LICA LONG TERM SOIL ACIDIFICATION MONITORING
WHITNEY LAKES SITE ESTABLISHMENT

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Prepared for:
Lakeland Industry and Community Association

March 2012

EXECUTIVE SUMMARY

In 2007 LICA commissioned a preliminary study of potential soil and water acidification within the LICA Area which included recommendations for monitoring soil chemistry. The protocol of a long term monitoring program by Alberta Environment and Water was adopted by LICA, and a study to examine and select potential sites for monitoring was initiated in fall 2009.

An assessment of potential monitoring sites was conducted in 2009 and 2010, with a number of sites recommended as being suitable for soil monitoring. The criteria for suitable sites for monitoring, description of the site selection process, and application of a soil acidification model to predict potential acidification rates in the sites assessed were described in the 2011 report *Long Term Soil Acidification Monitoring in the LICA Study Area* (Abboud and Turchenek 2011). The establishment of a monitoring site and collection of the baseline soil chemistry data in Moose Lake Provincial Park was carried out in 2010, and results of the initial sampling and chemical analysis of soil samples are also described in the above report. Another site was established in Whitney Lakes Provincial Park in 2011. The establishment of this site and presentation of the baseline soil data for this site are the subjects of the report herein.

As at the Moose Lake site, long term sampling plots were established at two locations, which are referred to as the West and East Whitney Lakes sub-sites. Each sub-site was subdivided into 12 plots and each of these was further subdivided into 12 subplots. One subplot within each of the 12 plots was sampled, thus providing 12 replicates for statistical analysis. Sampling is to occur every four years. The layers sampled in each subplot are the LFH horizon and the 0-2, 2-5, 5-10, 10-15, 15-30, 30-45, and 45-60 cm intervals. At each of the two sub-sites, soil profile descriptions were also completed according to protocols of the Canadian soil classification system. Soil samples were obtained by digging a square pit (about 60 cm x 60 cm) near the centre of each subplot. About one litre of sample was obtained from each of the above soil layers.

Laboratory analyses were completed according to methods applied in the Alberta Environment and Water long term monitoring program. After completion of analyses, all remaining sample materials were archived. Data are presented in table format in this report. These data represent the baseline conditions for the soil monitoring program at the Whitney Lakes Provincial Park site. As sampling of this site is carried out in the future, statistical analyses will be carried out to detect any changes over time.

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Glossary of Terms Abbreviations and Symbols

A horizon — A mineral soil horizon formed at or near the surface in the zone of removal of materials in solution and suspension, or maximum accumulation of organic carbon, or both.

AEW — Alberta Environment and Water.

AITF — Alberta Innovates Technology Futures.

Al^{3+} — Aluminum ion.

B horizon — A mineral soil horizon characterized by one or more of the following: an enrichment in silicate clay, iron, aluminum or humus; a prismatic or columnar structure that exhibits pronounced coatings or staining associated with substantial amounts of exchangeable sodium, and/or an alteration of hydrolysis, reduction, or oxidation to give a change in colour or structure from the horizons above or below, or both.

BC:Al ratio — Ratio of base cations to aluminum in water in soil pores. BC refers to the sum of the cations calcium, magnesium, sodium and potassium.

Brunisolic soil, Brunisol — Brunisols in northeast Alberta are Boreal forest soils that occur mainly in sandy glacial sediments under jack pine forests. The main characteristics of these soils are the presence of a gray coloured topsoil (Ae) horizon) underlain by a brown to reddish brown coloured upper subsoil (Bm horizon).

C horizon — A mineral soil horizon comparatively unaffected by the pedogenic processes operative in A and B horizons, except for gleying and the accumulation of carbonates and more soluble salts.

Ca^{+} — Calcium ion.

Ca:Al ratio — Ratio of calcium to aluminum in water in pores in the soil.

Cation — Ion with a positive charge.

Cation exchange — The interchange between a cation in solution and another on the surface of any surface-active material in the soil such as clay or organic matter.

Cation exchange capacity — The total amount of exchangeable cations that a soil can adsorb, expressed in centimoles (positive charge) per kg of soil ($cmol_c\ kg^{-1}$).

Clay — A soil particle <0.002 mm equivalent diameter.

$cmol_c\ kg^{-1}$ — See ‘cation exchange capacity’ above.

Coarse fragments — Soil particles larger than 2 mm diameter; general term for gravel, cobbles, stones and boulders.

Drainage — The removal of excess surface water or groundwater from land by natural runoff and percolation, or by surface or subsurface drains.

Eolian — Well sorted materials, predominantly sand and silt, deposited by wind (e.g., sand dunes).

Exceedance	An emission whose measured value is more than that allowed by government regulations.
Forest floor	All dead vegetable and organic matter including litter and unincorporated humus on the mineral soil surface under forest vegetation; also called the LFH soil horizon, litter layer, or duff layer.
Glaciofluvial	Material moved by glaciers and subsequently deposited by streams flowing from the melting ice. The deposits are commonly sorted, such that they consist mainly of sand or gravel.
Glacial	Generally refers to the landscape and materials in the landscape that were produced by or derived from glaciers and ice sheets; e.g., sandy, glaciofluvial plain.
Horizon, soil	A layer of soil or soil material nearly parallel to the land surface; it differs from adjacent soil layers in properties such as colour, structure, texture, consistence and chemical, biological and mineralogical composition.
in situ	In place; commonly refers to an approach to remove bitumen from oil sand while the oil sand deposit is still in place underground.
K^+	Potassium ion.
kmol	1,000 mole (see mol L^{-1} below).
kmol ha^{-1} yr^{-1}	Kilomoles hydrogen ion equivalents per hectare per year. In assessing the amounts and critical loads of acidifying compounds, the deposition of nitrogen oxide or sulphur dioxide on land or water is converted to equivalent units of acidity (hydrogen ion equivalents) on an area (hectare) basis. Sulphur deposition is commonly expressed as kilograms of sulphur per hectare. One mole of sulphur is 32 grams, and 1 kmol is 32,000 g, or 32 kg. If 32 kilograms of sulphur falls on 1 ha of soil or water, this is equal to 1 kmol ha^{-1}. Sulphur is converted to sulphur dioxide (SO_2), and then to sulphuric acid (H_2SO_4). Since there are two hydrogen ions (H) in H_2SO_4, the number of hydrogen ions equivalent to 1 kmol of sulphur is 2 kmol.
LICA	Lakeland Industry and Community Association.
LFH	See *horizon, soil*.
LFH	Organic soil horizon developed primarily from leaves, twigs, and woody materials, with a minor component of mosses; same as forest floor.
Litter	See forest floor, LFH.
Mg^+	Magnesium ion
mol L^{-1}	Unit of concentration of a substance in water; a mole is the unit amount of a substance. One mole of a substance is the mass that contains the same number of particles (atoms, molecules, ions, or electrons) as there are atoms in 12 grams of the isotope carbon-12.
Na^+	Sodium ion.

NAD 83	North American Datum 1983, Geographic coordinate system. This datum must be recorded with GPS coordinates.
NH_4^+	Ammonium ion.
NO_2	Nitrogen dioxide.
NO	Nitric oxide.
NO_3^-	Nitrate ion.
NO_x	General expression for oxides of nitrogen (mainly NO +NO_2).
PAI	Potential Acid Input; usually expressed as kmol ha^{-1} yr^{-1}.
Parent material	The unconsolidated mineral (e.g., sand, clay, clay till) or organic material (e.g., peat) from which a soil has developed by soil forming processes.
pH, soil	The negative logarithm of the hydrogen-ion activity of a soil solution. The degree of acidity or alkalinity of a soil, as determined by a suitable electrode or indicator at a specified moisture content or soil-water (or $CaCl_2$ solution) ratio and expressed in terms of the pH scale.
Precipitation	The rain and snow that falls on the earth's surface.
Profile, soil	A vertical section of the soil through all its horizons and extending into the parent material.
Reaction, soil	The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms used herein with certain ranges in pH are: acid, less than 5.5; neutral, 5.5-7.4; alkaline, greater than 7.4.
Sand	A soil particle between 0.05 and 2.0 mm equivalent diameter. Also, a textural class composed mainly of sand-sized particles.
Silt	A soil particle between 0.002 and 0.05 mm equivalent diameter.
Soil	The naturally occurring, unconsolidated mineral or organic material at least 0.1 m thick that occurs at the earth's surface and is capable of supporting plant growth. Soil extends from the earth's surface through the genetic horizons, if present, into the underlying material to the depth of the control section (normally about 1 to 2 m). Soil development involves climatic factors and organisms, conditioned by relief and water regime, acting through time on geological materials, and thus modifying the properties of the parent material.
SO_2	Sulphur dioxide.
SO_4^{2-}	Sulphate ion.
Solution, soil	The aqueous liquid phase of the soil and its solutes consisting of ions from the surfaces of the soil particles and of other soluble materials.
SO_x	General expression for oxides of sulphur (mainly SO+SO_2).
Subsoil	The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil) in which roots normally grow.

Subxeric	Soil moisture condition whereby water moves very rapidly; soil is moist for a short period following precipitation.
Texture, soil	The relative percentages of the soil separates in a soil (i.e., sand, silt and clay particles).
Topsoil	(i) The layer of soil moved in cultivation. (ii) The A horizon. (iii) The Ah horizon. (iv) Presumably fertile soil material used to topdress road banks, gardens and lawns.
UTM	Universal Transverse Mercator (cartography); map coordinate system.
Water holding capacity	The percentage of water remaining in the soil material after having been saturated and after drainage of free water has practically ceased.
WBEA	Wood Buffalo Environmental Association.
Weathering	The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by biological, chemical, and physical agents or combinations of them.
Xeric	Soil moisture condition whereby water moves very rapidly; soil is moist for a negligible to brief period following precipitation.

1.0 INTRODUCTION

The Lakeland Industry and Community Association has as one of its objectives the implementation of a program to measure, monitor, and collect regional environmental air and soil data in the LICA area (LICA 2009). In 2009, the Alberta Research Council (now Alberta Innovates – Technology Futures (AITF)) provided recommendations for establishing a long term soil acidification monitoring program and conducted a preliminary assessment of potential soil monitoring sites. The program follows the protocols of the Long Term Soil Acidification Monitoring (LTSAM) program of Alberta Environment (now Alberta Environment and Water (AEW). The purpose of the AEW program is to track possible changes in acidification status in different parts of the province. Eight sites were established in the early 1980s, and a ninth site was added in 2008. The AEW program was recommended by AITF in part because of the presence of a monitoring site already located within the LICA study area, located in the east side of the LICA area near Cold Lake.

An assessment of potential monitoring sites was conducted in 2009 and 2010, with a number of sites recommended as being suitable for soil monitoring. The criteria for suitable sites for monitoring, description of the site selection process, and application of a soil acidification model to predict potential acidification rates in the sites assessed were described in the 2011 report *Long Term Soil Acidification Monitoring in the LICA Study Area* (Abboud and Turchenek 2011). The establishment of a monitoring site and collection of the baseline soil chemistry data in Moose Lake Provincial Park was carried out in 2010, and results of the initial sampling and chemical analysis of soil samples are also described in the above report. Another site was established in Whitney Lakes Provincial Park in 2011. The establishment and presentation of the baseline soil data for this site are presented herein.

