LICA LONG TERM SOIL ACIDIFICATION MONITORING
WHITNEY LAKES SITE - 2015

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EXECUTIVE SUMMARY

The Lakeland Industry and Community Association (LICA) implemented a long term Acid Deposition monitoring program in 2010 with establishment of the Moose Lake site within Moose Lake Provincial Park. A second site, the Whitney Lakes long term soil acidification monitoring site, was established in 2011. Soil sampling and laboratory analysis of soil samples to establish baseline soil chemistry data for the site were completed at that time. The intended long term monitoring interval is four years. This report presents the data from the second sampling event carried out in fall of 2015.

The LICA monitoring system follows the protocols of Alberta Environment and Parks (AEP; previously Alberta Environment and Sustainable Resource Development) in their Long Term Soil Acidification Monitoring Program. Background information, site selection and results of the first sampling event are described in *LICA Long Term Soil Acidification Monitoring - Whitney Lakes Site Establishment* (Abboud and Turchenek 2012).

Soil acidification parameters are soil attributes that can be directly affected by acidic inputs, and which in turn could affect other components of the ecosystem. These attributes include pH, exchangeable base saturation, aluminum (Al) concentration in soil solution, base cation (BC) concentration in soil solution, and the ratio of BC to Al concentrations. Associated attributes are levels of carbon (C), nitrogen (N) and sulphur (S) in surface soil horizons. In particular, total sulphur content can increase in the LFH and surface mineral soil layers due to deposition of sulphur oxides. Carbon and N are included with S analyses because the ratios of the three elements can reveal dynamics of these nutrients over a long term.

Soil acidification parameters were examined using descriptive statistics and analysis of variance to determine variability in the data. Base saturation and pHc were the least variable, while BC:Al ratio and individual dissolved ions had coefficients of variation exceeding 1.0 (i.e., >100%) in some cases. Total C, N and S, as well as the ratios of these with each other, were highly variable, particularly in the upper mineral layers.

There were some differences in acidification parameters between sub-sites (East and West) and between the two sampling years (2011 and 2015). These differences are attributed to variability both within and between sub-sites. Total Carbon reflects the amount of organic matter in the soil, and is highest in the LFH layer and in the upper mineral soil layers. Differences in other parameters such as cation exchange capacity, base cations, BC:Al ratio, Total Nitrogen and Total Sulphur follow the Total Carbon differences because of the adsorptive capacity of organic matter for cations, and because Total Sulphur and Total Nitrogen are generally in organic form in the soil. All data inferences based on the two (2011 and 2015) sampling events are considered to pertain primarily to natural variability of the soil properties. With only two sampling events, no inferences regarding trends are possible.

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1.0 INTRODUCTION

The Lakeland Industry and Community Association (LICA) implemented a long term Acid Deposition monitoring program in 2010 with establishment of the Moose Lake site within Moose Lake Provincial Park. A second site, the Whitney Lakes long term soil acidification monitoring site, was established in 2011. Soil sampling and laboratory analysis of soil samples to establish baseline soil chemistry data for the site was completed at that time. The long term monitoring was established to re-sample soils at four year intervals. This report presents the data from the second sampling event carried out in fall of 2015.

Background information and site selection are described in *Long Term Soil Acidification Monitoring in the LICA Study Area* (Abboud and Turchenek 2011). Establishment of the Whitney Lakes site and results of the first sampling event are presented in *LICA Long Term Soil Acidification Monitoring - Whitney Lakes Site Establishment* (Abboud and Turchenek 2012). The LICA monitoring system follows the protocols of Alberta Environment and Parks (AEP; previously Alberta Environment and Sustainable Resource Development) in their Long Term Soil Acidification Monitoring Program (Roberts et al. 1989). This program consists of eight monitoring sites established in the late 1980s throughout the Province of Alberta. One of these sites is located within the LICA study area, thus providing a historical monitoring basis for the LICA program. One other site was established near Tucker Lake, northeast of the Town of Bonnyville, in addition to the monitoring sites established at Moose Lake and Whitney lakes in 2011 and 2012.

Each monitoring site consists of two sub-sites; these are referred to as the West and East sub-sites at the Whitney Lakes monitoring site. Each sub-site is delineated by a 24 m by 24 m square area that is further subdivided into plots and subplots for replication purposes. At each of the sub-sites (i.e., East and West), twelve replicates are taken of eight soil layers (LFH and 0-2, 2-5, 5-10, 10-15, 15-30, 30-45 and 45-60 cm layers. The report of Abboud and Turchenek (2011) should be consulted for further details of the monitoring protocol. Details of sampling methods and laboratory analysis are also provided in the report of the 2011 sampling event (Abboud and Turchenek 2012).

All soil chemical parameters (see Section 3) were measured for all replicates and all layers in the initial monitoring event in 2010. The purpose was to establish the baseline for the entire depth of sampling. In the current sampling event, and in subsequent years, only the LFH, 0-2, 2-5, 5-10, and 10-15 cm depth samples will be analyzed. This is done in part to reduce the analytical costs associated with monitoring. In addition, it has been shown that any effects to date have occurred only in the surface soils layers in the AEP long term monitoring program (Abboud et al. 2012). Consequently, the long term aspect of monitoring entails determination of the acid chemistry of surface soil layers to 15 cm depth. All samples are archived and will be available for laboratory analysis in the future, should results indicate that changes are occurring potentially to depths greater than 15 cm.

2.0 METHODS

2.1 SOIL SAMPLING

Soil sampling was carried out as described in Section 4.2.2 of the 2011 soil monitoring report (Abboud and Turchenek (2012).

2.2 LABORATORY ANALYSES

Soil analyses were completed at the Soil Laboratory of the Northern Forestry Centre in Edmonton, Alberta. Samples submitted to the laboratory from the field were kept frozen if they could not be immediately processed. Sample processing consisted of drying at about 30°C and then passing them through a 2 mm sieve. Methods are as described in the 2011 soil monitoring report (Abboud and Turchenek (2012), and method references are repeated below in Table 1.

Table 1. Analytical Methods Applied in Soil Analysis

Parameter	Method	Notes
pH ($CaCl_2$)	Method 3.11 in McKeague (1978)	The soil-to-solution ratio for litter (LFH) material is 1:4 and for mineral soil is 1:2. Solution is 0.1 M $CaCl_2$. Measurement is with a combination pH electrode.
Electrical Conductivity	Method 4.13 in McKeague (1978)	The EC and pH were measured 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 analysis of the extract for Na, K, Ca, Mg, Al, Fe, Mn and S.
Cation Exchange Capacity - Unbuffered	Method 18.2 in Carter and Gregorich (2008)	By unbuffered 0.1 M $BaCl_2$ extraction, and calculation of CEC as sum of exchangeable cations.
Exchangeable Cations	Method 18.2 in Carter and Gregorich (2008)	By ICP-OES analysis for Ca, Mg, Na, K, Fe, Mn, and Al in the unbuffered $BaCl_2$ extract from CEC analysis.
Total Carbon, Nitrogen, and Sulphur	Method 3.611 in McKeague (1978)	Combustion method using a LECO[2] TruSpec CN Carbon/Nitrogen Analyzer (LECO, 2006).

[1] ICP-OES – Inductively Couples Plasma – Atomic Emission Spectroscopy
[2] LECO – Trade name of combustion unit for C, N and S analysis.

2.3 STATISTICS

Basic statistics (i.e., mean, standard deviation and coefficient of variability) were calculated for the acidification indicators and their input variables. Coefficient of variation (CV) refers to the standard deviation divided by the mean. Analysis of variance (ANOVA) was performed on the main soil acidification variables, namely pH, base saturation, and base cation:aluminum (BC:Al) ratio, as well as some of the other variables. A two-factor ANOVA using MS Excel© was carried out in order to examine the differences between the two sub-sites (East and West) and the two samples years (2010 and 2014). Tukey's test (Steel and Torrie 1980) was subsequently carried out on these attributes in order to determine whether differences in the data were statistically significant (α=0.05 level of confidence). The statistics were based on the 12 replicates from each sub-site.

