



The Appleton Wetland; Its Decline, Cause and Recommended Action

Appendix F: Level Reference at Appleton

Report prepared by

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Level Reference at Appleton

Introduction

At the beginning of our research project it was clear that without a means of measuring water levels with an accurate reference point close to the Appleton Bay we could not determine accurate water levels in the wetland. This Appendix covers three aspects of establishing reference points:

1. Finding a Geodetic Survey Benchmark near Appleton.
2. Establishing an accurate benchmark near the waterfront of the property at 521 River Road in Appleton.
3. Establishing an accurate staff gauge at Tree Station 1 of the MVFN 2011 Tree Project in order to provide properly calibrated water levels for that project.

In particular, it was important that the reference points be measured relative to the same geodetic vertical datum as used to establish the calibration of the staff gauge on the Bridge Street bridge in Almonte. Specifically, the Canadian Geodetic Vertical Datum of 1928 (CGVD28), which was adopted officially by an Order in Council in 1935. The data on available geodetic benchmarks can be found on website:

<http://webapp.geod.nrcan.gc.ca/geod/data-donnees/passive-passif.php?network=pvc>

Finding a Geodetic Survey Benchmark near Appleton

The Geodetic Survey benchmark that is closest to Appleton is numbered 70U888, and the information sheet for that benchmark follows below.

Station Report

Name	Province	NTS map sheet	Unique Number	Provincial Identifier
70U888	Ontario	031F01	70U888	

Horizontal Data

Geographic

Latitude	Longitude
45° 11' 9.6"	76° 7' 4.8"

UTM

Zone	Easting (metres)	Northing (metres)	Scale
18	412170.083	5004220.905	.99969

Vertical Data

Elevation	Vertical Datum	Order	Method	Published Year
135.020	CGVD28	Second order	Differential	1970

Marker Type	Inspected in	Established by	Status	Comments
Permanent agency marker	1970	Geodetic survey division - nrcan	Good	None

Location

Appleton

Rock exposure in western part of a "t" road junction, 1.0 km northeast from bridge over Mississippi River in Appleton, tablet in top of rock in school yard, 7.0 m east, 2.4 m north of most southerly corner of fence.

Unfortunately, the old school mentioned was retired long ago, was later converted to the North Lanark Museum, subsequently was demolished by fire, and then replaced by a new building with new landscaping added to the site. At some time during that history the benchmark disappeared. The prospect of digging up a large chunk of Museum lawn to find a benchmark that may or may not have been destroyed seemed like a stopper.

Discussion with Ryan MacKenzie, a treasure hunting hobbyist with a very sensitive metal detector that was able to discriminate between scrap iron and other less common metals, suggested a much more selective search. A search with the metal detector was conducted on September 29, 2013, with the permission of the Museum curator. There were a few false alarms due to nonferrous scraps near the surface followed by a strong indication of the right thing. After digging out a small hole about nine inches deep, there was the official looking brass plaque with 70U888 inscribed on it.



Figure F-1 The hole and benchmark



Figure F-2 The hole and museum



Figure F-3 The BM inside pipe collar



Figure F-4 Coverplate in lawn over the BM

After finding the benchmark (BM) and verifying that it was still solidly attached to the bed rock shelf, we concluded that we had a valid elevation reference. As followup, we placed a plastic pipe collar around the benchmark, backfilled around it, and put a removable coverplate on it. It affords easy access when needed, and solid but unobtrusive protection at other times.

Establishing an accurate benchmark at the river shore

With a good and relatively close geodetic benchmark identified, the next step was to do a level survey from the benchmark to the waterfront of Appleton Bay and establish accurately the level for a new benchmark installed there. The Google Earth image below shows the area involved. The Museum and the 70U888 benchmark are located at the intersection of River Road and Appleton Sideroad. The new waterfront benchmark is located at 521 River Road. The level survey involved an easy run down River Road to the corner, and then a short run across the 521 property to the new benchmark. The total distance was about 720 metres with an elevation change of 15.5 metres.



Figure F-5 Google Earth image of the area in Appleton to be surveyed for the new benchmark

The survey was undertaken on October 11, 2013 with Ross Taggart, a retired former professional surveyor, operating the level, Joachim Moenig as rod man, and Al Seaman taking notes. There was a double set of observations;

- a) from benchmark 70U8888 to the new benchmark, and
- b) from the new benchmark back to benchmark 70U8888.

A quick checksum showed that the total elevation change on the two runs agreed to within 2 millimetres and concluded that the measurements were well within acceptable limits of accuracy. The field notes have been transcribed to a spreadsheet that shows the complete set of observations along both runs, with an analysis of the variances in elevation between the two runs for each turning point. A copy of that spreadsheet follows on the next pages.