2.0 METHODS

2.1 SITE SELECTION

Whitney Lakes Provincial Park was selected for establishment of a soil acidification monitoring site because of the suitability of soils and the long term protection status that location in a provincial park could provide. Site selection information is presented in the 2011 report *Long Term Soil Acidification Monitoring in the LICA Study Area* (Abboud and Turchenek 2011). The site is located in a jack pine stand similar to that at the Moose Lake Provincial Park site. While a considerable area of jack pine forest was potentially available for a site in Whitney Lakes Provincial Park, much of it has been affected by mistletoe infestation and by extensive tree fall. Part of the forest located in the southwest corner of the park is relatively free of these effects, and monitoring plots were therefore located in this vicinity. Attributes of the soil at this site, summarized from the above noted 2011 report, are presented below.

- The pH of the soil is about 4.5 in both the LFH (also called litter or duff) and the surface mineral soil layers.
- The cation exchange capacity and exchangeable base saturation are low, but they are higher than that at the Moose Lake site; this site thus has more acid buffering capacity than the Moose Lake site.
- The soil model showed that the pH could decrease from 4.9 to 4.5 in 50 years at an acid deposition rate of 0.3 kmol $ha^{-1}yr^{-1}$. The pH could decrease by a full unit in 50 years at a rate of 0.5 kmol $ha^{-1}yr^{-1}$. Note that the current deposition rate is estimated to be 0.14 to 0.17 kmol $ha^{-1}yr^{-1}$ (AMEC Earth & Environmental 2007).
- The soil model showed that within 50 years the exchangeable base saturation percentage could decrease from 19% to 4%, and base cation to aluminum ratio could change from 13 to 9, even at very low rates of acid deposition.
- Soil models are not expected to be accurate in prediction, but they do indicate trends. The modelling of the Whitney Lakes soil suggests that soil chemistry changes could occur within the possible lifetime of industrial activities in the region. The soil parameter with the greatest potential change is base saturation percentage, with changes consisting of decreases to levels that could affect vegetation growth, according to previous research.

2.2 Plot Establishment

The sampling design for monitoring was based on a stratified random sampling procedure as originally established by AEW in the Long Term Soil Acidification Monitoring program (Roberts et al. 1989). Two sub-sites (24 m X 24 m) were located within each site in order to alleviate concerns about loss of a site through fire or other agent, and each sub-site was subdivided into 12 plots (6 m X 8 m) which were assigned letters from A to L. The plots were further subdivided into 12 subplots (2 m X 2 m).

Components of monitoring plot establishment were as follows:

- at a proposed site, the landscape was examined and two sub-site locations were selected based on uniformity of landscape and tree canopy, and on distance from potential human disturbances and from other types of ecosystems (100 m is suggested;

i.e., at least 100 m from neighbouring aspen, muskeg, or other non- jack pine ecosystems);
- plots and subplots at each sub-site were measured;
- corners of plots were staked with cedar pegs, with about 5-10 cm of the stake left exposed above ground level;
- ~10 cm diameter treated posts were installed, with 1 m exposed above-ground, at the corners of each sub-site;
- GPS coordinates, legal location, and distance of the two sub-sites from each other were recorded; and,
- metal or other permanent labels were appended to one corner post at each sub-site.

The two sampling locations at the Whitney Lakes site are referred to as the West and East Whitney Lakes sub-sites. The layout for each of these is presented in Figures 1 and 2.

The 12 plots within each sub-site are labelled A to L. The subplots were randomly assigned a number from 1-12, with number 1 indicating the subplot sampled in the first sampling event, number 2 designating the subplot for the second sampling event, and so on. This sampling scheme provides a total of 12 replicates for each sampling event, and 12 sampling events over the course of the monitoring program.

2.3 Soil Sampling

Soil samples were obtained from 8 depths in each subplot, as follows: LFH horizon, 0-2 cm, 2-5 cm, 5-10 cm, 10-15 cm, 15-30 cm, 30-45 cm, and 45-60 cm intervals. In obtaining soil samples, a square pit (about 60 cm x 60 cm) is dug near the centre of each subplot. The sample size from each layer is about 1 litre. The upper soil layers are sampled with a flat scoop, and lower layer samples are obtained by scraping the pit sides. A small area of surface vegetation is carefully removed to reveal the LFH (or duff) layer, which is sampled by scraping the material off the soil surface with a stainless-steel spoon or other suitable utensil. All sampling is completed using plastic gloves to avoid contamination.

During excavation of soil pits, care is taken to prevent contamination of the soil surface and adjacent subplots. The soils are dug with a shovel, and excavated soil materials are placed on plastic sheets or tarps. After completion of sampling, major soil layers are replaced in the original sequence. Each layer is tamped so that all material is replaced with minimal increase in final volume. The topsoil and vegetation cap, originally cut to open the pit, are replaced. Litter and lichen are spread over the surface so as to leave it with a natural appearance, and to encourage rapid re-establishment of the lichen and any other plants (e.g., bearberry, lingonberry) that may have been disturbed in the sampled area.

Samples are collected in plastic bags and subsequently transported to the lab for analysis. Samples are kept cool, and if there is a delay in processing the samples at the lab, the samples are frozen.