3.0 RESULTS

3.1 SOIL ACIDIFICATION PARAMETERS

Soil acidification parameters are soil attributes that can be directly affected by acidic inputs, and which in turn could affect other components of the ecosystem. These attributes include pH, exchangeable base saturation, aluminum (Al) concentration in soil solution, base cation (BC) concentration in soil solution, and the ratio of BC to Al concentrations. A detailed discussion of these is presented in the 2011 LICA soil monitoring report (Abboud and Turchenek 2011). Of the attributes, research has demonstrated effects on vegetation mainly with respect to base saturation percentage and base cation to aluminum ratio. Decreases in either of these attributes can occur with addition of acidic or acidifying substances to the soil. Likewise, pH is expected to decrease. Associated attributes are levels of carbon (C), nitrogen (N) and sulphur (S) in surface soil horizons. In particular, total sulphur content can increase in the LFH and surface mineral soil layers due to deposition of sulphur oxides. Carbon and nitrogen are included in the analyses because the ratios of the three elements can reveal dynamics of these nutrients over a long term.

3.2 SOIL MONITORING RESULTS

Soil samples from the East and West Whitney lakes sub-sites were analyzed for various soil parameters, as described above. The complete data are provided in Appendices A and B. Data in Appendix A are presented with simple statistics for each soil attribute according to soil layer and soil sub-site. Appendix B presents data as received from the laboratory.

Tables 2, 3 and 4 summarize the data for the main acidification indicators and the main parameters from which they were calculated. The following examines some aspects of the data; no comments regarding trends are made as there are only two sampling events at this time.

3.2.1 pHc

The data show slight increases in pHc (pH of soil mixed with $CaCl_2$ solution) in all layers between 2010 and 2014 (Table 2). Statistically significant differences are noted, but the differences are small and variability is low, with coefficients of variation (CV) 0.08 or lower.

3.2.2 Base Saturation

Base saturation is a key acidification indicator defined as the proportion of exchangeable base cations (K, Na, Ca and Mg) to the cation exchange capacity (Table 2). Values within layers differ by up to 0.1 (i.e., about 10%). This parameter is more variable than pHc, with CVs ranging from 0.07 to 0.16. Differences are mainly non-significant, and both increases and decreases occur between the sampling years.

Table 2. Soil pH, Base Saturation, Cation Exchange Capacity and Exchangeable Bases at the Whitney Lakes Site - 2015

pHc		LFH				0-2 (cm)				2-5 (cm)				5-10 (cm)				10-15 (cm)			
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	5.28	a	0.42	0.08	5.51	a	0.24	0.04	4.62	a	0.18	0.04	5.54	a	0.30	0.05	4.31	a	0.15	0.03
2015	**West**	5.51	ab	0.32	0.06	5.66	a	0.23	0.04	4.88	ab	0.15	0.03	5.56	a	0.23	0.04	4.42	ab	0.10	0.02
2011	**East**	5.41	ab	0.44	0.08	5.53	a	0.37	0.07	4.63	a	0.17	0.04	5.62	a	0.35	0.06	4.41	ab	0.22	0.05
2015	**East**	5.70	b	0.42	0.07	5.84	a	0.38	0.07	4.76	a	0.16	0.03	5.78	a	0.35	0.06	4.62	b	0.29	0.06
Base Saturation (sum of exchangeable base cations as a proportion of CEC)																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	-	-	-	-	0.74	a	0.11	0.16	0.77	a	0.10	0.14	0.77	a	0.11	0.14	0.79	a	0.11	0.14
2015	**West**	-	-	-	-	0.81	a	0.06	0.08	0.87	b	0.06	0.07	0.83	a	0.09	0.11	0.80	a	0.10	0.12
2011	**East**	-	-	-	-	0.84	b	0.10	0.11	0.85	b	0.07	0.09	0.79	b	0.09	0.11	0.74	b	0.07	0.10
2015	**East**	-	-	-	-	0.83	a	0.08	0.10	0.81	ab	0.06	0.08	0.74	a	0.08	0.11	0.72	a	0.08	0.11
Cation Exchange Capacity (cmol/kg)																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	-	-	-	-	3.77	a	1.63	0.43	2.28	a	1.29	0.57	1.28	ab	0.35	0.27	1.01	a	0.22	.0.22
2015	**West**	-	-	-	-	3.56	a	0.96	0.27	2.26	a	0.89	0.39	1.09	a	0.16	0.15	0.85	a	0.13	0.15
2011	**East**	-	-	-	-	6.19	b	3.22	0.52	3.48	a	1.07	0.31	1.84	b	0.96	0.52	1.09	a	0.35	0.32
2015	**East**	-	-	-	-	5.43	ab	2.27	0.42	2.71	b	1.27	0.47	1.23	a	0.28	0.23	0.95	b	0.15	0.16
Sum of Bases (cmol/kg)																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	-	-	-	-	2.85	a	1.52	0.53	1.80	a	1.19	0.66	1.01	ab	0.37	0.36	0.81	a	0.24	0.29
2015	**West**	-	-	-	-	2.88	a	0.88	0.31	1.99	a	0.89	0.45	0.91	a	0.19	0.21	0.69	a	0.17	0.25
2011	**East**	-	-	-	-	5.38	ab	3.26	0.61	3.01	a	1.02	0.34	1.49	b	0.90	0.61	0.82	a	0.31	0.38
2015	**East**	-	-	-	-	4.58	b	2.17	0.47	2.24	a	1.14	0.51	0.93	a	0.28	0.30	0.69	a	0.16	0.24

Abbreviations: pHc – pH measured in 0.01M $CaCl_2$ Exch Bases – sum of exchangeable K, Na, Ca and Mg
CEC – cation exchange capacity BSat – base saturation (sum of exchangeable base/CEC)
Mean – average of 12 replicates in each sub-site
SD – standard deviation CV – coefficient of variation Sig - significance
a, b, ab, c, bc – significance indicators; means followed by the same letter do not differ significantly from one another at P=0.05 (Tukey's test).

Table 3. Water Soluble Ions and Base Cation:Aluminum Ratios at the Whitney Lakes Site - 2015

