

Peace Project Water Use Plan

Williston Air Photos and DEM

Reference: GMSWORKS #14

Williston Air Photos and DEM 2011

Study Period: May 2011 to December 2011

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Williston Reservoir Aerial Photos & Digital Elevation Model

2011 Project Report

Introduction

The Williston Reservoir Air Photos and DEM project is a supporting project for physical works and monitoring projects within the Peace Water License Requirements (WLR) program. The spatial data collected as part of this project will be used as supplementary data for wetland enhancement, tributary enhancement, dust control, and debris management. In addition to its use within WLR projects, the data is likely to benefit various users within BC Hydro.

The project is scheduled to collect spatial data three times over a 10-year period. The terms of reference indicates data collection is to occur in project years 1, 5, and 10 (2009, 2013, and 2018, respectively). In early 2011, BCH adjusted the schedule to advance data collection from 2013 to 2011 to take advantage of abnormally low reservoir conditions. A larger area of the drawdown zone is exposed during low reservoir conditions enabling more information to be collected. The schedule for the final set of photos remains unchanged with a 2018 start date. This report describes the second set of air photo acquisition and related photogrammetry. The project in 2011 consisted of two components and related deliverables.

- i. Aerial photos at a 1:10,000 scale (or digital equivalent) of the drawdown zone for the entire reservoir,
- ii. Aerial photos at a 1:5000 scale (or digital equivalent) of selected areas, and
- iii. Digital elevation model (supplementing existing data)

Methodology

Air Photos and Related Photogrammetry

BC Hydro fully prepared digital flight maps and flying heights for both the 1:10,000 and 1:5000 scale photography. The area of coverage for the 1:10,000 scale photography included the drawdown zone for the entire reservoir as well as the area 200 m beyond the full pool line. The coverage area for the 1:5000 scale photography included:

- Boat launches: Billy's Bay, Finlay Bay, Dunlevy, Elizabeth Creek, Six Mile Bay, Cutthumb and Mackenzie Landing)
- Two wetland areas: Airport Lagoon/culvert, Beaver Pond (GMSWORKS#17 project sites)
- 1 km upstream from the full pool line for four tributaries: Six Mile Creek, Lamonti Creek, Ole Creek and Factor Ross Creek(GMSWORKS#19 and GSMON#17 project sites)

Aerial photography of Williston Reservoir was acquired by Kisik Aerial Survey Inc. and Aero-Photo (1961) Inc. was subcontracted for additional support due to the tight time frame for data capture. The photos were obtained using a digital sensor and the data was collected according to the BC Hydro Survey & Photogrammetry Department Aerial Photography Specification AP97-1.1 (Appendix 1) and in accordance to BC Government specifications (Appendix 2). One exception to these specifications was the minimum solar angle. Pre-flight discussions between BC Hydro and Kisik Aerial Survey resulted in a reduction in the solar angle minimum from 35 to 32 degrees to allow more time per day for photo acquisition.

Aerial triangulation (AT), a process that allows for the spatial positions of all points on an aerial photograph to be mapped precisely, was completed on all photography and adjusted to surveyed ground control points and secondary control points. BC Hydro utilized 59 previously surveyed control points, plus 6272 secondary points.

BC Hydro Photogrammetry generated a waterline at time of photography to be used for two related processes. The first was supplied to TerraSond Hydrographic to aid in their bathymetric data for GMSWorks#25 Williston Bathymetry project. The second was for elimination of previously collected LiDAR points in areas of change due to erosion, or erroneous LiDAR points (water returns that are not valid). The resulting polygon was then supplied to J.R. CanMap and Delta Aerial Surveys Ltd. who compiled a Digital Elevation Model of the area above the supplied water line and up to existing LiDAR DEM points. A further examination of LiDAR data was performed and areas of change were noted and corrected.

Contours at 1M interval were created for the entire reservoir and utilized the LiDAR, Photogrammetric DEM and additional mapping to produce the Bare Earth Digital Model. This is the final resulting Digital Elevation Model and refers to all elevation points at ground level. Orthophotos were generated from the imagery. The orthophotos were controlled using the combined (LiDAR from 2009, Photogrammetric DEM from 2011) Bare Earth Digital Model data set, and were produced to the area encompassed by the 200 metre full pool line. Both the contours and orthophoto data set were produced to 1 Km x 1 Km tiles for ease of viewing.