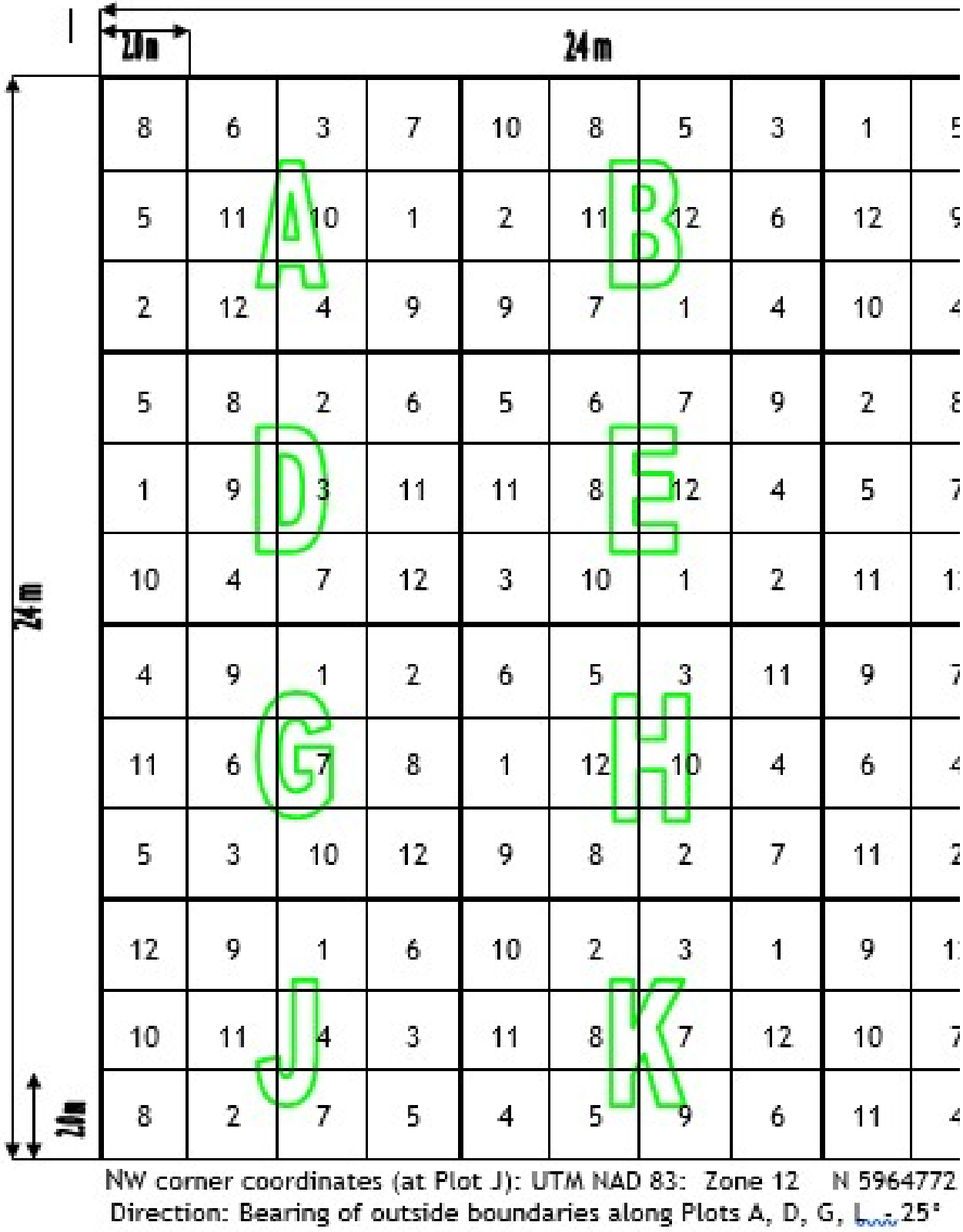

Figure 1. Plot Layout of the Whitney Lakes West Sub-Site

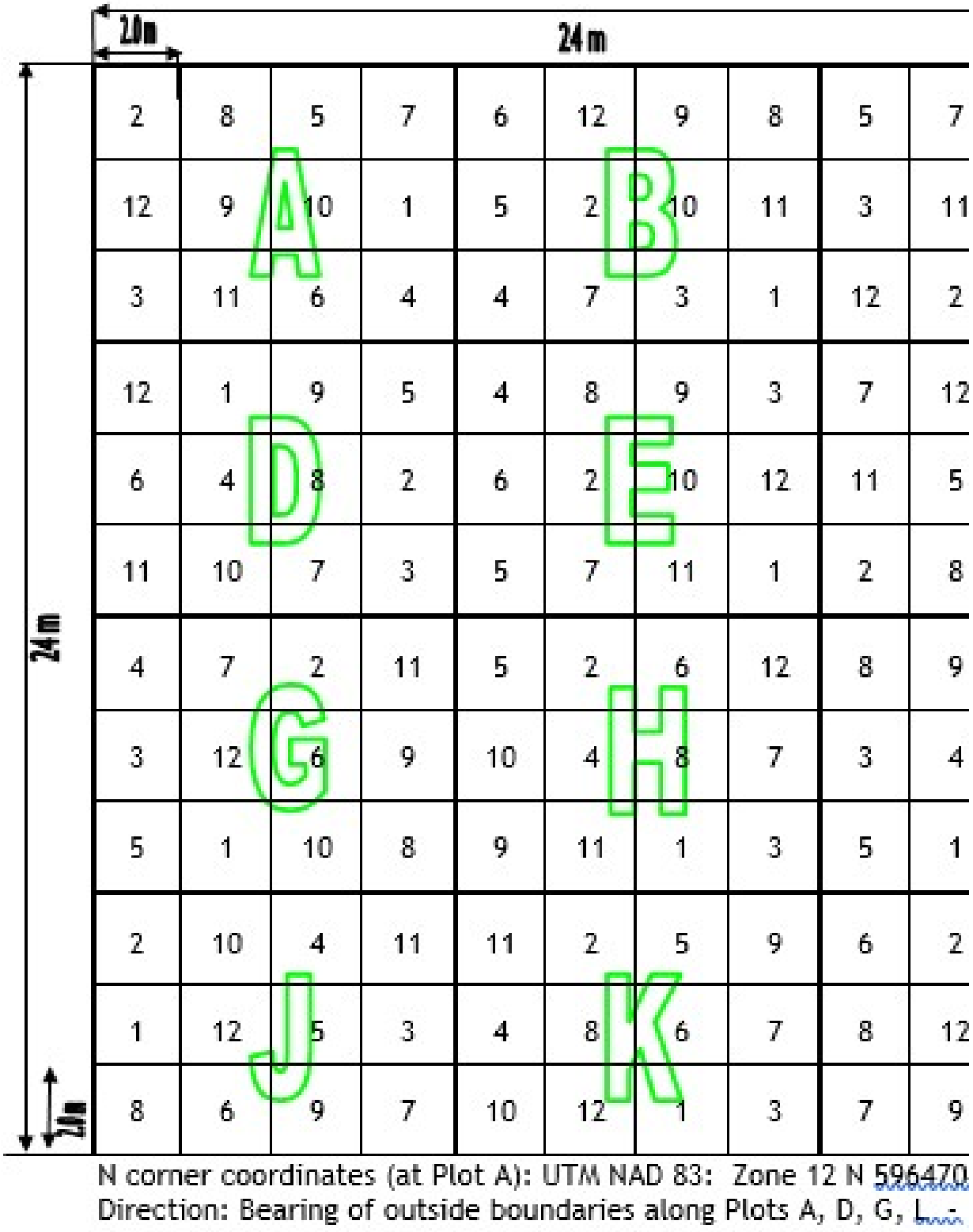

Figure 2. Plot Layout of the Whitney Lakes East Sub-Site

2.4 SOIL PROFILE DESCRIPTIONS

Long term soil monitoring is carried out by sampling of discrete layers, as described above. Full profile descriptions are also completed according to protocols of the *Canadian Soil Classification System* (Soil Classification Working Group 1998) and *CanSIS Manual for Describing Soils in the Field* (Expert Committee on Soil Survey 1983). A single soil pit was excavated to about 1-metre depth adjacent to each of the East and West plots. Natural soil horizons were described and samples were collected for soil texture analysis and for nutrient analysis of the upper soil layers. The soil descriptions are presented in Appendix A.

2.5 LABORATORY ANALYSES

Laboratory analyses were completed according to methods applied in the AEW long term monitoring program. Samples are initially dried at about 30°C, and then passed through a 2 mm sieve or through a rotary grinder with 2 mm openings. The grinder is used to break up any soil clumps and to separate coarse roots from the soil fine earth fraction. The methods used for the various analyses are listed in Table 4.

Table 1. Analytical Methods used for Soils Analysis

Parameter	Method	Notes
pH ($CaCl_2$)	Method 3.11 in McKeague (1978)	The soil-to-solution ratio for litter material is 1:4 and for mineral soil is 1:2. Solution is $CaCl_2$. Measurement is with a combination pH electrode.
pH (H_2O)	Method 4.12 in McKeague (1978)	As above, using de-ionized water.
Soil Texture (% Sand, Silt and Clay)	Method 2.12 in McKeague (1978)	Hydrometer method; does not include pre-treatment for removal of hydrous oxides and organic matter.
Electrical Conductivity	Method 4.13 in McKeague (1978)	Measurement occurs in the saturated paste extract of a soil sample.
Soluble Ions	Method 3.21 in McKeague (1978)	By the saturated paste method and ICP-OES[1] analysis of the extract.
Cation Exchange Capacity - Buffered	Method 15 (i) in Kalra & Maynard	By 1.0 M CH_3COONH_4 (ammonium acetate) extractant buffered at pH 7, and measurement of NH_4^+ by distillation.
Cation Exchange Capacity - Unbuffered	Method 18.2 in Carter and Gregorich (2008)	By 0.1 M $BaCl_2$ (barium chloride) extractant, and measurement of Ba by ICP-OES.
Exchangeable Cations	Method 18.2 in Carter and Gregorich (2008)	ICP-OES scan for Ca, Mg, Na, K, Fe, Mn, Al and Si on the unbuffered $BaCl_2$ extract.
Total Carbon (C), Nitrogen (N), and Sulphur (S)	Method 3.611 in McKeague (1978)	LECO[2] combustion method.
Available NH_4-N Available NO_3-N	Method 4.35 in McKeague (1978)	NH_4-N and NO_3-N extracted with 2N KCl and measured by steam distillation
Available Phosphorous (P)	Ashworth and Mrazek (1995)	Modified Kelowna extract using NH_4F, ammonium acetate and acetic acid, with measurement of P colorimetrically by autoanalyzer.

[1] **ICP-OES – Inductively Coupled Plasma-Optical Emission Spectroscopy**

[2] LECO – brand name of high temperature combustion apparatus for analysis of total carbon, nitrogen and sulphur

3.0 MONITORING SITE RESULTS

3.1 LAND DISPOSITION AND REQUIRED PERMITS

Establishment of a monitoring site within a Provincial Park was sought due to the protection status of parks and the likelihood of long-term monitoring without disturbance. Alberta Tourism, Parks and Recreation authorizes research activities in parks through issuance of permits. Application for a Research and Collection Permit was made in September 2011. This involved description of the types of research activity that will be conducted in the park, over what period of time, specific locations within a park, and other information. The permit is an addendum to Alberta Tourism, Parks and Recreation Research and Collection Permit No. 10-150, which was issued on 6 October 2010 for establishment of the first LICA soil monitoring site in Moose Lake Provincial Park. Issuance of a permit was not completed by the time of site establishment, but the work proceeded upon receiving permission via email from the Operations Manager, Northeast Region, Alberta Parks and Recreation.

3.2 SOIL MONITORING DATA

Soil samples from the East and West Whitney Lakes sub-sites were analyzed for various soil parameters, as described above, at the AITF Soil Laboratory in Edmonton. Analysis of all sampled layers was completed for the East sub-site. Analysis was carried out only for the top four layers from the West sub-site. This generally follows practice in the AEW long term monitoring program wherein analysis focuses on the top layers, which are expected to show any changes first. Deeper layer analyses have not been carried out, except for the first sampling event. All samples, whether analyzed or not, were archived to enable further analysis in the future if necessary.

The complete data are provided in Appendix B. Table 2 presents a summary of data for the main acidification indicators. The data consist of averages, standard deviations and coefficients of variation based on the 12 replicates from each sub-site. The data show that the highest cation exchange capacities and exchangeable base cation levels are in the 0-2 cm mineral layer.

The 2011 sampling event at the Whitney Lakes Provincial Park site is the first of several planned sampling events to be carried out at four-year intervals. As monitoring of this site is carried out in the future, statistical analyses will be carried out to assist detecting any changes in the parameters indicated in Table 2 over time.

Table 2. Mean Values of Soil Acidity Parameters at the Whitney Lakes Monitoring Site

Layer	Statistic	pHc	Exch Bases	CEC	BSat	K	Ca	Mg	Al	BC:Al	TC	TN	TS
(cm)			(cmol kg^{-1})			(mol L^{-1})					(%)		
West Plot													
LFH	Mean	4.4	na	na	na	na	na	na	na	na	35.9	0.96	0.10
	SD	0.1	na	na	na	na	na	na	na	na	8.40	0.22	0.02
	CV	0.02	na	na	na	na	na	na	na	na	0.23	0.23	0.19
0-2	Mean	4.8	4.36	4.85	0.90	17.2	34.9	7.0	6.3	8.4	2.34	0.05	0.01
	SD	0.2	0.90	0.92	0.05	8.42	9.12	1.84	3.18	3.31	0.76	0.03	0.003
	CV	0.05	0.21	0.19	0.05	0.49	0.26	0.26	0.50	0.39	0.32	0.50	0.31
2-5	Mean	4.9	3.87	4.25	0.90	9.8	27.8	5.5	5.3	7.4	1.44	0.03	0.01
	SD	0.2	1.33	1.25	0.07	4.01	7.51	1.50	2.33	3.23	0.42	0.01	0.002
	CV	0.04	0.34	0.29	0.07	0.41	0.27	0.27	0.44	0.44	0.29	0.48	0.29
5-10	Mean	4.8	2.2	2.5	0.9	6.5	19.2	4.2	8.7	5.9	0.67	0.01	0.004
	SD	0.2	0.7	0.7	0.1	1.75	4.51	0.85	10.99	3.59	0.27	0.004	0.002
	CV	0.05	0.30	0.27	0.06	0.27	0.24	0.20	1.26	0.61	0.41	0.42	0.42
10-15	Mean	4.8	1.50	1.72	0.87	4.0	13.4	2.8	5.7	4.5	0.28	<0.01	0.003
	SD	0.2	0.23	0.21	0.05	1.06	2.92	0.64	5.32	1.96	0.06	na	0.001
	CV	0.04	0.15	0.12	0.06	0.27	0.22	0.23	0.93	0.43	0.22	na	0.27
15-30	Mean	4.9	1.5	1.7	0.9	2.6	9.4	2.2	10.0	2.5	na	na	na
	SD	0.2	0.2	0.2	0.0	0.93	2.18	0.90	12.55	1.43	na	na	na
	CV	0.05	0.12	0.10	0.05	0.36	0.23	0.41	1.26	0.56	na	na	na
30-45	Mean	5.0	1.5	1.6	0.9	2.5	7.6	2.2	15.9	3.0	na	na	na
	SD	0.2	0.2	0.2	0.0	2.23	2.32	2.25	32.31	2.82	na	na	na
	CV	0.04	0.11	0.10	0.03	0.90	0.31	1.00	2.04	0.95	na	na	na
45-60	Mean	5.0	1.5	1.6	0.9	2.5	6.9	1.9	12.6	2.6	na	na	na
	SD	0.2	0.2	0.2	0.0	1.59	2.32	1.71	24.41	1.22	na	na	na
	CV	0.05	0.14	0.13	0.03	0.64	0.33	0.90	1.94	0.48	na	na	na
East Plot													
LFH	Mean	4.6	na	na	na	na	na	na	na	na	30.6	0.86	0.09
	SD	0.3	na	na	na	na	na	na	na	na	8.03	0.21	0.02
	CV	0.06	na	na	na	na	na	na	na	na	0.26	0.24	0.24
0-2	Mean	5.1	8.3	8.7	0.9	19.6	47.6	9.7	3.7	22.0	3.31	0.11	0.01
	SD	0.4	2.8	2.6	0.0	9.82	11.64	3.18	1.80	18.93	0.96	0.04	0.004
	CV	0.09	0.33	0.30	0.04	0.50	0.24	0.33	0.48	0.86	0.29	0.34	0.34
2-5	Mean	5.1	5.6	5.9	0.9	9.9	33.7	6.7	2.6	25.7	1.72	0.05	0.01
	SD	0.4	1.5	1.4	0.1	6.22	9.68	2.00	1.38	32.71	0.49	0.02	0.001
	CV	0.08	0.26	0.23	0.07	0.63	0.29	0.30	0.52	1.27	0.29	0.36	0.17
5-10	Mean	5.1	2.9	3.2	0.9	7.8	23.7	4.7	2.8	12.5	0.79	0.02	0.004
	SD	0.5	1.1	1.1	0.1	7.65	6.98	2.11	1.22	7.55	0.49	0.01	0.001
	CV	0.09	0.39	0.35	0.12	0.98	0.29	0.45	0.43	0.61	0.62	0.63	0.24
10-15	Mean	5.0	1.8	2.0	0.9	4.3	16.5	3.1	2.9	7.5	0.31	<0.01	0.003
	SD	0.4	0.6	0.5	0.1	2.78	6.00	1.25	0.87	4.07	0.09	na	0.001
	CV	0.09	0.32	0.26	0.10	0.64	0.36	0.41	0.30	0.54	0.28	na	0.26