Conclusion

The final elevation adopted for the new benchmark is 119.222 masl. This averages the 2 mm. end-to-end discrepancy between the two runs, and also balances the intermediate discrepancies to maximums of +/- 5 mm. We believe the 119.222 masl elevation to have an accuracy of better than 1 cm, and the 119.222 masl figure will be used in all water level work for Appleton.



Figure F-6 New benchmark location and inscription on inset

Appleton Level Survey - October 11, 2013 **10:00 AM to 11:30 AM**

Purpose - to establish the accurate elevation of a benchmark at the waterfront of the property at 521 River Road in Appleton.

Reference: Geodetic Benchmark 70U888 Elevation 135.020 masl (CGVD28)

Done by: Ross Taggart (level), Joachim Moenig (rod), Al Seaman (note keeper)

Run One - Museum to 521 River Road

Point	BS	HI	FS	IS	Elev
70U888					135.020
70U888	1.410	136.430			
TP1			2.150		134.280
TP1	0.906	135.186			
TP2			1.800		133.386
TP2	1.087	134.473			
TP3			1.510		132.963
TP3	1.339	134.302			
TP4			1.725		132.577
TP4	0.190	132.767			
TP5			2.785		129.982
TP5	0.562	130.544			
TP6			2.500		128.044
TP6	0.239	128.283			
TP7			3.751		124.532
TP7	0.080	124.612			
TP8			2.495		122.117
TP8	0.686	122.803			
BM-New			3.580		119.223
BM-New	1.458	120.681			
Water			3.000		117.681
Water	3.022	120.703			
BM-New			1.482		119.221
Checksum	6.499		22.296		-15.797

Run Two - 521 River Road to Museum

Point	BS	HI	FS	IS	Elev	Variance
BM-New					119.222	-0.001
BM-New	3.470	122.692				
TP8			0.579		122.113	-0.004
TP8	2.599	124.712				
TP7			0.185		124.527	-0.005
TP7	3.383	127.910				
TP6A			0.095		127.815	n/a
TP6A	2.702	130.517				
TP5			0.540		129.977	-0.005
TP5	2.644	132.621				
TP4			0.049		132.572	-0.005
TP4	1.699	134.271				
TP3			1.310		132.961	-0.002
TP3	1.550	134.511				
TP2			1.120		133.391	0.005
TP2	1.789	135.180				
TP1			0.899		134.281	0.001
TP1	2.085	136.366				
70U888			1.345		135.021	0.001
Checksum	21.921		6.122		15.799	

Establishing an accurate staff gauge at Tree Station 1

This work was done on September 6, 2013 between 10:00 AM and 12:00 PM by Mike O'Malley and Al Seaman.

The original Tree 1 from the MVFN 2011 Tree Project level study was located and is shown in the photo below.



Figure F-7 Tree 1 from MVFN 2011 Tree Project

A faded red digit "1" on the tree beside Mike O'Malley marks the location of this site. The GPS coordinates were resampled with a four minute average using a handheld GPS unit (a Garmin eTrex Vista HCx unit, WAAS enabled, and typically indicating a probable accuracy of 3 metres for readings averaged over 1-2 minutes). The results show a position of N 45° 11.186' W 076° 07.661'. An earlier level stake shows in the photo, but as a result of winter ice pressure it is leaning and is no longer considered accurate. The original red ribbon is still on the base of the tree, but in this photo it is obscured by new vegetation.

The excess vegetation was cleaned out and a permanent stainless steel tag was put on the tree positioned so that the tag top was even with the ribbon bottom, which was the old reference level for the tree ribbons. Although this ribbon was broken, staples in the ribbon fragment kept it in place. The photo below shows these details.



Figure F-8 Permanent stainless steel tag added at the bottom of orange ribbon

The old stake was removed and a new much longer one was driven into the river bed to the point that it was solid. A further brace between the stake and the adjacent tree was added. Using a carpenter's level and a straight board, the reference level from the tree tag/ribbon was transferred to the stake. A stainless steel tag was added to the stake so that the top of the tag was at the reference level. An aluminum metre stick was then fastened to the stake with the bottom end at ground level under the water. The photo below shows these details.

