:01:36 AM A-----         1,403,568  UBC_480_5456_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:37 AM A-----         3,843,687  UBC_480_5457_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:38 AM A-----         5,268,100  UBC_481_5455_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:41 AM A-----         9,320,143  UBC_481_5456_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:44 AM A-----        10,455,166  UBC_481_5457_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:45 AM A-----         3,720,497  UBC_481_5458_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:46 AM A-----         3,616,834  UBC_482_5454_UTM10_TIN_SP000-
2595_v1.dwg
30/06/2015 10:01:49 AM A-----        10,735,814  UBC_482_5455_UTM10_TIN_SP000-
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30/06/2015 10:01:51 AM A-----         7,085,488  UBC_482_5456_UTM10_TIN_SP000-
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30/06/2015 10:01:58 AM A-----         4,442,729  UBC_483_5454_UTM10_TIN_SP000-
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30/06/2015 10:01:58 AM A-----         3,671,450  UBC_483_5455_UTM10_TIN_SP000-
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30/06/2015 10:01:59 AM A-----         2,487,953  UBC_483_5456_UTM10_TIN_SP000-
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30/06/2015 10:02:02 AM A-----         8,872,608  UBC_483_5457_UTM10_TIN_SP000-
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30/06/2015 10:02:03 AM A-----         4,168,217  UBC_483_5458_UTM10_TIN_SP000-
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30/06/2015 10:02:03 AM A-----           433,579  UBC_484_5456_UTM10_TIN_SP000-
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30/06/2015 10:02:03 AM A-----           206,074  UBC_484_5457_UTM10_TIN_SP000-
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