Abbreviations:
pHc – pH measured in 0.01M $CaCl_2$
CEC – cation exchange capacity (BaCl2)
K, Ca, Mg, Al – water soluble cations
Exch Bases – sum of exchangeable K, Na, Ca and Mg
BSat – base saturation (sum of exchangeable bases/CEC)
BC:Al – ratio of (K+Ca+Mg) concentration to Al concentration
TC – total carbon
TN – total nitrogen
TS – total sulphur
Mean – average of 12 replicates (i.e., subplots) in each plot
SD – standard deviation
CV – coefficient of variation
na – not available or not applicable

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APPENDIX A

SOIL PROFILE DESCRIPTIONS
WHITNEY LAKES PROVINCIAL PARK
LONG TERM SOIL ACIDIFICATION MONITORING SITE

Whitney Lakes Provincial Park – West Sub-Site

Location:	Zone 12U E0530706E N5964727 (UTM NAD83) Within Whitney Lakes Provincial Park
Classification:	
Subgroup:	Eluviated Dystric Brunisol
Family	Sandy, siliceous, neutral, cold, subarid family
Series:	Nestow
Landform:	
Genetic Material:	Eolian overlying glaciofluvial
Surface Expression:	Level to undulating; 0-3% slopes (generally area is hummocky)
Drainage/ Perviousness:	Very rapidly drained; high perviousness
Site Features:	Site gently undulating; non stony
Vegetation:	a1 ecosite phase (Beckingham and Archibald 1996); jack pine/bearberry/lichen

Profile Description:

LF	2 to 0 cm	Dark brown, dark gray and black; non to slightly decomposed needles, bearberry leaves and lichen.
Ae1	0 to 8 cm	Light gray (10YR 6/1, moist), with black blotches; sand; single grain; loose; abundant, fine to coarse roots; no coarse fragments.
Ae2	8 to 16 cm	Light brownish gray (10YR 6/2, moist); sand; single grain; loose; plentiful, fine to coarse roots; no coarse fragments.
Bm1	16 to 60 cm	Yellowish brown (10YR 5/5, moist); sand; single grain; loose; very few coarse fragments; few, fine to coarse roots; gradual, smooth boundary.
Bm2	60 to 100 cm	Light yellowish brown (10YR 6/4, moist); sand; single grain; loose; very few coarse fragments; very few roots.

Notes: An AB horizon, though not present in the above profile, was present in two of the twelve of the soil pits dug for sampling.

Whitney Lakes Lake Provincial Park - East Sub-Site

Location:	Zone 12U E530240 N5964754 (UTM NAD83) Within Whitney Lakes Provincial Park
Classification:	
Subgroup:	Eluviated Dystric Brunisol
Family	Sandy, siliceous, neutral, cold, subarid family
Series:	Nestow
Landform:	
Genetic Material:	Glaciofluvial
Surface Expression:	undulating; 1-3% slopes
Drainage/ Perviousness:	Very rapidly drained; high perviousness
Site Features:	Site is gently undulating, located on a flat topped ridge between steeper slopes; non stony; many profiles contain fine gravel from the surface downward, or from other depths downward; this profile shows fine gravel in the Bm2 horizon.
Vegetation:	a1 ecosite phase (Beckingham and Archibald 1996); jack pine/bearberry/lichen

Profile Description:

LF	2 to 0 cm	Dark brown, dark gray and black; non to slightly decomposed needles, bearberry leaves, lichen and moss.
Ahe	0 to 7 cm	Light gray and dark gray (10YR 3/1 to 5/1, dry; mixed, salt and pepper colours); sand; single grain; loose; abundant, fine to coarse roots; no coarse fragments.
Ae1	7 to 15 cm	Light gray (10YR 6/1, moist), with black blotches; sand; single grain; loose; plentiful, fine to coarse roots; no coarse fragments.
Ae2	15 to 34 cm	Light brownish gray (10YR 6/2, moist); sand; single grain; loose; plentiful, fine to coarse roots; no coarse fragments.
Bm1	34 to 62 cm	Yellowish brown (10YR 5/6, moist); sand; single grain; loose; no coarse fragments; few, fine to coarse roots; <2% gravel gradual, smooth boundary.
Bm2	62 to 100 cm	Light yellowish brown (10YR 6/4, moist); sand; single grain; loose; very few coarse fragments; very few roots; no coarse fragments.

Notes: The Ahe horizon occurs sporadically and was present in about one-third of the soil pits examined. An AB horizon, though not present in the above profile, was present in about one quarter of the soil pits dug for sampling.

APPENDIX B

LABORATORY DATA –
WHITNEY LAKES PROVINCIAL PARK SOIL MONITORING SITE

Table C1. Soil pH, electrical conductivity and soluble ions at the Whitney Lakes West Site

Subplot	Layer (cm)	Sat'n (%)	pH (ext)	EC ($dS\ m^{-1}$)	Na	K	Ca	Mg ($mg\ L^{-1}$)	Al	Fe	Mn	S
A1	**0-2**	57.0	5.1	0.17	1.4	10.9	26.3	5.5	9.6	5.8	4.4	4.9
	2-5	41.2	5.3	0.11	1.6	5.7	17.9	4.0	10.9	5.8	2.7	3.1
	5-10	38.8	5.6	0.10	1.5	4.6	17.5	3.5	7.6	4.1	1.2	2.8
	10-15	38.0	5.6	0.09	1.6	5.0	15.1	4.2	21.8	11.8	0.8	2.5
	15-30	36.4	6.0	0.05	2.6	4.5	7.7	4.8	47.0	23.8	0.2	1.4
	30-45	34.0	6.2	0.03	1.4	9.2	9.8	9.2	116	55.7	0.5	1.1
	45-60	34.0	6.0	0.04	1.5	7.2	9.0	7.1	88.0	44.7	0.3	1.3
B1	**0-2**	52.0	5.6	0.33	3.7	34.3	49.6	10.0	8.7	7.6	7.9	8.8
	2-5	41.2	5.7	0.20	3.3	9.2	34.1	5.7	6.7	3.8	6.9	4.7
	5-10	39.2	5.5	0.08	2.0	6.7	11.5	3.0	17.6	9.3	1.1	2.5
	10-15	37.6	5.6	0.06	2.0	2.9	7.0	1.3	1.9	1.1	0.3	2.1
	15-30	35.6	5.8	0.04	1.6	3.3	6.3	2.4	20.3	10.4	0.1	1.7
	30-45	35.6	5.8	0.04	1.6	3.1	5.2	2.7	29.1	13.9	0.1	2.2
	45-60	34.4	6.2	0.02	1.5	2.8	3.3	2.1	22.9	12.1	<0.1	0.8
C1	**0-2**	54.0	5.6	0.18	1.2	10.9	30.9	4.7	3.5	2.5	2.0	5.0
	2-5	46.8	5.6	0.13	1.6	6.2	24.1	3.8	4.1	2.6	1.2	4.1
	5-10	39.6	5.7	0.10	2.8	5.0	21.4	3.9	6.4	4.4	1.0	2.9
	10-15	35.2	5.7	0.06	3.1	2.9	15.3	3.2	7.4	5.2	0.6	2.0
	15-30	35.6	5.8	0.04	2.6	2.4	10.4	2.4	8.6	4.8	0.2	1.1
	30-45	35.6	5.8	0.03	3.6	2.3	7.5	2.0	7.9	3.4	0.1	1.2
	45-60	34.0	5.9	0.03	2.3	2.6	9.0	2.1	5.1	1.5	0.1	1.0
D1	**0-2**	59.6	5.2	0.16	1.2	10.5	24.6	6.2	4.9	2.7	2.7	5.9
	2-5	40.4	5.9	0.10	1.9	6.2	15.1	3.9	4.6	2.5	1.1	2.9
	5-10	37.6	5.7	0.07	1.6	7.7	12.0	6.0	41.1	21.9	0.3	2.0
	10-15	36.8	6.0	0.06	1.7	5.8	12.2	2.9	6.7	3.6	0.3	1.5
	15-30	36.0	6.1	0.04	1.8	2.9	8.7	1.9	7.3	3.5	0.2	1.2
	30-45	35.2	6.0	0.03	1.5	2.6	7.9	1.6	5.7	2.1	0.1	0.8
	45-60	35.2	5.6	0.05	3.1	2.1	6.3	1.2	2.7	1.2	0.1	2.6
E1	**0-2**	52.8	5.4	0.26	1.2	24.1	41.9	8.2	12.2	8.2	6.9	8.9
	2-5	48.4	5.6	0.21	1.5	12.4	36.6	7.0	6.9	4.2	3.2	7.8
	5-10	44.8	5.4	0.15	2.0	7.6	25.1	4.7	4.2	2.4	3.1	5.1
	10-15	37.2	5.4	0.09	4.0	2.9	14.1	2.6	3.5	2.0	1.0	3.2
	15-30	35.6	5.6	0.05	2.1	1.4	11.0	1.7	4.9	2.0	0.2	1.4
	30-45	35.6	6.0	0.03	2.4	1.2	8.0	1.4	4.1	1.5	<0.1	1.3
	45-60	35.6	6.3	0.03	2.2	1.3	5.4	1.1	3.1	1.2	<0.1	1.5
F1	**0-2**	54.8	5.7	0.18	2.4	12.3	28.9	5.9	5.2	3.4	2.3	5.8
	2-5	49.6	6.0	0.17	1.6	7.5	30.0	5.4	3.9	2.3	1.6	5.4
	5-10	42.8	5.6	0.12	5.5	5.9	22.3	3.9	4.1	2.6	1.6	3.9
	10-15	36.8	5.6	0.08	7.1	3.4	16.2	2.8	4.4	2.7	0.7	2.5
	15-30	35.6	5.7	0.06	6.7	2.0	9.6	1.6	5.1	2.5	0.1	1.6
	30-45	35.2	5.8	0.05	5.9	1.4	7.4	1.2	3.7	1.5	<0.1	2.3
	45-60	35.2	5.6	0.05	7.4	2.3	9.6	1.6	4.7	1.8	<0.1	2.3

