



Reference: 15-02

25 February 2015

Wayne Carlson,
Senior Ranger – Southern Regional Parks
Auckland Council
PO Box 72-132
Papakura

References: 1) DML Revised Quotation for Survey of Hunua Falls dated 9 December 2014

REPORT OF SURVEY – HUNUA FALLS

1. Survey Location and Requirements

Auckland Council contracted Discovery Marine Ltd (DML) to undertake a survey of the lake and the surrounding low lying flat land at the base of the Hunua Falls in accordance with the DML proposal of 9 December 2014. The falls are a popular swimming and recreation location in the Hunua Regional Park. The general location of the lake and falls are indicated in the following image.

The survey was undertaken to provide information that Auckland Council could use for improved safety signage and as a baseline survey in the absence of any other data.

The lake is approximately 60m across and is formed behind a rock ridge that dams the discharge into a small stream. The deepest part of the lake is approximately 17m lower than the level of the rock ridge.



DISCOVERY MARINE LIMITED
PO Box 4048, Mount Maunganui, 3149, Bay of Plenty, New Zealand
p. New Zealand 0800 365 787 p. Australia 1800-625-317
e. info@dmlsurveys.co.nz w. www.dmlsurveys.co.nz
ABN 68 914 988 491



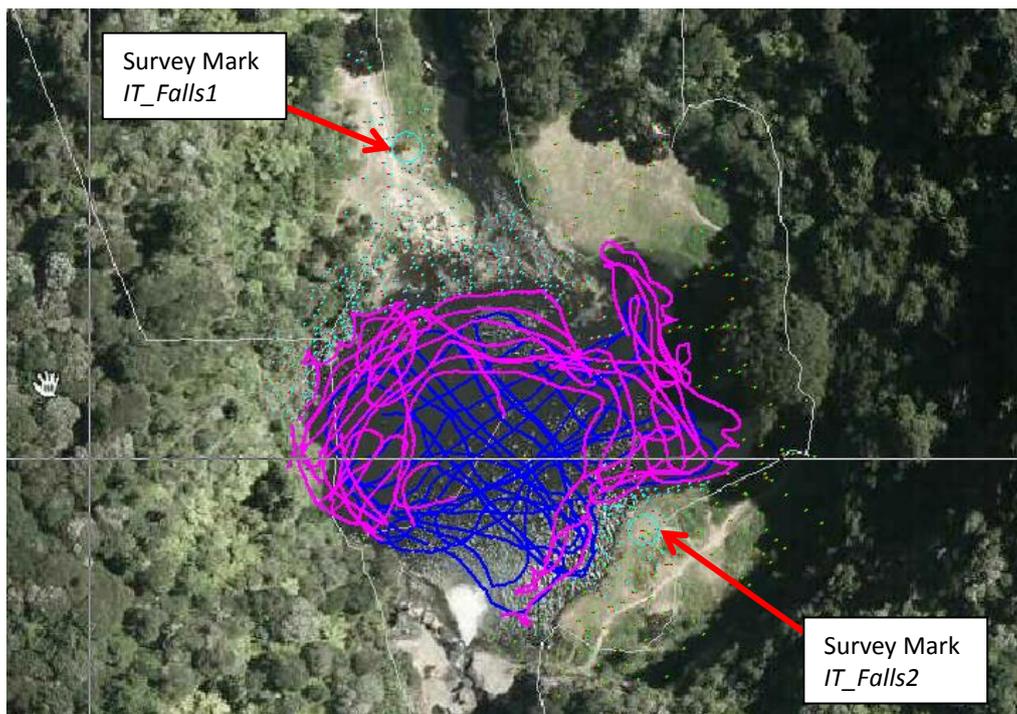
2. Weather & Sea Conditions

The survey was completed in clear conditions with a light wind. The lake surface was relatively calm with small ripples propagating out from the impact area of the waterfall.

3. Survey Coverage and Methodology

The survey was undertaken using a combination of land surveying techniques (both RTK and theodolite/prism observations to provide spot positions on land), and hydrographic surveying (using RTK positioning and a digital echo sounder) from a kayak and inflatable dinghy.