BC:Al Ratio		0-2 (cm)				2-5 (cm)				5-10 (cm)				10-15 (cm)			
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	7.96	a	3.27	0.41	6.91	a	3.14	0.45	5.09	a	3.25	0.64	3.53	a	1.40	0.40
2015	**West**	11.93	a	4.03	0.34	13.59	a	9.13	0.67	11.97	a	12.35	1.03	4.03	a	3.32	0.82
2011	**East**	21.22	a	18.22	0.86	24.55	a	31.87	1.30	11.33	a	7.18	0.63	6.53	a	3.74	0.57
2015	**East**	24.41	a	31.50	1.29	16.58	a	16.71	1.01	7.14	a	4.70	0.66	5.30	a	6.76	1.28
K (mmol/L)																	
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	0.44	a	0.22	0.49	0.25	a	0.10	0.41	0.17	a	0.04	0.27	0.10	a	0.03	0.27
2015	**West**	0.38	a	0.17	0.45	0.24	a	0.10	0.41	0.15	a	0.05	0.34	0.10	a	0.05	0.52
2011	**East**	0.50	a	0.25	0.50	0.25	a	0.16	0.63	0.20	a	0.20	0.98	0.11	a	0.07	0.64
2015	**East**	0.50	a	0.15	0.31	0.34	a	0.14	0.43	0.20	a	0.11	0.56	0.14	a	0.10	0.72
Ca (mmol/L)																	
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	0.87	a	0.23	0.26	0.69	a	0.19	0.27	0.48	a	0.11	0.24	0.33	a	0.07	0.22
2015	**West**	1.03	a	0.57	0.55	0.84	ab	0.32	0.39	0.59	a	0.23	0.40	0.34	a	0.11	0.32
2011	**East**	1.19	a	0.29	0.24	0.84	ab	0.24	0.29	0.59	a	0.17	0.29	0.41	ab	0.15	0.36
2015	**East**	1.33	a	0.55	0.41	1.03	b	0.38	0.37	0.68	a	0.23	0.34	0.51	b	0.20	0.40
Mg (mmol/L)																	
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	0.29	a	0.08	0.26	0.23	a	0.06	0.27	0.17	a	0.03	0.20	0.11	a	0.03	0.23
2015	**West**	0.32	a	0.16	0.51	0.25	a	0.09	0.38	0.17	a	0.06	0.36	0.11	a	0.03	0.30
2011	**East**	0.40	a	0.13	0.33	0.28	a	0.08	0.30	0.19	a	0.09	0.45	0.13	a	0.05	0.41
2015	**East**	0.42	a	0.11	0.25	0.32	a	0.12	0.38	0.21	a	0.08	0.38	0.16	a	0.07	0.44
Al (mmol/L)																	
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	**West**	0.23	b	0.12	0.50	0.20	b	0.09	0.44	0.32	b	0.41	1.26	0.21	ab	0.20	0.93
2015	**West**	0.15	ab	0.07	0.47	0.12	a	0.05	0.39	0.12	a	0.06	0.48	0.21	ab	0.12	0.58
2011	**East**	0.14	a	0.07	0.48	0.10	a	0.05	0.52	0.10	a	0.05	0.43	0.11	a	0.03	0.30
2015	**East**	0.13	a	0.04	0.31	0.13	a	0.04	0.32	0.20	a	0.09	0.48	0.27	b	0.13	0.47

Abbreviations: K, Ca, Mg, Al – water soluble cations BC:Al – ratio of (K+Ca+Mg) concentration to Al concentration
Mean – average of 12 replicates in each sub-site SD – standard deviation CV – coefficient of variation Sig - significance:
a, b, ab, c, bc – significance indicators; means followed by the same letter do not differ significantly from one another at P=0.05 (Tukey's test).

Table 4. Total Soil Carbon, Nitrogen and Sulphur at the Whitney Lakes Site - 2015

Total Carbon (%)		LFH (cm)				0-2 (cm)				2-5 (cm)				5-10 (cm)				10-15 (cm)			
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	35.9	b	8.40	0.23	2.34	a	0.76	0.32	1.44	a	0.42	0.29	0.67	a	0.27	0.41	0.28	a	0.062	0.22
2015	West	30.2	ab	8.86	0.29	2.53	a	0.92	0.37	1.59	a	0.33	0.21	0.72	a	0.26	0.37	0.27	a	0.11	0.42
2011	East	30.6	ab	8.03	0.26	3.31	a	0.96	0.29	1.72	a	0.49	0.29	0.79	a	0.49	0.62	0.31	a	0.09	0.28
2015	East	21.8	a	7.04	0.32	3.60	a	1.79	0.50	1.57	a	0.61	0.39	0.56	a	0.15	0.27	0.29	a	0.086	0.30
Total Nitrogen (%)																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	0.96	b	0.22	0.23	0.054	a	0.027	0.50	0.026	a	0.013	0.48	0.007	a	0.003	0.46	0.005	a	0.000	0.000
2015	West	0.90	b	0.26	0.29	0.085	a	0.027	0.32	0.053	b	0.014	0.26	0.023	b	0.011	0.48	0.007	a	0.006	0.766
2011	East	0.86	ab	0.21	0.24	0.11	ab	0.036	0.34	0.045	ab	0.016	0.36	0.013	a	0.010	0.80	0.005	a	0.000	0.000
2015	East	0.65	a	0.22	0.34	0.14	b	0.077	0.55	0.059	b	0.027	0.45	0.014	a	0.006	0.39	0.006	a	0.002	0.272
Total Sulphur (%)																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	0.10	b	0.019	0.19	0.009	ab	0.003	0.31	0.01	a	0.00	0.29	0.0004	a	0.002	0.42	0.003	b	0.001	0.27
2015	West	0.08	ab	0.022	0.26	0.008	a	0.002	0.29	0.01	a	0.00	0.45	0.0003	a	0.002	0.64	0.002	a	0.001	0.47
2011	East	0.09	b	0.022	0.24	0.012	b	0.004	0.34	0.01	a	0.00	0.17	0.0004	a	0.001	0.24	0.003	b	0.001	0.26
2015	East	0.06	a	0.017	0.27	0.013	b	0.004	0.35	0.01	a	0.00	0.56	0.0003	a	0.002	0.49	0.002	ab	0.001	0.35
C:N Ratio																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	37.55	a	3.90	0.10	48.48	b	15.56	0.32	61.63	c	19.23	0.31	103.7	c	34.3	0.33	55.44	ab	12.38	0.22
2015	West	33.82	a	2.01	0.059	29.29	a	3.21	0.11	30.27	ab	2.97	0.10	32.5	a	7.7	0.24	40.96	a	12.44	0.30
2011	East	35.62	a	4.54	0.13	32.10	a	3.97	0.12	39.18	b	6.33	0.16	72.1	b	25.0	0.35	62.58	b	17.56	0.28
2015	East	33.69	a	3.32	0.10	25.96	a	2.65	0.10	27.22	a	3.10	0.11	42.2	a	10.7	0.25	50.69	ab	15.37	0.30
C:S Ratio																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	357	a	51.30	0.14	271.39	a	102.8	0.38	267.16	a	62.88	0.24	213.6	a	118.4	0.55	109.49	a	44.86	0.41
2015	West	370	a	35.27	0.10	309.36	a	76.03	0.25	507.84	a	608.54	1.20	371.5	a	275.9	0.74	186.99	a	114.18	0.61
2011	East	324	a	52.23	0.16	287.35	a	85.33	0.30	265.05	a	62.56	0.24	188.2	a	77.3	0.41	133.00	a	61.87	0.47
2015	East	348	a	49.28	0.14	282.85	a	82.83	0.29	426.95	a	343.20	0.80	235.5	a	173.1	0.74	134.37	a	58.39	0.43
N:S Ratio																					
Year	**Sub-site**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**	**Mean**	**Sig**	**SD**	**CV**
2011	West	9.52	ab	1.23	0.13	6.06	a	2.84	0.47	4.54	a	1.23	0.27	2.1	a	1.07	0.51	1.94	a	0.51	0.26
2015	West	10.94	b	0.83	0.08	10.55	b	2.39	0.23	16.70	a	19.72	1.18	11.5	b	8.08	0.70	5.47	b	5.71	1.04
2011	East	9.08	a	0.65	0.07	9.09	ab	2.95	0.32	6.83	a	1.50	0.22	3.0	a	1.65	0.55	2.05	a	0.49	0.24
2015	East	10.34	b	1.02	0.10	10.95	b	3.16	0.29	15.40	a	11.22	0.73	6.0	a	4.64	0.78	2.81	ab	1.31	0.47

Abbreviations: See previous table.

3.2.3 Cation Exchange Capacity and Sum of Exchangeable Bases

Both of these parameters are variable, with CV ranging from 0.15 to 0.57 for CEC, and 0.24 to 0.66 for sum of bases (Table 2). The main difference occurs between sites, where both CEC and sum of bases are higher in the 0-2 cm and 2-5 cm layers of the East site as comparted to the West site. This is consistent between the two sampling years.