Abbreviations:
Sat'n – saturation; the percentage by weight of water in a saturated soil sample
Ext – extract; the pH measured in water extracted from a saturated soil sample

Table B1. Soil pH, electrical conductivity and soluble ions at the Whitney Lakes West Site (concluded)

Subplot	Layer (cm)	Sat'n (%)	pH (ext)	EC (dS m^{-1})	Na	K	Ca	Mg (mg L^{-1})	Al	Fe	Mn	S
G1	**0-2**	56.4	4.9	0.25	6.1	16.5	38.6	8.1	7.9	5.4	6.8	9.0
	2-5	45.4	5.4	0.15	2.0	8.3	22.2	5.0	6.1	3.9	3.0	4.5
	5-10	39.6	5.4	0.09	4.8	4.7	14.3	3.4	7.9	5.0	0.9	3.0
	10-15	38.0	5.2	0.08	2.9	4.7	11.5	2.6	5.0	3.2	0.7	2.7
	15-30	36.0	5.4	0.07	3.3	2.8	9.8	2.2	5.4	3.1	0.3	2.5
	30-45	35.2	5.6	0.06	2.4	2.6	10.1	2.0	6.2	2.7	0.2	2.4
	45-60	35.6	5.9	0.05	1.8	2.9	9.9	1.8	4.5	1.6	0.1	2.2
	5-10	44.0	5.3	0.14	2.6	8.8	21.9	4.3	3.2	1.7	2.3	4.2
H1	**0-2**	58.4	5.4	0.32	2.6	29.5	48.6	9.8	9.9	7.5	7.3	10.0
	2-5	49.6	5.4	0.26	2.5	19.3	39.8	8.3	7.0	4.4	4.6	7.8
	5-10	44.0	5.3	0.14	2.6	8.8	21.9	4.3	3.2	1.7	2.3	4.2
	10-15	36.8	5.5	0.09	2.9	3.9	14.0	2.6	3.3	2.0	0.8	2.6
	15-30	36.8	5.5	0.06	3.4	2.5	8.5	1.7	3.5	2.0	0.2	2.7
	30-45	35.6	5.9	0.03	3.9	0.8	4.5	0.8	3.8	1.6	<0.1	1.5
	45-60	36.0	5.7	0.03	2.8	1.3	4.2	0.8	3.0	1.4	<0.1	2.1
I1	**0-2**	49.6	6.0	0.18	1.2	11.7	30.3	6.4	2.8	2.0	2.0	5.3
	2-5	47.6	6.0	0.17	1.1	10.5	27.2	6.0	2.4	1.6	1.2	4.0
	5-10	40.8	5.9	0.14	1.7	7.6	24.2	4.9	2.4	1.7	1.3	3.5
	10-15	37.2	5.9	0.08	2.8	3.2	15.5	3.1	5.0	3.4	0.6	1.9
	15-30	35.6	6.2	0.07	2.3	2.1	15.0	2.7	5.8	3.0	0.2	1.4
	30-45	35.2	6.2	0.05	2.8	1.7	11.0	2.1	5.5	2.5	0.1	1.1
	45-60	35.2	5.9	0.05	4.3	2.1	7.7	1.4	5.1	2.5	0.1	1.9
J1	**0-2**	45.6	5.7	0.14	2.4	7.4	22.0	4.4	3.5	2.6	2.4	3.8
	2-5	44.8	5.7	0.15	2.1	8.4	25.6	4.7	4.2	3.1	2.4	4.7
	5-10	42.0	5.8	0.12	2.7	4.6	21.2	3.6	3.3	2.5	1.4	3.1
	10-15	38.8	5.5	0.10	3.0	4.2	17.0	2.9	3.8	3.0	1.3	2.9
	15-30	35.6	5.6	0.04	2.8	1.3	8.5	1.6	4.9	2.5	0.2	1.0
	30-45	34.8	6.2	0.03	2.5	0.8	3.5	0.6	0.6	0.3	<0.1	0.7
	45-60	35.6	6.1	0.03	2.8	1.4	4.4	0.8	2.8	1.3	<0.1	0.7
K1	**0-2**	56.4	5.8	0.25	1.1	20.5	38.8	6.8	3.6	2.8	3.2	6.6
	2-5	49.6	5.7	0.16	1.9	8.6	26.8	5.0	3.2	2.1	1.9	4.6
	5-10	40.4	5.4	0.12	5.0	5.4	18.5	3.8	3.4	2.5	1.6	3.8
	10-15	36.8	5.4	0.08	3.7	3.2	12.7	2.4	3.8	2.8	0.6	3.0
	15-30	35.2	5.9	0.05	2.9	2.0	9.2	1.7	4.8	2.7	<0.1	1.6
	30-45	35.2	5.8	0.06	3.4	1.9	9.4	1.9	3.6	1.5	<0.1	4.1
	45-60	35.2	6.4	0.03	3.3	1.8	8.7	1.8	6.1	2.3	0.1	1.0
L1	**0-2**	51.6	5.7	0.22	1.3	17.9	38.7	8.0	4.0	3.2	3.2	6.9
	2-5	45.6	5.7	0.21	2.1	14.9	34.5	7.9	3.9	2.6	2.9	6.0
	5-10	39.6	5.4	0.14	2.9	9.7	20.5	5.1	3.4	2.4	2.5	5.0
	10-15	36.0	5.3	0.09	4.1	5.5	9.6	2.5	2.1	1.4	0.9	4.4
	15-30	35.2	5.5	0.06	2.2	3.7	7.7	1.9	2.2	1.2	0.2	2.4
	30-45	35.6	5.7	0.05	3.8	2.3	6.7	1.5	4.2	1.8	<0.1	1.7
	45-60	35.2	5.9	0.04	3.6	2.1	5.5	1.2	2.8	1.3	<0.1	1.6

Table B2. Soil pH, electrical conductivity and soluble ions at the Whitney Lakes East Site

Subplot	Layer (cm)	Sat'n (%)	pH (ext)	EC (dS m^{-1})	Na	K	Ca	Mg	Al	Fe	Mn	S
					(mg L^{-1})							
A1	**0-2**	58.4	5.2	0.22	1.6	15.3	35.9	6.9	5.6	4.1	3.2	7.5
	2-5	55.6	5.2	0.19	1.5	9.5	32.3	5.4	5.1	3.3	2.2	6.6
	5-10	47.0	5.4	0.14	3.1	5.5	22.7	3.9	3.5	2.6	1.3	4.6
	10-15	37.6	5.5	0.07	2.4	2.7	12.7	2.2	3.4	2.6	0.8	2.3
B1	**0-2**	55.2	5.4	0.21	1.3	21.9	31.8	7.6	5.1	3.7	3.6	6.9
	2-5	46.8	6.2	0.12	0.8	6.7	19.7	4.3	1.9	1.4	0.3	2.6
	5-10	42.0	6.1	0.13	1.1	6.6	23.8	4.2	1.5	1.4	0.4	3.0
	10-15	36.4	6.2	0.09	2.0	3.8	18.3	3.1	3.2	2.3	0.4	2.2
C1	**0-2**	63.2	5.6	0.25	1.9	14.7	45.7	8.2	4.3	3.6	2.8	7.1
	2-5	46.0	5.8	0.17	1.2	6.1	34.1	5.4	3.1	2.2	1.6	4.8
	5-10	36.0	5.6	0.10	1.8	3.3	20.4	3.2	2.8	2.2	1.0	2.4
	10-15	35.2	5.5	0.08	1.8	2.4	15.6	2.4	2.8	1.8	0.7	2.4
D1	**0-2**	68.4	5.0	0.28	1.2	13.8	52.1	11.9	5.9	3.4	5.2	9.3
	2-5	46.4	5.1	0.13	1.4	6.0	18.7	4.4	4.9	2.9	2.7	4.9
	5-10	37.6	5.4	0.10	2.9	5.9	12.5	2.8	2.8	1.8	1.7	3.6
	10-15	35.6	5.4	0.05	2.5	1.7	6.9	1.4	2.9	2.5	0.2	1.5
E1	**0-2**	58.8	5.4	0.24	2.4	12.0	48.1	8.4	5.7	3.9	4.1	7.1
	2-5	51.6	5.6	0.20	2.9	8.6	36.2	6.5	3.5	2.1	2.2	6.2
	5-10	40.8	5.5	0.12	1.5	5.9	23.6	3.6	3.4	2.5	1.7	3.1
	10-15	36.0	5.4	0.10	1.9	4.5	20.0	3.0	3.9	2.6	1.2	3.0
F1	**0-2**	68.4	6.3	0.44	3.1	34.6	77.4	17.6	1.3	0.8	1.5	8.4
	2-5	47.2	6.2	0.25	2.4	17.3	41.7	10.4	1.4	0.9	1.1	6.1
	5-10	40.0	6.3	0.18	3.0	10.6	33.5	7.0	1.4	1.2	0.9	3.3
	10-15	36.0	6.4	0.16	3.2	8.0	30.5	5.7	1.9	1.4	0.6	2.8
G1	**0-2**	53.4	5.6	0.30	2.7	29.3	47.2	13.1	5.5	3.8	4.4	8.8
	2-5	48.0	5.9	0.22	2.2	17.3	34.5	8.8	2.5	1.4	1.7	5.2
	5-10	48.8	5.9	0.26	2.3	30.1	33.6	9.6	2.6	1.6	1.8	5.3
	10-15	36.4	5.8	0.14	3.9	11.5	22.2	4.8	3.5	3.2	1.0	3.5
H1	**0-2**	65.2	5.7	0.26	1.2	11.7	48.4	8.7	2.5	1.8	2.5	6.9
	2-5	47.6	6.0	0.19	1.7	5.9	32.9	6.5	1.1	0.5	1.5	4.1
	5-10	40.0	6.1	0.13	2.1	3.9	22.6	4.4	2.1	1.5	1.0	2.9
	10-15	35.2	5.8	0.07	1.4	3.1	12.8	2.4	2.0	1.7	0.4	1.9
I1	**0-2**	54.8	6.3	0.23	1.8	8.2	44.4	6.1	1.1	0.6	0.7	4.1
	2-5	46.0	6.3	0.28	1.2	4.9	53.3	7.6	0.4	0.1	0.8	3.5
	5-10	38.4	6.4	0.13	2.1	2.7	26.0	4.5	1.4	1.1	0.5	2.2
	10-15	36.0	6.2	0.10	3.0	2.7	17.1	3.7	2.3	1.7	0.4	2.1
J1	**0-2**	61.6	6.0	0.33	1.7	25.1	57.7	9.1	3.0	2.2	2.6	8.6
	2-5	48.8	5.8	0.17	2.6	6.0	28.8	5.3	2.8	1.8	1.6	4.9
	5-10	39.2	5.7	0.10	4.6	2.9	15.0	3.2	2.9	2.0	1.5	3.6
	10-15	36.0	5.4	0.08	2.3	4.1	12.6	2.5	4.3	3.0	1.1	2.6
K1	**0-2**	77.2	5.8	0.31	1.3	37.2	43.1	10.0	2.6	2.2	2.0	8.1
	2-5	55.6	6.1	0.29	3.3	24.2	43.8	9.7	2.6	1.4	1.7	7.1
	5-10	38.0	6.1	0.19	2.1	12.5	33.2	7.5	5.8	3.7	1.7	5.0
	10-15	35.2	5.7	0.10	3.5	4.7	16.6	3.6	3.6	2.9	0.5	3.2
L1	**0-2**	60.4	6.1	0.22	0.8	11.1	39.8	8.3	2.2	1.6	0.8	4.2
	2-5	49.0	5.9	0.17	1.1	6.4	28.7	6.2	2.4	1.5	0.8	4.6
	5-10	36.0	5.9	0.09	1.7	3.8	18.1	3.2	3.6	2.8	0.6	2.2
	10-15	35.2	6.0	0.07	1.2	2.8	12.4	1.8	1.5	1.1	0.2	1.4