The following image shows the survey coverage achieved. The single points shown are spot positions from RTK and Theodolite/Prism observations, whereas the pink track lines are from the Kayak work (shallow) and the blue track lines from the inflatable dinghy (deeper areas).



This survey was conducted in two separate phases, the first on 27-28 January 2015 involved static GPS observations of up to four hours each at three locations. These observations were used to compute the position of marks to be used for this and any future surveys. Observations were made at: a known existing LINZ mark (LINZ Code A8TU) and two iron tubes installed by DML adjacent to the falls area. (Marks IT_Falls1 and IT_Falls2, see above image for approximate location).

The LINZ mark was a beacons trig on Jones Road with known co-ordinates. This mark was used to provide a check on the computed co-ordinates. The iron tubes were used both as a base station for RTK observations and checks, and to provide a baseline for the theodolite observations.

The data collection phase of the survey was undertaken on 10 February 2015 by a team of three survey personnel. The RTK base station was set up over IT_Falls1 using the derived validated co-ordinates. Position checks were made using IT-Falls2, and then a third mark was installed in the open grassy area near the main carpark (IT_Carpark). The RTK Base Station was then moved to the new mark as it had increased reception of GPS satellites. Topographic data was collected using RTK across the rocky and land areas where GPS coverage could be obtained and to ensure an overlap was achieved between the topographic and hydrographic data.

The theodolite and prism were used to collect topographic data points at approximately 10m (or less) intervals across the land areas where GPS coverage could not be obtained (close to the trees and the steep rock faces of the falls basin).

Hydrographic data was obtained in the shallow rocky areas using a Kayak fitted with an electronic survey outfit, and in the deeper areas and close to the falls themselves using an inflatable dinghy fitted with the same electronic survey outfit. Positioning of both boats for the hydrographic survey was by RTK from the mark IT_Carpark.

Whilst the flow over the falls was only small there was still a significant amount of aeration and spray/wind from the falling water. An attempt was made to get survey data very close to the flow and along the rock wall by the waterfall but this was abandoned due to the likelihood of water flooding into and capsizing the kayak or boat. No data was collected directly under or very close to the actual falls. A visual inspection confirmed the rock wall behind the falls to be nearly vertical. Data points in this area were manually edited to ensure the contours and profiles showed this situation behind the falls.



RTK Topographic Surveying across the rock ridge and shallows

4. Survey Platforms and Equipment

This hydrographic survey was undertaken using DML's kayak and 3.0m inflatable boat as shown below. Both were fitted with the equipment described below.



Surveying by Kayak



Surveying by Inflatable Dinghy

a. Echo Sounder

The following echo sounder was used.

Type:	Tritech PA500
Depth Acquisition:	8 – 10 soundings per second
Frequency:	500 kHz
Beam width:	SBES - 6°
Rated Accuracy:	+/- 1cm

b. Boat Positioning System

A Trimble RTK GNSS system was used throughout the survey. The GNSS system consisted of a Trimble R6 Base Station setup over a locally established mark (IT_Carpark) and the R6 Rover mounted on a pole on the boat. Corrections were provided from the Base Station via UHF radio link. The RTK GNSS system was also used for all topographic surveying.

System Accuracy: Horizontal accuracy of +/-0.02m and vertical accuracy of +/- 0.04m.

c. Theodolite and Prism

A total station and standard reflecting prism was used for topographic data point collection

Type: Sokkia SET500 Total Station,
 Horizontal /Vertical Angle Accuracy: 5"
 Distance Measuring Range: 1m to 2km with prism
 Distance Accuracy: +/- (3mm + 2ppm X Distance)

5. Horizontal Datum/Grid

The survey was conducted on the NZGD2000 Datum and MT EDEN2000 Grid. The coordinates of IT_Falls 1 and 2 were derived from static observations. The final co-ordinates of marks used during the survey are listed in the following table. Copies of the location description for the IT's are included with the deliverables.