BC Hydro Photogrammetry Services performed QA/QC at each stage of the process ensuring the quality of the deliverables met all specifications. The QC of deliverables was done by various techniques including visual inspection in the 3D workstation, software content checking for such items as duplicate points. Drainage planimetry outside of the 200 m full pool was not checked or completed for this version of the project. In 2009, some areas were not captured with aerial photography. Air photos in 2011 captured those missed areas, but the planimetrics were not part of the deliverable at this time, only the orthophoto and DEM were delivered for those areas not previously captured.

Results

Data capture occurred between May 15, 2011 and May 29, 2011 inclusive and resulted in the following:

High level (1:10000) digital photos: 3390
Low level (1:5000) digital photos: 163

All imagery was delivered by June 28, 2011.

Aerial triangulation was performed by 4DGIS LTD. and BC Hydro personnel and was completed by September 30, 2011. There were some delays in final processing due to various issues, including:

- Quality of the aerial photography was not always good. There are some instances where features on the image are smudged. Kisik Aerial Survey was notified and will take a look at the issue. No adverse results were noticed less than 30 images were affected.
- Forward overlap in some cases was close to 50% or less instead of 60% minimum. Kisik Aerial Survey was notified and will take a look at the issue.

- Lateral overlap in some cases was 10% or less instead of specified 30%. Kisik Aerial Survey has been notified and will take a look at the issue. No adverse results were noticed less than 30 images were affected.
- Snow was on the ground at the time aerial photography was taken, so data collection and orthophoto are affected and resulted in a few small areas of snow cover on the final orthophoto and created areas of indefinite (areas of obscured ground) DEM less than 3% of total area.
- Previous version (2009) AT was not completely tied together. In AT, all levels of photo should have common control points and should include some of the points from the LiDAR data set. This was not completed in the 2009 data set and this resulted in some discrepancies between the two epochs of data. The 2011 version has been completely tied to all existing data in 2011 including the LiDAR data.

Results of the AT were:

- Root Mean Square Error of primary survey control targets (transferred to 2011 digital photos) did not exceed 0.016 m for x, y or z (this is considered excellent)
- Root Mean Square Error of secondary control including 2718 lake elevation points 0.034 m (this is considered good), 3442 AGPS (camera locations) 0.118 m (this is considered good) and 112 other points 0.170 m (this is considered acceptable).
- 110 images were not included due to 100% or near 100% water.

Due to complications as stated above, the AT was processed in three stages (each arm in Williston was created separately, then combined in a final version) allowing for some compilation to begin before a final Aerial Triangulation result was delivered.

Due to complications and schedule delay in the AT process, compilation of Bare Earth Digital Elevation Model and QC of 2009 LiDAR data was completed using BC Hydro personnel and two contractors (J.R. CanMap and Delta Aerial Surveys Ltd.) to ensure the data was compiled on time. BC Hydro Photogrammetry compiled the water line at time of photography for delivery to contractors and GMSWorks #25 project. Contractors were given the task of compiling a Bare Earth Digital Elevation Model from the previous 2009 LiDAR data that was captured at a reservoir elevation of 664.0 m. In 2011 the elevation varied from 656.4 to 660.0 m. While the Bare Earth DEM was being compiled, the 2009 LiDAR data set was also checked for any erosion or erroneous elevation points. These areas were delineated and were part of the deliverables from the contractors. All data from contractors was delivered by Dec. 20, 2011.

Other Users

Photogrammetry Services has had many enquiries for using the data. A partial list of users to date and the program or description follows:

Erosion impact study of Dunlevy area for Site C
 Beach Dust study in Finlay Reach for H. Brownlow
 Bennett Dam LiDAR and Ortho data for Scott Gillis
 Bennett Dam LiDAR and Ortho data for Quarry above tailrace Jason Braund-Read
 Bennett Dam Study for Gord Anderlini