Table B3. pH($CaCl_2$), and Total Carbon, Nitrogen and Sulphur at the Whitney Lakes West Site

Subplot	Layer (cm)	pH ($CaCl_2$)	Total Carbon (%)	Total Nitrogen (%)	Total Sulphur (%)
A1	LFH	4.2	43.0	1.13	0.117
	0-2	4.5	2.26	0.05	0.009
	2-5	4.6	0.88	0.02	0.004
	5-10	4.7	0.52	<0.01	0.001
	10-15	4.8	0.33	<0.01	0.002
	15-30	5.1			
	30-45	5.4			
	45-60	5.2			
B1	LFH	4.4	38.2	0.89	0.102
	0-2	5.0	2.36	0.03	0.009
	2-5	5.1	1.19	0.01	0.003
	5-10	4.8	0.32	<0.01	0.002
	10-15	4.7	0.18	<0.01	0.002
	15-30	4.9			
	30-45	5.0			
	45-60	5.1			
C1	LFH	4.5	34.4	0.83	0.086
	0-2	4.9	2.27	0.04	0.010
	2-5	4.9	1.80	0.04	0.007
	5-10	5.0	0.82	0.01	0.005
	10-15	4.8	0.29	<0.01	0.003
	15-30	5.0			
	30-45	4.8			
	45-60	4.9			
D1	LFH	4.5	29.2	0.75	0.083
	0-2	4.6	3.32	0.10	0.016
	2-5	4.8	0.88	0.01	0.005
	5-10	4.9	0.30	<0.01	0.004
	10-15	5.1	0.19	<0.01	0.003
	15-30	5.1			
	30-45	5.1			
	45-60	4.7			
E1	LFH	4.6	41.8	1.22	0.126
	0-2	4.8	2.06	0.04	0.008
	2-5	5.0	1.58	0.03	0.008
	5-10	4.7	1.19	0.01	0.006
	10-15	4.6	0.30	<0.01	0.003
	15-30	4.8			
	30-45	5.1			
	45-60	5.3			
F1	LFH	4.4	40.9	1.13	0.094
	0-2	4.9	3.16	0.10	0.010
	2-5	5.1	1.94	0.05	0.007
	5-10	4.9	0.86	<0.01	0.005
	10-15	4.8	0.32	<0.01	0.004
	15-30	4.8			
	30-45	4.9			
	45-60	4.8			

Table B3. pH($CaCl_2$), and Total Carbon, Nitrogen and Sulphur at the Whitney Lakes West Site (concluded)

Subplot	Layer (cm)	pH ($CaCl_2$)	Total Carbon (%)	Total Nitrogen (%)	Total Sulphur (%)
G1	LFH	4.3	43.7	1.04	0.114
	0-2	4.4	2.85	0.06	0.010
	2-5	4.6	1.34	0.02	0.006
	5-10	4.5	0.41	<0.01	0.004
	10-15	4.5	0.26	<0.01	0.004
	15-30	4.5			
	30-45	4.8			
	45-60	5.1			
H1	LFH	4.4	21.7	0.74	0.092
	0-2	4.7	2.31	0.06	0.010
	2-5	4.8	2.16	0.05	0.007
	5-10	4.7	0.98	0.01	0.005
	10-15	4.7	0.25	<0.01	0.003
	15-30	4.7			
	30-45	4.9			
	45-60	4.7			
I1	LFH	4.5	47.7	1.26	0.134
	0-2	5.1	1.29	0.03	0.007
	2-5	5.2	1.37	0.03	0.006
	5-10	5.2	0.82	0.01	0.003
	10-15	5.0	0.31	<0.01	0.002
	15-30	5.4			
	30-45	5.4			
	45-60	5.0			
J1	LFH	4.4	21.6	0.55	0.072
	0-2	4.8	1.16	0.01	0.005
	2-5	5.0	0.99	0.01	0.003
	5-10	5.1	0.66	<0.01	0.002
	10-15	4.9	0.37	<0.01	0.002
	15-30	4.8			
	30-45	5.0			
	45-60	5.2			
K1	LFH	4.4	35.7	1.04	0.100
	0-2	5.2	3.46	0.08	0.006
	2-5	5.0	1.76	0.03	0.006
	5-10	4.5	0.63	0.01	0.003
	10-15	4.6	0.32	<0.01	0.002
	15-30	5.0			
	30-45	5.0			
	45-60	5.4			
L1	LFH	4.4	33.4	0.94	0.085
	0-2	5.1	1.57	0.04	0.008
	2-5	5.2	1.40	0.02	0.005
	5-10	4.7	0.48	<0.01	0.003
	10-15	4.6	0.20	<0.01	0.003
	15-30	4.7			
	30-45	4.8			
	45-60	4.8			

Table B4. pH($CaCl_2$), and Total Carbon, Nitrogen and Sulphur at the Whitney Lakes East Site

Subplot	Layer (cm)	pH ($CaCl_2$)	Total Carbon (%)	Total Nitrogen (%)	Total Sulphur (%)
A1	LFH	4.5	24.0	0.72	0.090
	0-2	4.6	2.92	0.08	0.010
	2-5	4.6	2.42	0.05	0.006
	5-10	4.5	2.00	0.02	0.005
	10-15	4.7	0.43	<0.01	0.002
B1	LFH	4.4	32.6	0.88	0.093
	0-2	4.8	2.39	0.08	0.010
	2-5	5.4	1.11	0.03	0.006
	5-10	5.4	1.20	0.02	0.005
	10-15	5.3	0.46	<0.01	0.002
C1	LFH	4.4	41.2	0.84	0.091
	0-2	4.9	3.74	0.11	0.013
	2-5	5.1	1.78	0.05	0.007
	5-10	4.8	0.41	<0.01	0.003
	10-15	4.7	0.25	<0.01	0.003
D1	LFH	4.7	18.3	0.55	0.067
	0-2	4.5	4.22	0.14	0.013
	2-5	4.4	1.35	0.03	0.006
	5-10	4.3	0.38	<0.01	0.003
	10-15	4.3	0.19	<0.01	0.003
E1	LFH	4.3	19.7	0.57	0.057
	0-2	4.7	2.87	0.08	0.010
	2-5	4.7	1.74	0.04	0.006
	5-10	4.8	0.75	0.01	0.004
	10-15	4.7	0.40	<0.01	0.002
F1	LFH	4.9	27.3	0.80	0.088
	0-2	5.8	3.75	0.13	0.017
	2-5	5.5	1.53	0.05	0.007
	5-10	5.6	0.55	0.01	0.003
	10-15	5.9	0.26	<0.01	0.004
G1	LFH	4.5	39.0	1.24	0.143
	0-2	4.9	3.17	0.11	0.008
	2-5	5.3	1.46	0.04	0.005
	5-10	5.4	1.39	0.04	0.006
	10-15	5.2	0.40	<0.01	0.002
H1	LFH	4.5	33.5	0.97	0.101
	0-2	5.1	4.91	0.16	0.010
	2-5	5.3	1.47	0.04	0.007
	5-10	5.2	0.63	0.01	0.004
	10-15	4.9	0.27	<0.01	0.003

Table B4. pH($CaCl_2$), and Total Carbon, Nitrogen and Sulphur at the Whitney Lakes East Site (concluded)

Subplot	Layer (cm)	pH ($CaCl_2$)	Total Carbon (%)	Total Nitrogen (%)	Total Sulphur (%)
I1	LFH	5.2	22.0	0.67	0.081
	0-2	5.8	2.21	0.08	0.009
	2-5	5.8	1.38	0.04	0.007
	5-10	5.7	0.46	0.01	0.004
	10-15	5.4	0.30	<0.01	0.003
J1	LFH	4.5	34.6	0.94	0.099
	0-2	5.4	2.49	0.07	0.010
	2-5	5.1	1.42	0.03	0.005
	5-10	4.6	0.55	<0.01	0.003
	10-15	4.7	0.30	<0.01	0.002
K1	LFH	4.4	38.5	1.05	0.113
	0-2	5.2	4.79	0.16	0.023
	2-5	5.4	2.72	0.09	0.009
	5-10	5.4	0.52	<0.01	0.004
	10-15	4.9	0.21	<0.01	0.002
L1	LFH	5.1	36.8	1.08	0.113
	0-2	5.4	2.26	0.06	0.012
	2-5	5.1	2.23	0.06	0.007
	5-10	5.1	0.68	0.01	0.004
	10-15	5.2	0.29	<0.01	0.003

Table B5. Exchangeable Cations, Cation Exchange Capacity and Base Saturation at the Whitney Lakes West Site