Mark Name	Northing (m) Eden 2000	Easting (m) Eden 2000	Height (m) AVD 1946	Notes
A8CLG	778990.491	424287.747	255.37	LINZ Co-ords
IT_Falls1	779055.584	428946.604	39.469	Co-ords from static observations
IT_Falls2	778991.176	428986.196	39.269	Co-ords from static observations
IT_Carpark	779179.153	428917.596	42.852	Co-ords from RTK

6. Vertical Datum/Tides

All topographic points were observed in terms of Auckland Mean Sea Level 1946, and all soundings were reduced for lake level (tide) by RTK GNSS water level measurements recorded at 5 second intervals throughout the survey. Final data points are in terms of Auckland Vertical Datum 1946 (Mean Sea Level).

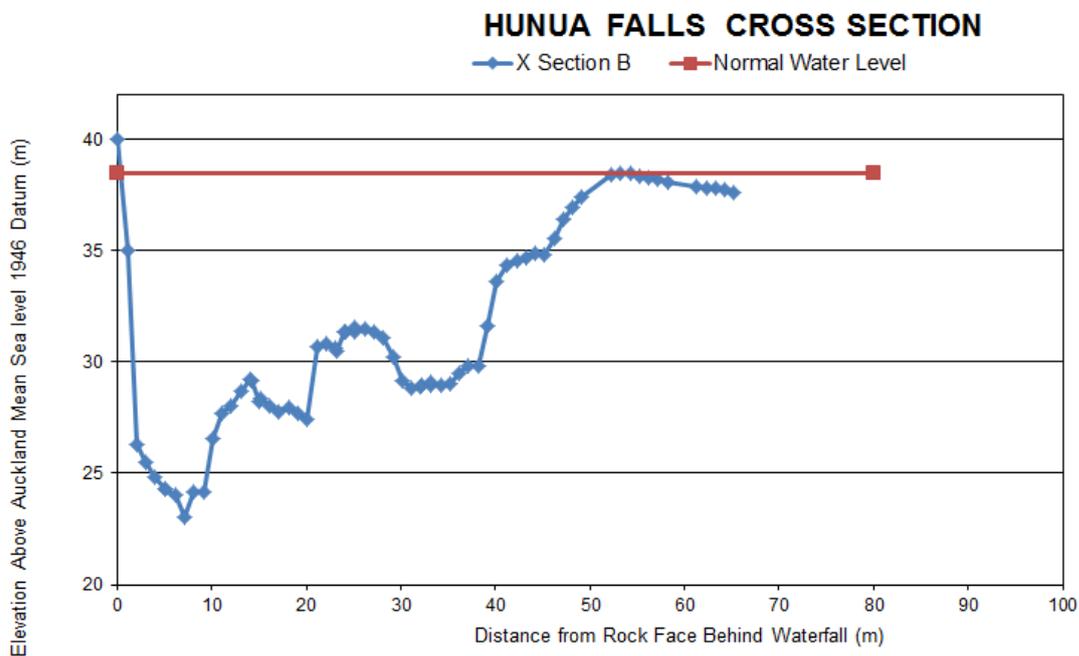
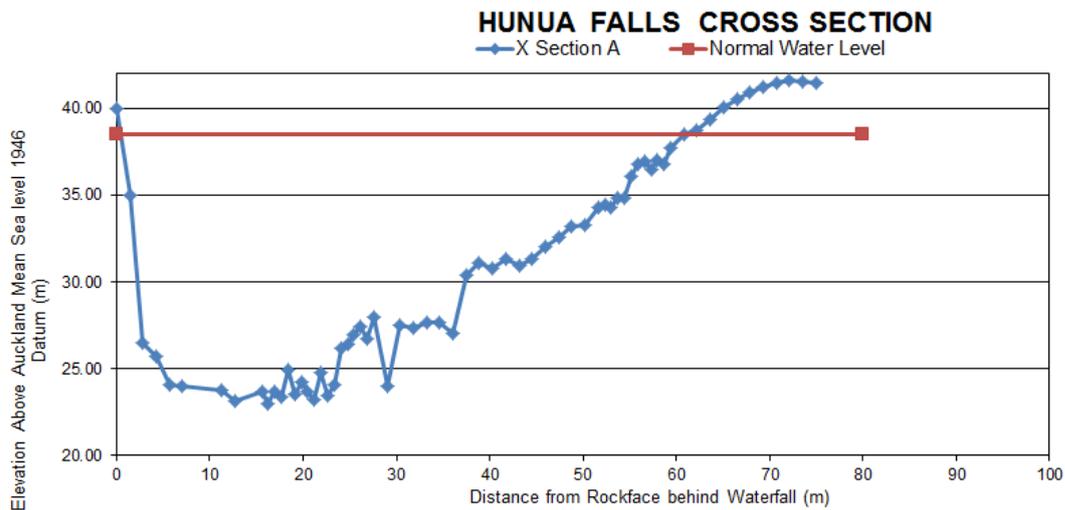
7. Software