3.2.4 Base Cation to Aluminum Ratio (BC:Al) and Water Soluble Ions

Variability of the BC:Al ratio is relatively high as indicated by CV values ranging from 0.34 up to 1.30 among all soil layers (Table 3). Water soluble ions are likewise quite variable, with soluble Al having the widest CV range at 0.20 to 1.26 (20 to 126%) among all the layers, sites and years of sampling. Nevertheless, the means of Al values when compared among sites are similar, ranging from 0.10% to 0.32%. Ca CVs range from 0.22 to 0.55, and Mg CVs range from 0.23 to 0.51.

Higher BC:Al ratios in the 0-2 cm and 2-5 cm layers, as compared to lower layers are a consequence of the higher base cation contents (K, Ca and Mg), which are associated with the higher organic carbon levels in the surface layers. The organic C reflects the amount of organic matter in the soil. With increasing organic matter content, there is increasing capacity to adsorb and retain exchangeable cations. The organic matter also decomposes slowly, releasing nutrients including base cations, thus leading to relatively higher concentrations in the surface soil layers.

3.2.5 Total Carbon

Total C has relatively high variability, with CVs ranging from 0.21 to 0.62 (Table 4). High C contents are typical of LFH (informally referred to as litter or duff) layers in forest soils. Relatively higher C in the 0-2 cm and 2-5 cm mineral layers reflects the influence of the litter layer, whereby particulate or soluble C mixes or leaches from the LFH into the upper mineral soil. The C content in the West sub-site is lower as compared to the East sub-site; however, these differences are not statistically different, which is suggested by CVs in the 0.23 to 0.32 range.

3.2.6 Total Nitrogen and Total Sulphur

TN and TS contents are low in the mineral soil layers, and they display variability similar to that for TC (Table 4). Similar to TC, the levels in the mineral soil layers are highest in the 0-2 cm layer and then diminish with depth. TS is an important monitoring parameter, as sulphur can accumulate in the LFH layer and thus reflect the amount of deposition at a site.

3.2.7 C:N, C:S and N:S Ratios

Of these ratios, C:S is of particular interest for the same reasons as indicated for TS above. If TS increases in the soil surface layers, it is expected that C:S would decrease. Similar

observations apply to the C:N ratios. Some values are relatively high, particularly the 2011 ratios for the West sub-site as compared to the East sub-site. Values such as these are attributed to variability in site-specific conditions. The C:S ratios are high due the considerably larger fraction of C in organic matter as compared to S. There is variability in these ratios, but differences among the mean values are not significant.

3.3 CONCLUSION

Soil acidification parameters were examined using descriptive statistics and analysis of variance to determine variability in the data. Base saturation and pHc were the least variable, while BC:Al ratio had CVs up to 0.73, with individual dissolved ions exceeding 1.0 (i.e., >100%) in some cases. Total C, N and S were also examined, with ratios of TC and TN to TS calculated to observe possible trends in S accumulation over the long term. Levels of each of these were quite variable, particularly in the upper mineral layers.

Differences in acidification parameters between sub-sites (East and West) and between the two sampling years (2010 and 2014) are generally attributable to natural variability. TC, TN and TS contents are highest in the LFH layer and in upper mineral soil layers (0-2 cm and 2-5 cm). The TC reflects the amount of organic matter in the soil. Differences in other parameters such as cation exchange capacity, base cations, BC:Al ratio, TN and TS follow the TC differences because of the adsorptive capacity of organic matter for cations, and because TS and TN are generally in organic form in the soil.

All data inferences based on the 2011 and 2015 sampling events pertain only to natural variability of the soil properties. With only two sampling events, no inferences regarding trends are possible.

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APPENDIX A

DATA AND BASIC STATISTICS

WHITNEY LAKES SOIL MONITORING SITE - 2015

Appendix Table A1. pHc, Cation Exchange Capacity and Exchangeable Ions - 2015 Data and Descriptive Statistics

Plot	Subplot/ Layer	pHc	Na	K	Ca	Mg	Al	Fe	Mn	TEC	Bases	Base Saturation
			(cmol/kg)									
-	A2/0-2	4.3	0.048	0.16	2.78	0.48	0.34	0.007	0.31	4.13	3.47	0.84
West	B2/0-2	4.2	0.040	0.17	4.69	0.63	0.41	0.025	0.70	6.66	5.52	0.83
West	C2/0-2	4.4	0.039	0.11	2.52	0.29	0.39	0.007	0.36	3.73	2.97	0.80
West	D2/0-2	5.0	0.029	0.081	3.67	0.47	0.021	<0.001	0.13	4.41	4.26	0.97
West	E2/0-2	4.8	0.050	0.15	5.75	0.79	0.092	0.008	0.58	7.42	6.74	0.91
West	F2/0-2	4.9	0.037	0.055	2.65	0.43	0.020	<0.001	0.10	3.29	3.17	0.96
West	G2/0-2	4.6	0.039	0.21	2.96	0.51	0.12	0.003	0.24	4.08	3.72	0.91
West	H2/0-2	4.5	0.048	0.12	3.58	0.58	0.21	0.001	0.21	4.75	4.32	0.91
West	I2/0-2	4.7	0.047	0.20	6.72	0.68	0.16	0.007	0.32	8.12	7.64	0.94
West	J2/0-2	5.1	0.035	0.14	3.47	0.48	0.009	<0.001	0.13	4.26	4.12	0.97
West	K2/0-2	5.0	0.045	0.12	2.66	0.41	0.023	0.001	0.088	3.34	3.23	0.97
West	L2/0-2	5.0	0.041	0.092	6.45	0.82	0.011	<0.001	0.20	7.62	7.40	0.97
	Mean	4.7	0.041	0.13	3.99	0.55	0.15	0.007	0.28	5.15	4.71	0.91
	SD	0.3	0.006	0.047	1.53	0.16	0.15	0.008	0.19	1.78	1.69	0.062
	CV	0.06	0.150	0.35	0.38	0.29	1.02	1.06	0.68	0.35	0.36	0.067
East	A2/0-2	5.0	0.042	0.072	0.89	0.22	0.21	0.003	0.041	1.48	1.23	0.83
East	B2/0-2	5.0	0.040	0.062	1.13	0.27	0.07	0.001	0.019	1.59	1.50	0.94
East	C2/0-2	5.7	0.044	0.049	1.01	0.24	0.11	0.006	0.011	1.48	1.35	0.92
East	D2/0-2	4.8	0.039	0.157	6.43	0.89	0.08	0.002	0.28	7.88	7.51	0.95
East	E2/0-2	4.6	0.013	0.114	5.91	0.85	0.02	<0.001	0.28	7.19	6.89	0.96
East	F2/0-2	4.7	0.028	0.065	6.29	0.77	0.11	<0.001	0.64	7.91	7.15	0.90
East	G2/0-2	5.1	0.035	0.206	8.54	0.96	<0.001	<0.001	0.18	9.93	9.75	0.98
East	H2/0-2	5.3	0.043	0.248	6.36	1.05	<0.001	<0.001	0.11	7.81	7.70	0.99
East	I2/0-2	4.6	0.041	0.127	8.86	0.87	0.047	0.005	0.31	10.26	9.90	0.96
East	J2/0-2	4.3	0.042	0.148	4.14	0.57	0.37	0.004	0.36	5.64	4.90	0.87
East	K2/0-2	4.9	0.037	0.181	7.36	0.96	0.021	0.001	0.22	8.78	8.54	0.97
East	L2/0-2	4.3	0.041	0.130	4.03	0.67	0.27	0.004	0.36	5.51	4.87	0.89
	Mean	4.9	0.037	0.13	5.08	0.70	0.13	0.003	0.23	6.29	5.94	0.93
	SD	0.4	0.009	0.062	2.84	0.30	0.12	0.002	0.18	3.20	3.16	0.049
	CV	0.08	0.23	0.48	0.56	0.43	0.89	0.61	0.77	0.51	0.53	0.05