Subplot	Layer (cm)	pH ($CaCl_2$)	Na	K	Ca	Mg	Al	Fe	Mn	Bases	CEC[1]	Base Saturation
			($cmol\ kg^{-1}$)									
A1	LFH	4.2										
	0-2	4.5	0.07	0.12	2.35	0.31	0.34	0.01	0.29	2.84	3.48	0.82
	2-5	4.6	0.03	0.08	1.34	0.22	0.37	0.01	0.18	1.66	2.22	0.75
	5-10	4.7	0.03	0.07	1.23	0.21	0.23	0.01	0.06	1.55	1.85	0.83
	10-15	4.8	0.03	0.07	1.16	0.24	0.18	0.02	0.04	1.49	1.72	0.87
	15-30	5.1	0.07	0.05	1.01	0.32	0.09	0.01	0.01	1.46	1.58	0.93
	30-45	5.4	0.08	0.06	1.03	0.31	0.07	0.02	<0.01	1.47	1.55	0.94
	45-60	5.2	0.11	0.05	1.07	0.26	0.07	0.02	<0.01	1.50	1.59	0.95
B1	LFH	4.4										
	0-2	5.0	0.07	0.27	3.80	0.47	0.13	0.01	0.54	4.61	5.29	0.87
	2-5	5.1	0.06	0.11	2.30	0.25	0.13	0.01	0.53	2.73	3.40	0.80
	5-10	4.8	0.05	0.09	0.89	0.15	0.15	0.01	0.06	1.18	1.40	0.84
	10-15	4.7	0.05	0.06	0.73	0.15	0.17	0.01	0.03	0.99	1.19	0.83
	15-30	4.9	0.06	0.05	0.83	0.17	0.10	0.01	0.01	1.11	1.24	0.90
	30-45	5.0	0.05	0.04	0.87	0.18	0.08	0.01	0.01	1.14	1.24	0.92
	45-60	5.1	0.06	0.05	1.14	0.24	0.05	0.01	0.01	1.49	1.56	0.96
C1	LFH	4.5										
	0-2	4.9	0.06	0.12	4.26	0.42	0.10	0.01	0.17	4.86	5.14	0.95
	2-5	4.9	0.08	0.10	4.17	0.42	0.14	0.01	0.13	4.77	5.05	0.94
	5-10	5.0	0.07	0.07	2.41	0.32	0.10	0.01	0.08	2.87	3.05	0.94
	10-15	4.8	0.08	0.05	1.24	0.26	0.10	0.01	0.03	1.63	1.78	0.92
	15-30	5.0	0.07	0.06	1.17	0.29	0.09	0.01	0.01	1.59	1.70	0.94
	30-45	4.8	0.06	0.05	1.18	0.35	0.11	0.01	<0.01	1.65	1.77	0.93
	45-60	4.9	0.06	0.07	1.45	0.42	0.07	0.01	0.01	1.99	2.08	0.96
D1	LFH	4.5										
	0-2	4.6	0.04	0.16	4.75	0.71	0.37	<0.01	0.43	5.66	6.47	0.87
	2-5	4.8	0.07	0.10	1.63	0.35	0.16	0.01	0.10	2.15	2.42	0.89
	5-10	4.9	0.07	0.10	1.18	0.30	0.09	0.01	0.03	1.65	1.78	0.93
	10-15	5.1	0.05	0.12	1.11	0.30	0.06	0.01	0.02	1.58	1.66	0.95
	15-30	5.1	0.05	0.08	1.13	0.28	0.06	0.01	0.01	1.54	1.62	0.95
	30-45	5.1	0.04	0.06	0.92	0.24	0.06	0.01	0.01	1.27	1.34	0.94
	45-60	4.7	0.05	0.04	0.91	0.22	0.09	0.01	0.01	1.23	1.34	0.92
E1	LFH	4.6										
	0-2	4.8	0.06	0.17	2.99	0.40	0.12	0.01	0.27	3.62	4.03	0.90
	2-5	5.0	0.06	0.15	4.26	0.51	0.16	0.01	0.24	4.99	5.39	0.92
	5-10	4.7	0.06	0.09	2.24	0.33	0.25	0.01	0.21	2.72	3.19	0.85
	10-15	4.6	0.09	0.05	1.07	0.21	0.23	0.01	0.05	1.41	1.71	0.83
	15-30	4.8	0.08	0.04	1.28	0.25	0.10	0.01	0.01	1.65	1.78	0.93
	30-45	5.1	0.08	0.04	1.13	0.25	0.06	0.01	0.01	1.50	1.57	0.95
	45-60	5.3	0.05	0.04	1.02	0.25	0.05	0.01	0.01	1.37	1.43	0.95
F1	LFH	4.4										
	0-2	4.9	0.06	0.17	4.55	0.56	0.10	<0.01	0.22	5.34	5.66	0.94
	2-5	5.1	0.07	0.10	4.66	0.49	0.08	<0.01	0.17	5.32	5.56	0.96
	5-10	4.9	0.03	0.07	2.00	0.28	0.09	<0.01	0.10	2.38	2.56	0.93
	10-15	4.8	0.07	0.05	1.23	0.23	0.11	0.01	0.04	1.58	1.72	0.91
	15-30	4.8	0.09	0.04	1.24	0.23	0.12	0.01	0.01	1.60	1.74	0.92
	30-45	4.9	0.07	0.04	1.27	0.25	0.06	0.01	<0.01	1.63	1.70	0.96
	45-60	4.8	0.06	0.04	1.43	0.30	0.08	0.01	<0.01	1.82	1.91	0.95

[1] CEC – cation exchange capacity; measured by the barium chloride method

Table B5. Exchangeable Cations, Cation Exchange Capacity and Base Saturation at the Whitney Lakes West Site (concluded)

Subplot	Layer (cm)	pH ($CaCl_2$)	Na	K	Ca	Mg	Al	Fe	Mn	Bases	C.E.C.	Base Saturation
			($cmol\ kg^{-1}$)									
G1	LFH	4.3										
	0-2	4.4	0.06	0.16	3.50	0.47	0.46	0.01	0.43	4.19	5.08	0.82
	2-5	4.6	0.06	0.11	2.00	0.35	0.29	0.01	0.17	2.52	2.98	0.85
	5-10	4.5	0.07	0.08	1.22	0.28	0.28	0.01	0.06	1.66	2.01	0.83
	10-15	4.5	0.07	0.08	1.03	0.28	0.24	0.01	0.03	1.46	1.73	0.84
	15-30	4.5	0.08	0.07	1.00	0.27	0.27	0.01	0.02	1.42	1.72	0.83
	30-45	4.8	0.05	0.06	1.10	0.27	0.07	0.01	0.01	1.47	1.56	0.95
	45-60	5.1	0.05	0.05	1.16	0.27	0.02	<0.01	0.01	1.52	1.56	0.98
H1	LFH	4.4										
	0-2	4.7	0.05	0.24	3.99	0.53	0.14	0.01	0.38	4.82	5.35	0.90
	2-5	4.8	0.06	0.17	3.50	0.47	0.13	0.01	0.28	4.20	4.62	0.91
	5-10	4.7	0.06	0.13	2.18	0.33	0.31	0.01	0.17	2.71	3.20	0.85
	10-15	4.7	0.01	0.07	1.10	0.23	0.19	0.01	0.04	1.42	1.66	0.85
	15-30	4.7	0.08	0.07	1.13	0.27	0.20	0.01	0.02	1.54	1.77	0.87
	30-45	4.9	0.04	0.04	1.06	0.24	0.16	0.02	0.01	1.38	1.56	0.88
	45-60	4.7	0.04	0.04	1.12	0.25	0.14	0.02	0.01	1.45	1.62	0.90
I1	LFH	4.5										
	0-2	5.1	0.04	0.15	3.35	0.52	0.06	0.01	0.17	4.06	4.30	0.94
	2-5	5.2	0.07	0.17	4.38	0.64	0.06	0.01	0.14	5.27	5.47	0.96
	5-10	5.2	0.06	0.13	2.83	0.44	0.09	0.01	0.10	3.46	3.67	0.94
	10-15	5.0	0.02	0.08	1.45	0.30	0.09	0.01	0.04	1.85	2.00	0.93
	15-30	5.4	0.05	0.05	1.39	0.30	0.06	0.02	0.02	1.80	1.89	0.95
	30-45	5.4	0.02	0.05	1.31	0.30	0.08	0.02	0.01	1.68	1.78	0.94
	45-60	5.0	0.05	0.05	1.12	0.24	0.09	0.02	0.01	1.46	1.57	0.93
J1	LFH	4.4										
	0-2	4.8	0.06	0.10	2.33	0.33	0.25	0.01	0.21	2.82	3.28	0.86
	2-5	5.0	0.06	0.10	2.82	0.36	0.19	0.01	0.18	3.33	3.72	0.90
	5-10	5.1	0.04	0.06	1.87	0.27	0.09	0.01	0.08	2.24	2.43	0.92
	10-15	4.9	0.02	0.06	1.41	0.24	0.17	0.01	0.07	1.73	1.97	0.87
	15-30	4.8	0.04	0.04	1.22	0.29	0.16	0.01	0.01	1.59	1.77	0.89
	30-45	5.0	0.06	0.04	1.16	0.26	0.11	0.02	0.01	1.53	1.67	0.91
	45-60	5.2	0.06	0.05	1.23	0.26	0.06	0.01	0.01	1.60	1.69	0.95
K1	LFH	4.4										
	0-2	5.2	0.06	0.17	4.30	0.47	0.05	0.01	0.21	5.00	5.27	0.95
	2-5	5.0	0.04	0.14	4.45	0.53	0.14	0.01	0.21	5.16	5.51	0.93
	5-10	4.5	0.04	0.09	1.57	0.31	0.33	0.01	0.12	2.00	2.46	0.81
	10-15	4.6	0.05	0.07	1.22	0.27	0.23	0.02	0.04	1.61	1.90	0.85
	15-30	5.0	0.07	0.06	1.27	0.28	0.11	0.02	0.01	1.67	1.81	0.93
	30-45	5.0	0.07	0.05	1.14	0.29	0.09	0.01	<0.01	1.55	1.65	0.94
	45-60	5.4	0.06	0.05	1.03	0.27	0.06	0.01	<0.01	1.41	1.49	0.95
L1	LFH	4.4										
	0-2	5.1	0.07	0.18	3.79	0.53	0.08	0.01	0.21	4.56	4.86	0.94
	2-5	5.2	0.07	0.18	3.56	0.55	0.08	0.01	0.20	4.36	4.66	0.94
	5-10	4.7	0.05	0.11	1.35	0.32	0.23	0.01	0.12	1.84	2.20	0.84
	10-15	4.6	0.05	0.08	0.83	0.26	0.31	0.01	0.06	1.22	1.59	0.76
	15-30	4.7	0.04	0.08	0.92	0.28	0.24	0.02	0.02	1.31	1.59	0.82
	30-45	4.8	0.03	0.06	0.92	0.26	0.16	0.02	0.01	1.27	1.45	0.87
	45-60	4.8	0.02	0.05	1.04	0.28	0.12	0.02	0.01	1.38	1.53	0.90

Table B6. Exchangeable Cations, Cation Exchange Capacity and Base Saturation at the Whitney Lakes East Site