The following software was used to produce the deliverables.

Acquisition: Trimble HYDROPro
 NAVIGATION Module
 NAVEDIT Module
 Data Quality Control: Trimble Terramodel v10.2
 Data Rendering: Golden Software Surfer8

8. Data Processing

The RTK and theodolite topographic data were imported into Terramodel and overlaps were used to compare and verify consistency between datasets before datasets were merged to make one set of topographic data.



9. Estimated Data Accuracy.

Based on inspection of overlapping data, (topographic and hydrographic data) the horizontal accuracy of final data is assessed as better than +/-0.1m, and the vertical accuracy of final data is assessed as better than +/-0.15m.

10. Comments & Results

The lake at Hunua Falls and the surrounding land was surveyed to project specifications. The main difficulty during the survey was the poor GPS coverage around the edges of the basin. This meant more land survey work was required to achieve coverage than anticipated, however topographic points were observed at intervals or better than 10m.

The only areas not able to be surveyed were; the base of the rock cliff across the south western side of the lake (the vertical cliff the waterfall drops down), and the area of the lakebed directly below the falls. Data points in these areas were interpolated from visual field observations to ensure contours reflected the true shape of the lake edge. A false elevation of 40.0m was used along the boundary of this area of the lake to define the outline shape of the basin.

The following measurements of ground level are provided to assist Auckland Council in depicting the “depths” of the lake for the public in relation to visible features in the area. These features are also shown on the 2D Image.

Feature Name	Northing (m) Eden 2000	Easting (m) Eden 2000	Ground Level Height (m) AVD 1946	Notes
Sign/Lifering	779070.57	428933.66	42.65	Ground level at warning sign on main approach path
End of Path	779071.7	428938.8	41.94	Wood boundary of the end of tar seal path on main approach path
Seat	779058	428988	40.48	Ground level of seat on north side of stream
High Point on Rock Ridge	779032.91	428957.12	38.53	High point on rock ridge across lake discharge (very close to cross section B)
Deepest part of Lake	778991.0	428958.2	21.4	Lowest point of the lake by echo sounder

The greatest elevation difference obtained between the high point on the rock ridge (38.5m) and deepest part of the lake was 17.1m. The deepest part is approximately 2m off cross section A on the western side, at a distance of 12m out from the rock wall behind the waterfall.

The gridded data points behind the waterfall were edited to reflect both the steepness of the cliff behind the waterfall and to ensure depth contours reflected the seabed shape. The XYZ data for the two profiles is included in the excel sheets provided.

The 2D image and the two cross sections were generated from data gridded at 1m intervals. Elevations on the 2D image are referred to Auckland MSL 1946 vertical datum.

11. Retention of Data

DML will retain copies of the project deliverables, including source data files, on its servers for a period of 12 months from completion of the project. The data will then be archived to a digital medium and retained for 7 years. After the initial 12 month period client requests to access and supply project data will incur a fee.

DML wishes to thank Auckland Council for the opportunity to undertake this unusual and slightly challenging survey. We look forward to opportunities when we work together again in the future.

For Discovery Marine Ltd



B.R. Wallen, MNZIS
Survey Manager



Enclosures:

ASCII XYZ of reduced merged field observations, (cleaned topo and hydro merged datasets)
ASCII XYZ of 1m gridded data from field observations(used to produce contours and images)
2D Colour Image of Survey from gridded data
DXF Contours from gridded dataset
EXCEL spread sheets of XYZ data and Cross Sections
PDF descriptions of marks IT_Falls1, IT_Falls2 and IT Carpark