Appendix Table A1. pHc, Cation Exchange Capacity and Exchangeable Ions - 2015 Data and Descriptive Statistics (continued)

Plot	Subplot/ Layer	pHc	Na	K	Ca	Mg	Al	Fe	Mn	TEC	Bases	Base Saturation
			(cmol/kg)									
West	**A2/2-5**	4.5	0.040	0.070	2.76	0.33	0.39	0.004	0.28	3.88	3.20	0.82
West	**B2/2-5**	4.7	0.041	0.117	3.69	0.49	0.21	0.013	0.43	4.99	4.34	0.87
West	**C2/2-5**	4.7	0.040	0.080	2.81	0.27	0.17	0.003	0.18	3.56	3.20	0.90
West	**D2/2-5**	4.9	0.033	0.101	4.45	0.51	0.044	0.002	0.16	5.30	5.09	0.96
West	**E2/2-5**	5.0	0.046	0.144	4.18	0.63	0.051	0.005	0.26	5.32	5.00	0.94
West	**F2/2-5**	5.0	0.033	0.045	2.40	0.41	0.027	<0.001	0.072	2.99	2.89	0.97
West	**G2/2-5**	4.9	0.051	0.169	3.36	0.47	0.12	0.002	0.14	4.31	4.05	0.94
West	**H2/2-5**	4.9	0.034	0.111	4.13	0.54	0.084	<0.001	0.13	5.03	4.81	0.96
West	**I2/2-5**	5.0	0.056	0.090	3.68	0.45	0.071	0.002	0.10	4.45	4.27	0.96
West	**J2/2-5**	5.3	0.041	0.106	6.24	0.59	<0.001	<0.001	0.089	7.06	6.97	0.99
West	**K2/2-5**	4.9	0.037	0.100	3.73	0.51	0.062	0.001	0.14	4.59	4.38	0.96
West	**L2/2-5**	5.0	0.041	0.110	5.16	0.71	0.047	<0.001	0.106	6.17	6.02	0.98
	Mean	4.9	0.04	0.10	3.88	0.49	0.12	0.004	0.17	4.80	4.52	0.94
	SD	0.2	0.007	0.032	1.07	0.12	0.11	0.004	0.10	1.11	1.18	0.05
	CV	0.04	0.17	0.31	0.28	0.25	0.93	0.92	0.59	0.23	0.26	0.051
East	**A2/2-5**	4.8	0.041	0.100	6.35	0.800	0.028	<0.001	0.20	7.52	7.30	0.97
East	**B2/2-5**	5.1	0.039	0.156	4.93	0.679	0.039	0.002	0.14	5.99	5.80	0.97
East	**C2/2-5**	5.6	0.038	0.143	3.86	0.636	0.023	<0.001	0.11	4.82	4.68	0.97
East	**D2/2-5**	4.6	0.025	0.072	4.94	0.630	0.113	<0.001	0.20	5.98	5.67	0.95
East	**E2/2-5**	4.9	0.023	0.067	4.46	0.567	<0.001	<0.001	0.14	5.26	5.12	0.97
East	**F2/2-5**	4.9	0.030	0.058	2.98	0.414	0.027	<0.001	0.20	3.71	3.48	0.94
East	**G2/2-5**	5.2	0.031	0.122	4.05	0.498	<0.001	<0.001	0.11	4.81	4.70	0.98
East	**H2/2-5**	5.2	0.040	0.199	5.31	0.924	<0.001	<0.001	0.12	6.59	6.48	0.98
East	**I2/2-5**	4.7	0.042	0.062	3.68	0.426	0.126	0.002	0.11	4.45	4.21	0.95
East	**J2/2-5**	4.3	0.083	0.134	3.45	0.398	0.518	0.004	0.29	4.87	4.06	0.83
East	**K2/2-5**	5.1	0.040	0.115	3.70	0.539	0.005	0.001	0.09	4.49	4.39	0.98
East	**L2/2-5**	4.5	0.042	0.102	2.84	0.425	0.269	0.002	0.20	3.88	3.41	0.88
	Mean	4.9	0.040	0.11	4.21	0.58	0.13	0.002	0.16	5.20	4.94	0.95
	SD	0.4	0.015	0.043	1.03	0.16	0.17	0.001	0.06	1.13	1.18	0.046
	CV	0.07	0.38	0.39	0.24	0.29	1.32	0.57	0.36	0.22	0.24	0.04

Appendix Table A1. pHc, Cation Exchange Capacity and Exchangeable Ions - 2015 Data and Descriptive Statistics (continued)

Plot	Subplot/ Layer	pHc	Na	K	Ca	Mg	Al	Fe	Mn	TEC	Bases	Base Saturation
			(cmol/kg)									
West	**A2/5-10**	4.8	0.037	0.034	1.84	0.224	0.081	0.001	0.065	2.29	2.14	0.94
West	**B2/5-10**	4.6	0.043	0.090	1.87	0.342	0.151	0.008	0.16	2.67	2.34	0.88
West	**C2/5-10**	4.9	0.046	0.043	1.88	0.212	0.052	<0.001	0.077	2.31	2.18	0.94
West	**D2/5-10**	5.0	0.039	0.070	3.41	0.327	0.032	<0.001	0.091	3.97	3.85	0.97
West	**E2/5-10**	4.9	0.042	0.068	1.73	0.354	0.040	0.002	0.086	2.32	2.19	0.94
West	**F2/5-10**	4.7	0.037	0.040	1.31	0.285	0.078	<0.001	0.046	1.80	1.67	0.93
West	**G2/5-10**	4.9	0.032	0.073	1.87	0.295	0.050	<0.001	0.052	2.37	2.27	0.96
West	**H2/5-10**	4.9	0.044	0.120	2.94	0.405	0.041	<0.001	0.064	3.61	3.51	0.97
West	**I2/5-10**	5.0	0.044	0.050	2.07	0.368	0.059	0.002	0.045	2.64	2.53	0.96
West	**J2/5-10**	5.5	0.042	0.062	3.91	0.444	<0.001	<0.001	0.041	4.50	4.46	0.99
West	**K2/5-10**	4.5	0.047	0.074	1.64	0.327	0.16	0.002	0.092	2.35	2.09	0.89
West	**L2/5-10**	4.8	0.047	0.072	2.17	0.407	0.12	0.001	0.071	2.89	2.70	0.93
	Mean	4.9	0.042	0.066	2.22	0.33	0.079	0.002	0.07	2.81	2.66	0.94
	SD	0.2	0.005	0.024	0.78	0.07	0.046	0.003	0.033	0.80	0.83	0.032
	CV	0.05	0.11	0.36	0.35	0.21	0.58	1.17	0.44	0.29	0.31	0.034
East	**A2/5-10**	4.6	0.050	0.116	5.18	0.718	0.048	<0.001	0.106	6.22	6.07	0.98
East	**B2/5-10**	4.9	0.050	0.105	2.38	0.426	0.076	0.001	0.086	3.13	2.96	0.95
East	**C2/5-10**	5.5	0.037	0.109	3.43	0.486	0.009	<0.001	0.058	4.13	4.06	0.98
East	**D2/5-10**	4.5	0.016	0.023	1.60	0.285	0.048	<0.001	0.052	2.02	1.92	0.95
East	**E2/5-10**	5.2	0.029	0.063	3.18	0.406	<0.001	<0.001	0.048	3.73	3.68	0.99
East	**F2/5-10**	4.7	0.030	0.033	1.87	0.286	0.043	<0.001	0.066	2.32	2.22	0.95
East	**G2/5-10**	4.9	0.075	0.067	1.63	0.294	<0.001	<0.001	0.025	2.09	2.06	0.99
East	**H2/5-10**	5.4	0.039	0.155	3.10	0.601	<0.001	<0.001	0.022	3.92	3.90	0.99
East	**I2/5-10**	4.8	0.038	0.044	2.22	0.297	0.051	0.001	0.042	2.69	2.60	0.96
East	**J2/5-10**	4.5	0.048	0.049	0.90	0.162	0.18	0.005	0.039	1.39	1.16	0.84
East	**K2/5-10**	5.0	0.043	0.077	1.95	0.335	0.004	0.001	0.044	2.46	2.41	0.98
East	**L2/5-10**	4.7	0.038	0.056	1.81	0.265	0.085	0.001	0.058	2.32	2.17	0.94
	Mean	4.9	0.041	0.07	2.44	0.38	0.061	0.00	0.05	3.03	2.93	0.96
	SD	0.3	0.014	0.039	1.14	0.16	0.052	0.002	0.024	1.30	1.31	0.042
	CV	0.07	0.35	0.52	0.47	0.41	0.86	0.99	0.45	0.43	0.45	0.044