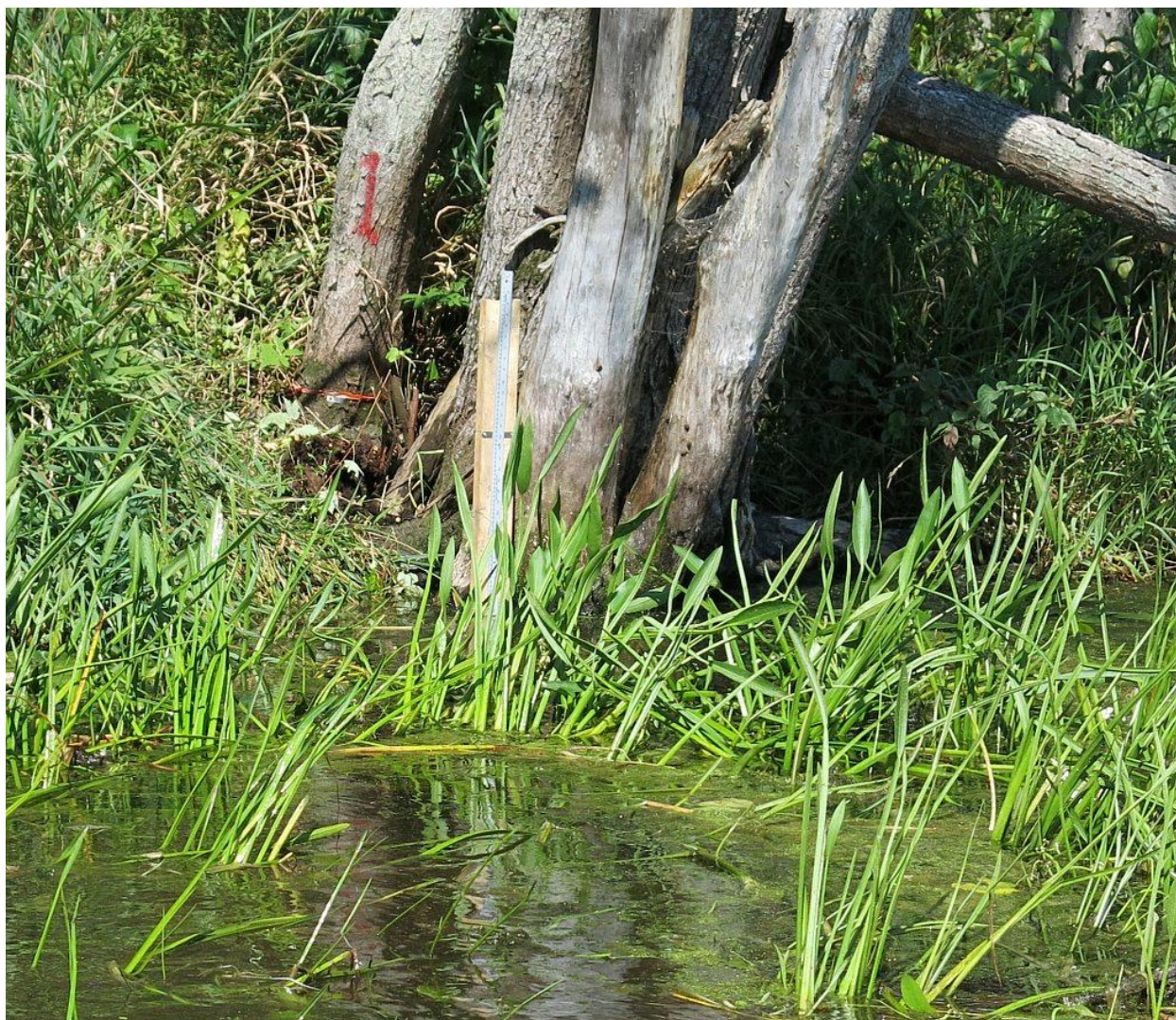


Figure F-9 New stake with metre stick and reference level tag

The metre stick crossed the reference height tag at the 37 cm level on the metre stick. In addition, the water level at that time crossed the metre stick at 80 cm. See photos below.



Figure F-10 Stake with metre stick and reference tag Figure F-11 Stake with metre stick at water level

Immediately after completing that work, around 11:50 AM, the water level at the shoreline of 521 River Road was measured relative the provisional benchmark at that location. At the time the benchmark level was estimated to be 119.095 masl. The result shows a water level at that time of 117.441 masl (an average of two readings).

On that basis, assuming water level between the 521 River Road shoreline and the stake to be flat, the top of the metre stick scale on the stake is (117.441 plus 0.80) or 118.241 masl.

The old tree ribbon reference level would then be (118.241 minus 0.37) or 117.871 masl.

On September 14, 2013, further checks on calibration of the scale on the stake relative to water level readings made with the provisional benchmark showed this original calibration to be valid.

It must be emphasized that the above calibration was subject to verification of the true level of the provisional benchmark. Correcting the calibration of the wetland marker to agree with the final benchmark level needed to be completed.

Note: Recalibration - October 11, 2013

Based on the level survey from Geodetic Benchmark 70U888 to the new benchmark at 521 River Road as covered at the beginning of this Appendix, the new benchmark is now considered to be at an elevation of 119.222 masl, as compared to the provisional level of 119.095 masl (a difference of 0.127 m). A correction of +0.127 should therefore be added to all values as derived above.

Specifically: 0 level on stake scale: 118.368 masl
Bottom of ribbon on tree: 117.998 masl