Subplot	Layer (cm)	pH ($CaCl_2$)	Na	K	Ca	Mg	Al	Fe	Mn	Bases	C.E.C.	Base Saturation
			($cmol\ kg^{-1}$)									
A1	LFH	4.5										
	0-2	4.6	0.03	0.17	4.81	0.58	0.24	0.01	0.34	5.59	6.17	0.91
	2-5	4.6	0.01	0.12	4.95	0.50	0.41	0.01	0.28	5.57	6.28	0.89
	5-10	4.5	0.01	0.10	3.30	0.36	0.55	0.02	0.21	3.76	4.53	0.83
	10-15	4.7	0.02	0.05	1.39	0.22	0.30	0.01	0.06	1.68	2.06	0.82
B1	LFH	4.4										
	0-2	4.8	0.01	0.23	3.82	0.64	0.17	0.01	0.32	4.71	5.21	0.90
	2-5	5.4	0.01	0.12	3.95	0.59	0.03	<0.01	0.05	4.67	4.75	0.98
	5-10	5.4	0.00	0.12	3.95	0.48	0.04	0.01	0.05	4.55	4.65	0.98
	10-15	5.3	0.01	0.09	2.32	0.33	0.08	0.01	0.03	2.74	2.86	0.96
C1	LFH	4.4										
	0-2	4.9	0.01	0.17	6.78	0.73	0.14	0.01	0.31	7.68	8.15	0.94
	2-5	5.1	0.01	0.11	5.61	0.56	0.16	0.01	0.22	6.30	6.68	0.94
	5-10	4.8	0.01	0.07	1.96	0.30	0.20	0.01	0.07	2.34	2.62	0.89
	10-15	4.7	0.01	0.06	1.86	0.32	0.18	0.01	0.05	2.25	2.49	0.90
D1	LFH	4.7										
	0-2	4.5	0.01	0.16	6.62	0.91	0.41	0.01	0.56	7.70	8.68	0.89
	2-5	4.4	0.01	0.08	2.18	0.34	0.54	0.01	0.27	2.60	3.41	0.76
	5-10	4.3	0.01	0.05	0.64	0.14	0.39	0.01	0.09	0.84	1.32	0.64
	10-15	4.3	0.01	0.05	0.60	0.14	0.39	0.02	0.02	0.80	1.23	0.65
E1	LFH	4.3										
	0-2	4.7	0.01	0.17	6.27	0.67	0.21	0.01	0.45	7.13	7.80	0.91
	2-5	4.7	0.01	0.15	5.15	0.54	0.28	0.01	0.36	5.84	6.48	0.90
	5-10	4.8	0.01	0.10	2.26	0.30	0.16	0.01	0.12	2.66	2.95	0.90
	10-15	4.7	0.01	0.08	1.65	0.26	0.18	0.01	0.07	2.00	2.25	0.89
F1	LFH	4.9										
	0-2	5.8	0.01	0.33	12.4	1.64	0.02	<0.01	0.12	14.43	14.6	0.99
	2-5	5.5	0.01	0.22	5.30	0.82	0.03	<0.01	0.09	6.35	6.48	0.98
	5-10	5.6	0.01	0.16	2.49	0.44	0.02	<0.01	0.04	3.10	3.16	0.98
	10-15	5.9	0.01	0.15	1.93	0.39	0.02	<0.01	0.02	2.48	2.52	0.98
G1	LFH	4.5										
	0-2	4.9	0.01	0.27	4.43	0.79	0.16	0.01	0.32	5.50	5.98	0.92
	2-5	5.3	0.01	0.20	4.10	0.63	0.06	<0.01	0.15	4.93	5.15	0.96
	5-10	5.4	0.01	0.28	3.99	0.69	0.04	<0.01	0.12	4.96	5.13	0.97
	10-15	5.2	0.01	0.15	1.30	0.28	0.06	0.01	0.03	1.74	1.84	0.95
H1	LFH	4.5										
	0-2	5.1	0.01	0.15	8.05	0.85	0.07	0.01	0.30	9.05	9.43	0.96
	2-5	5.3	0.01	0.11	4.76	0.58	0.05	<0.01	0.12	5.46	5.63	0.97
	5-10	5.2	0.01	0.08	2.25	0.34	0.07	<0.01	0.05	2.68	2.80	0.96
	10-15	4.9	0.01	0.06	1.23	0.23	0.11	0.01	0.02	1.53	1.67	0.92
I1	LFH	5.2										
	0-2	5.8	0.01	0.12	7.16	0.59	0.02	<0.01	0.07	7.87	7.96	0.99
	2-5	5.8	0.01	0.09	5.98	0.52	0.02	<0.01	0.05	6.59	6.66	0.99
	5-10	5.7	0.01	0.07	2.57	0.37	0.02	<0.01	0.02	3.02	3.06	0.98
	10-15	5.4	0.01	0.08	2.00	0.44	0.04	0.01	0.03	2.52	2.60	0.97

Table B6. Exchangeable Cations, Cation Exchange Capacity and Base Saturation at the Whitney Lakes East Site (concluded)

Subplot	Layer (cm)	pH ($CaCl_2$)	Na	K	Ca	Mg	Al	Fe	Mn	Bases	C.E.C.	Base Saturation
			($cmol\ kg^{-1}$)									
J1	LFH	4.5										
	0-2	5.4	0.01	0.23	7.93	0.73	0.04	0.01	0.22	8.90	9.17	0.97
	2-5	5.1	0.01	0.08	3.29	0.41	0.12	0.01	0.13	3.79	4.05	0.94
	5-10	4.6	0.01	0.06	1.31	0.26	0.29	0.01	0.13	1.63	2.06	0.79
	10-15	4.7	0.01	0.05	0.92	0.19	0.19	0.01	0.05	1.17	1.42	0.83
K1	LFH	4.4										
	0-2	5.2	0.01	0.47	10.2	1.43	0.05	0.01	0.32	12.08	12.5	0.97
	2-5	5.4	0.01	0.25	6.71	0.90	0.03	<0.01	0.16	7.87	8.07	0.98
	5-10	5.4	0.01	0.14	2.15	0.39	0.04	0.01	0.06	2.69	2.80	0.96
	10-15	4.9	0.01	0.08	1.03	0.26	0.13	0.01	0.02	1.39	1.55	0.89
L1	LFH	5.1										
	0-2	5.4	0.01	0.15	7.80	0.99	0.03	<0.01	0.10	8.94	9.07	0.99
	2-5	5.1	0.01	0.12	6.25	0.78	0.09	<0.01	0.13	7.15	7.37	0.97
	5-10	5.1	0.01	0.08	2.30	0.32	0.11	0.01	0.04	2.71	2.86	0.95
	10-15	5.2	0.01	0.07	1.45	0.22	0.07	0.01	0.02	1.74	1.83	0.95

Table B7. Nutrients and Texture in Pedogenic Horizons of the Whitney Lakes East and West Monitoring Sub-Sites

Sub-Site	Horizon	Depth (cm)	Plant Avail. (NO_3+NO_2)-N (mg kg^{-1})	Plant Avail. NH_4-N (mg kg^{-1})	Plant Avail. N (mg kg^{-1})	Plant Avail. P (mg kg^{-1})	Sand (%)	Silt (%)	Clay (%)
West	LFH	2-0	<0.05	28.5	45.3				
	Ae1	0-7	<0.05	1.05	10.5	92	5	3	<0.05
	Ae2	7-15	0.06	0.22	14.6	94	3	3	<0.05
	Bm1	15-34	<0.05	<0.05	34.8	94	3	3	0.06
	Bm2	34-62	0.05	<0.05	26.3	95	3	3	<0.05
	Bm3	62-100				95	2	3	0.05
East	LFH	2-0	0.37	45.3	42.2				
	Ae1	0-8	0.08	0.81	16.3	90	8	3	0.37
	Ae2	8-16	<0.05	1.96	65.8	92	5	3	0.08
	Bm1	16-60	<0.05	<0.05	59.5	89	7	5	<0.05
	Bm2	60-100				86	9	5	<0.05

APPENDIX C

WHITNEY LAKES LONG TERM ACID DEPOSITION MONITORING SITE PHOTOGRAPHS

Photo C1. Jack Pine Stand at Whitney Lakes East Monitoring Sub-Site

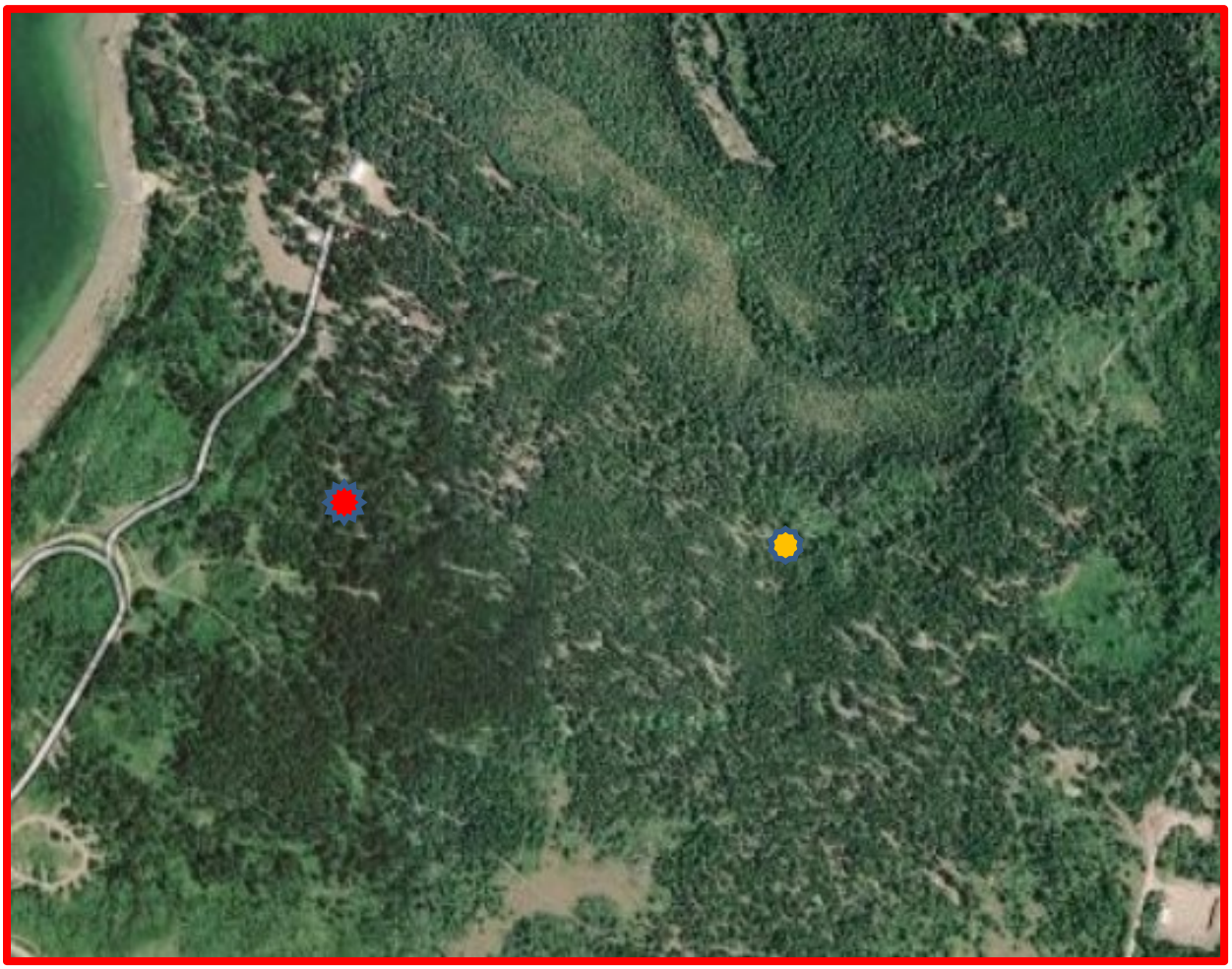
Photo C2. Soil Profile at Whitney Lakes East Monitoring Sub-Site

Photo C3. Jack Pine Forest Stand at Whitney Lakes West Monitoring Sub-Site

Photo C4. Soil profile at Whitney Lakes West Monitoring Sub-Site

APPENDIX D

LOCATION OF SOIL MONITORING SITES IN WHITNEY LAKES PROVINCIAL PARK



Map D1. Locations of Soil Monitoring Sub-Sites within Whitney Lakes Provincial Park

Gold – East Sub-Site

Red – West Sub-Site