Appendix Table A1. pHc, Cation Exchange Capacity and Exchangeable Ions - 2015 Data and Descriptive Statistics (concluded)

Plot	Subplot/ Layer	pHc	Na	K	Ca	Mg	Al	Fe	Mn	TEC	Bases	Base Saturation
			(cmol/kg)									
West	**A2/10-15**	5.1	0.034	0.019	1.40	0.233	<0.001	0.001	0.012	1.70	1.69	0.99
West	**B2/10-15**	4.5	0.040	0.048	1.34	0.310	0.156	0.006	0.041	1.94	1.73	0.90
West	**C2/10-15**	5.0	0.038	0.029	1.18	0.170	0.012	<0.001	0.026	1.45	1.42	0.97
West	**D2/10-15**	5.1	0.035	0.042	1.92	0.200	0.016	<0.001	0.041	2.26	2.20	0.97
West	**E2/10-15**	5.0	0.040	0.041	1.48	0.321	0.013	0.000	0.026	1.92	1.88	0.98
West	**F2/10-15**	4.7	0.033	0.028	1.00	0.251	0.067	<0.001	0.017	1.40	1.31	0.94
West	**G2/10-15**	4.8	0.033	0.048	1.13	0.201	0.055	<0.001	0.017	1.48	1.41	0.95
West	**H2/10-15**	5.0	0.040	0.11	1.74	0.342	0.015	<0.001	0.031	2.27	2.22	0.98
West	**I2/10-15**	4.8	0.043	0.047	1.29	0.365	0.058	0.001	0.015	1.82	1.75	0.96
West	**J2/10-15**	5.3	0.038	0.043	1.78	0.325	<0.001	<0.001	0.018	2.21	2.19	0.99
West	**K2/10-15**	4.4	0.040	0.060	0.91	0.230	0.189	0.002	0.042	1.47	1.24	0.84
West	**L2/10-15**	4.7	0.050	0.073	1.64	0.326	0.170	0.002	0.092	2.36	2.09	0.89
	Mean	4.9	0.039	0.049	1.40	0.27	0.075	0.002	0.032	1.86	1.76	0.95
	SD	0.3	0.005	0.023	0.32	0.066	0.070	0.002	0.022	0.36	0.36	0.048
	CV	0.05	0.13	0.48	0.23	0.24	0.93	0.93	0.70	0.19	0.21	0.050
East	**A2/10-15**	4.5	0.042	0.074	2.18	0.408	0.125	0.001	0.071	2.90	2.70	0.93
East	**B2/10-15**	4.8	0.045	0.066	1.17	0.259	0.107	0.002	0.034	1.68	1.53	0.91
East	**C2/10-15**	5.4	0.042	0.110	2.00	0.327	0.022	<0.001	0.042	2.54	2.48	0.97
East	**D2/10-15**	4.5	0.019	0.014	1.25	0.241	0.039	<0.001	0.023	1.58	1.52	0.96
East	**E2/10-15**	5.3	0.027	0.052	2.84	0.374	<0.001	<0.001	0.024	3.31	3.29	0.99
East	**F2/10-15**	4.7	0.033	0.035	1.64	0.323	0.021	<0.001	0.025	2.08	2.03	0.98
East	**G2/10-15**	4.9	0.043	0.053	1.35	0.267	0.001	0.002	0.012	1.73	1.71	0.99
East	**H2/10-15**	5.3	0.039	0.132	1.88	0.456	<0.001	<0.001	0.010	2.52	2.51	1.00
East	**I2/10-15**	5.0	0.043	0.039	1.76	0.279	0.002	0.001	0.022	2.14	2.12	0.99
East	**J2/10-15**	4.6	0.052	0.041	0.91	0.191	0.117	0.006	0.011	1.33	1.20	0.90
East	**K2/10-15**	5.1	0.045	0.036	1.27	0.224	<0.001	0.001	0.010	1.58	1.57	0.99
East	**L2/10-15**	4.9	0.042	0.052	1.56	0.240	0.020	0.001	0.019	1.94	1.90	0.98
	Mean	4.9	0.039	0.059	1.65	0.30	0.050	0.002	0.025	2.11	2.05	0.97
	SD	0.3	0.009	0.033	0.53	0.080	0.051	0.002	0.017	0.60	0.60	0.033
	CV	0.06	0.23	0.57	0.32	0.27	1.01	0.98	0.69	0.28	0.29	0.034

Appendix Table A2. Water Soluble Ions and Base Cation:Aluminum Ratio – 2015 Data and Descriptive Statistics

Sub-Site	Subplot/ Layer	Sat'n (%)	pH (Ext.)	E.C. (dS/m)	Na	K	Ca	Mg	Al	Fe	Mn	S	BC:Al Ratio
					(mg/L)								
West	**A2/0-2**	58.8	4.8	0.28	2.14	18.8	30.3	6.70	4.2	3.74	6.06	11.8	9.7
West	**B2/0-2**	68.4	4.6	0.33	2.22	17.4	52.7	9.78	8.35	9.60	11.7	11.8	7.0
West	**C2/0-2**	56.4	4.8	0.28	1.90	16.0	31.3	4.65	5.89	4.97	7.55	9.29	6.3
West	**D2/0-2**	51.6	5.7	0.16	1.06	9.49	22.1	3.97	2.72	1.47	1.13	4.70	9.5
West	**E2/0-2**	58.4	5.2	0.46	1.84	22.0	87.2	17.5	5.79	6.97	13.4	16.2	16.1
West	**F2/0-2**	41.2	5.7	0.14	0.50	3.05	20.5	4.09	2.26	1.87	1.12	3.32	9.0
West	**G2/0-2**	53.6	5.1	0.27	1.14	22.3	31.0	7.26	3.32	4.01	4.96	7.57	13.4
West	**H2/0-2**	55.6	5.1	0.16	0.74	6.98	19.9	4.55	2.62	2.48	2.11	4.47	8.9
West	**I2/0-2**	60.0	5.2	0.33	3.13	18.6	82.8	12.0	5.52	5.67	8.02	14.4	14.8
West	**J2/0-2**	50.0	5.8	0.20	1.41	17.4	35.5	6.58	3.23	3.12	2.80	5.83	13.4
West	**K2/0-2**	51.2	5.6	0.24	1.56	19.1	50.9	8.67	3.49	3.26	4.06	8.28	16.3
West	**L2/0-2**	60.4	5.7	0.15	1.19	5.62	31.5	6.31	1.72	1.34	1.21	5.61	18.7
	Mean	55.5	5.3	0.25	1.57	14.73	41.29	7.67	4.09	4.04	5.35	8.61	11.9
	SD	6.8	0.4	0.10	0.73	6.63	22.89	3.94	1.93	2.44	4.15	4.17	4.0
	CV	0.12	0.08	0.38	0.46	0.45	0.55	0.51	0.47	0.60	0.78	0.48	0.34
East	**A2/0-2**	54.4	5.6	0.21	1.95	17.2	42.1	8.85	3.39	2.96	2.47	7.68	14.7
East	**B2/0-2**	53.2	5.7	0.18	1.01	13.2	26.9	6.05	3.58	2.85	1.30	6.61	9.5
East	**C2/0-2**	111	6.2	0.44	2.01	22.9	112	16.49	0.89	0.53	2.23	10.18	123.6
East	**D2/0-2**	72.8	5.2	0.30	2.04	21.2	55.9	11.7	4.00	3.08	4.93	10.9	16.3
East	**E2/0-2**	67.6	5.0	0.26	1.96	17.6	49.6	10.4	4.31	3.67	3.97	9.68	13.2
East	**F2/0-2**	58.4	5.3	0.24	1.38	9.24	51.5	9.95	3.62	3.04	6.42	12.3	14.4
East	**G2/0-2**	68.4	5.7	0.24	1.38	26.6	43.9	8.30	2.48	1.77	1.71	9.81	23.0
East	**H2/0-2**	55.2	6.0	0.27	3.10	30.4	53.6	12.8	3.76	2.68	2.14	8.24	18.9
East	**I2/0-2**	70.4	5.1	0.28	2.19	13.3	76.7	11.1	4.07	4.01	5.39	11.7	18.0
East	**J2/0-2**	61.6	4.8	0.25	1.62	21.8	40.6	8.58	5.00	3.68	6.08	8.77	10.4
East	**K2/0-2**	75.2	5.4	0.26	1.15	22.4	47.1	9.49	2.85	2.16	2.76	7.19	20.3
East	**L2/0-2**	55.2	4.9	0.23	1.62	16.9	42.2	9.68	4.77	4.14	6.26	9.50	10.7
	Mean	66.9	5.41	0.26	1.78	19.40	53.49	10.28	3.56	2.88	3.81	9.38	24.4
	SD	15.8	0.44	0.06	0.56	6.00	21.87	2.62	1.11	1.02	1.92	1.77	31.5
	CV	0.24	0.08	0.25	0.31	0.31	0.41	0.25	0.31	0.36	0.50	0.19	1.29

Appendix Table A2. Water Soluble Ions and Base Cation:Aluminum Ratio – 2015 Data and Descriptive Statistics (continued)

West	**A2/2-5**	43.6	5.0	0.23	3.14	9.25	30.6	4.99	4.79	3.04	5.46	10.7	6.8
West	**B2/2-5**	43.6	5.2	0.28	2.46	14.3	42.9	7.83	5.77	5.35	6.83	9.49	8.2
West	**C2/2-5**	45.6	5.3	0.17	2.25	8.09	25.4	3.10	3.51	2.08	2.59	6.27	7.4
West	**D2/2-5**	47.2	5.6	0.16	1.37	9.78	23.9	4.19	2.37	1.30	1.36	5.63	11.6
West	**E2/2-5**	45.6	5.6	0.31	2.91	15.5	50.5	10.7	2.20	2.60	5.53	10.4	25.7
West	**F2/2-5**	36.8	5.7	0.11	0.69	2.32	16.1	3.68	3.81	2.63	0.84	2.44	4.3
West	**G2/2-5**	44.8	5.5	0.21	1.51	13.4	24.0	4.59	2.72	2.48	2.45	5.22	11.2
West	**H2/2-5**	44.0	5.5	0.16	0.79	7.38	20.5	3.96	1.69	1.50	1.15	4.12	13.8
West	**I2/2-5**	46.4	5.6	0.21	3.10	5.69	40.9	6.55	2.94	2.65	2.15	7.26	13.2
West	**J2/2-5**	53.6	5.9	0.23	2.59	12.5	58.4	8.41	1.54	1.03	2.45	7.27	37.1
West	**K2/2-5**	49.0	5.5	0.20	2.35	9.99	40.6	7.55	3.33	2.57	3.14	7.68	12.8
West	**L2/2-5**	41.6	5.7	0.14	1.62	6.43	28.5	6.27	2.83	2.03	1.12	4.24	10.8
	Mean	45.2	5.5	0.20	2.06	9.55	33.51	5.99	3.12	2.44	2.92	6.73	13.6
	SD	4.1	0.2	0.058	0.85	3.89	12.98	2.30	1.23	1.11	1.97	2.59	9.1
	CV	0.09	0.04	0.29	0.41	0.41	0.39	0.38	0.39	0.45	0.68	0.38	0.67
East	**A2/2-5**	41.6	5.5	0.17	2.15	12.2	32.3	6.89	3.93	3.31	2.68	5.77	9.6
East	**B2/2-5**	40.8	5.8	0.17	1.78	10.4	29.1	5.61	2.58	2.22	0.99	5.72	12.8
East	**C2/2-5**	56.0	6.2	0.31	2.74	14.4	83.8	13.87	1.21	0.83	1.80	9.24	67.8
East	**D2/2-5**	52.8	5.1	0.21	2.11	12.6	40.7	8.12	4.58	3.29	2.94	10.2	9.8
East	**E2/2-5**	42.0	5.5	0.19	2.27	10.4	39.1	7.10	4.57	3.54	2.03	8.18	9.0
East	**F2/2-5**	40.4	5.6	0.21	1.94	9.65	37.7	6.82	2.53	1.88	3.91	10.3	15.6
East	**G2/2-5**	50.4	5.8	0.22	1.64	19.0	42.2	7.41	2.27	1.54	2.40	7.32	21.9
East	**H2/2-5**	47.2	5.8	0.28	3.20	27.8	56.5	13.6	4.23	3.13	2.79	8.20	17.1
East	**I2/2-5**	46.4	5.3	0.16	2.45	5.32	33.2	4.89	4.57	3.69	2.03	6.39	6.9
East	**J2/2-5**	48.4	4.9	0.20	2.36	11.0	34.5	6.03	4.72	3.19	4.57	7.37	8.0
East	**K2/2-5**	50.8	5.7	0.19	1.74	12.7	32.8	6.03	3.73	3.14	1.64	6.26	10.1
East	**L2/2-5**	43.2	5.1	0.18	1.72	12.8	31.6	5.90	3.55	2.72	3.90	6.79	10.3
	Mean	46.7	5.53	0.21	2.17	13.18	41.11	7.69	3.54	2.71	2.64	7.64	16.6
	SD	5.2	0.37	0.04	0.47	5.61	15.26	2.95	1.14	0.89	1.05	1.61	16.7
	CV	0.11	0.07	0.22	0.21	0.43	0.37	0.38	0.32	0.33	0.40	0.21	1.01

Appendix Table A2. Water Soluble Ions and Base Cation:Aluminum Ratio – 2015 Data and Descriptive Statistics (continued)

West	**A2/5-10**	36.0	5.4	0.17	3.11	5.50	23.6	3.18	2.79	1.70	1.63	5.64	8.3
West	**B2/5-10**	39.2	5.1	0.20	2.41	9.57	25.4	4.75	4.48	3.17	2.85	5.29	6.5
West	**C2/5-10**	40.8	5.5	0.12	2.08	4.82	18.0	2.28	4.68	2.66	1.20	3.78	3.8
West	**D2/5-10**	40.0	5.7	0.15	1.46	7.48	23.1	3.17	2.42	1.24	1.04	4.10	10.0
West	**E2/5-10**	37.2	5.5	0.17	2.79	5.50	24.4	5.12	1.00	1.25	2.37	5.55	26.0
West	**F2/5-10**	36.0	5.4	0.08	0.85	1.49	10.1	2.52	5.24	3.65	0.62	1.62	2.0
West	**G2/5-10**	38.0	5.5	0.12	1.20	5.45	16.0	2.92	4.21	3.31	1.00	3.24	4.2
West	**H2/5-10**	37.2	5.7	0.14	0.90	6.91	19.0	3.35	1.82	1.54	0.83	3.47	11.7
West	**I2/5-10**	36.8	5.5	0.16	3.62	4.64	33.6	6.37	2.64	2.35	1.82	6.51	12.5
West	**J2/5-10**	39.6	6.0	0.21	2.91	7.13	46.9	6.78	0.96	0.99	1.44	5.34	45.7
West	**K2/5-10**	37.6	5.1	0.15	2.38	6.33	25.0	4.99	3.01	2.38	2.53	5.32	8.9
West	**L2/5-10**	38.0	5.4	0.11	1.53	4.87	18.6	4.43	5.15	3.59	1.04	3.05	4.0
	Mean	38.0	5.48	0.15	2.10	5.80	23.64	4.16	3.20	2.32	1.53	4.41	12.0
	SD	1.6	0.25	0.037	0.91	1.96	9.38	1.48	1.53	0.97	0.72	1.42	12.4
	CV	0.04	0.045	0.25	0.44	0.34	0.40	0.36	0.48	0.42	0.47	0.32	1.03
East	**A2/5-10**	36.4	5.2	0.13	2.20	5.53	19.4	4.31	8.56	6.51	1.11	3.02	2.5
East	**B2/5-10**	36.8	5.8	0.14	2.04	10.9	23.2	4.28	4.92	4.02	1.07	4.23	5.7
East	**C2/5-10**	37.6	6.2	0.19	2.16	3.58	37.9	7.47	2.99	2.39	0.61	4.52	12.1
East	**D2/5-10**	36.8	5.1	0.14	1.97	7.27	23.6	4.95	10.0	7.24	1.52	4.68	2.6
East	**E2/5-10**	36.8	5.9	0.20	2.63	9.15	48.4	6.86	2.47	2.01	1.71	6.86	18.8
East	**F2/5-10**	36.4	5.4	0.14	2.16	5.01	25.6	4.16	5.12	3.78	1.70	5.08	4.9
East	**G2/5-10**	36.4	5.6	0.14	1.73	8.43	27.3	5.06	4.71	3.62	1.16	4.14	6.3
East	**H2/5-10**	37.6	6.0	0.21	4.18	19.1	37.6	9.48	5.50	4.10	0.87	5.72	8.9
East	**I2/5-10**	37.2	5.5	0.14	2.41	4.60	25.3	4.05	7.86	5.90	1.24	4.87	3.1
East	**J2/5-10**	36.4	5.1	0.10	3.44	3.38	14.3	2.32	1.48	0.88	0.97	5.79	9.8
East	**K2/5-10**	36.8	5.7	0.14	1.90	8.93	23.4	4.42	5.49	4.32	1.13	4.56	4.9
East	**L2/5-10**	37.2	5.3	0.12	1.79	6.63	23.1	3.59	4.10	3.19	1.34	4.43	5.9
	Mean	36.9	5.57	0.15	2.38	7.71	27.41	5.08	5.27	4.00	1.20	4.82	7.1
	SD	0.4	0.36	0.03	0.73	4.29	9.36	1.95	2.51	1.85	0.33	0.97	4.7
	CV	0.01	0.065	0.22	0.31	0.56	0.34	0.38	0.48	0.46	0.27	0.20	0.66

Appendix Table A2. Water Soluble Ions and Base Cation:Aluminum Ratio – 2015 Data and Descriptive Statistics (concluded)

West	**A2/10-15**	36.0	5.7	0.10	2.36	3.49	12.6	2.31	9.96	5.83	0.21	2.73	1.4
West	**B2/10-15**	36.4	5.1	0.11	2.61	5.33	13.6	2.70	5.83	3.63	0.598	3.49	2.7
West	**C2/10-15**	38.4	5.7	0.08	1.88	3.81	11.6	1.88	6.77	3.97	0.453	2.29	1.8
West	**D2/10-15**	36.4	5.7	0.14	1.74	5.51	18.0	2.20	3.17	1.86	0.699	2.85	5.8
West	**E2/10-15**	36.0	5.8	0.08	2.10	1.12	10.3	2.16	3.59	2.81	0.31	2.48	2.8
West	**F2/10-15**	36.0	5.4	0.06	0.76	1.03	6.32	1.67	5.16	3.65	0.20	1.05	1.3
West	**G2/10-15**	36.0	5.5	0.09	1.08	2.93	9.53	1.89	6.26	4.20	0.31	1.90	1.7
West	**H2/10-15**	36.0	5.8	0.12	1.22	7.97	17.9	3.95	8.29	5.48	0.69	3.02	2.6
West	**I2/10-15**	36.0	5.5	0.11	2.48	1.83	15.4	3.41	1.43	1.29	0.34	3.02	10.8
West	**J2/10-15**	36.4	5.9	0.12	2.15	3.75	22.4	4.04	3.07	2.52	0.49	2.86	7.2
West	**K2/10-15**	36.0	4.9	0.11	2.43	5.14	14.2	3.02	1.85	1.41	1.07	3.62	8.9
West	**L2/10-15**	36.0	5.5	0.08	1.25	4.07	11.8	3.12	12.0	7.31	0.38	1.72	1.2
	Mean	36.3	5.54	0.10	1.84	3.83	13.64	2.70	5.61	3.66	0.48	2.59	4.0
	SD	0.7	0.30	0.022	0.62	2.00	4.34	0.81	3.26	1.85	0.25	0.74	3.3
	CV	0.02	0.05	0.23	0.34	0.52	0.32	0.30	0.58	0.51	0.52	0.29	0.82
East	**A2/10-15**	36.0	5.1	0.10	2.21	3.33	14.3	3.06	7.05	5.09	0.29	2.47	2.2
East	**B2/10-15**	36.0	5.6	0.13	1.86	7.65	20.1	3.92	5.34	4.27	0.75	3.41	4.3
East	**C2/10-15**	36.0	6.1	0.12	1.88	3.08	25.9	5.81	10.4	7.10	0.32	2.68	2.5
East	**D2/10-15**	36.4	5.1	0.12	2.14	5.62	20.5	4.04	12.4	8.79	0.72	3.76	1.8
East	**E2/10-15**	36.0	6.0	0.16	2.69	5.65	40.0	5.27	3.03	2.64	0.78	4.91	12.1
East	**F2/10-15**	36.4	5.4	0.10	1.95	3.99	16.4	3.41	10.3	7.06	0.49	3.04	1.7
East	**G2/10-15**	36.0	5.5	0.12	1.66	6.00	20.9	3.94	6.16	4.68	0.39	2.71	3.7
East	**H2/10-15**	36.0	6.0	0.17	3.76	16.9	30.5	8.21	10.9	8.06	0.47	4.80	3.8
East	**I2/10-15**	36.4	5.8	0.09	1.46	2.91	17.6	2.99	7.15	5.26	0.50	2.25	2.4
East	**J2/10-15**	36.0	5.3	0.08	2.97	2.55	9.8	1.68	0.41	0.19	0.22	6.37	24.8
East	**K2/10-15**	36.4	5.9	0.08	2.44	3.48	14.2	2.54	7.13	5.04	0.25	2.46	2.1
East	**L2/10-15**	36.4	5.6	0.09	1.47	4.21	17.4	2.93	7.93	5.93	0.47	2.87	2.3
	Mean	36.2	5.62	0.11	2.21	5.45	20.62	3.98	7.35	5.34	0.47	3.48	5.3
	SD	0.2	0.35	0.03	0.67	3.93	8.18	1.75	3.42	2.36	0.19	1.26	6.8
	CV	0.006	0.06	0.27	0.31	0.72	0.40	0.44	0.47	0.44	0.41	0.36	1.28

Appendix Table A3. Total Carbon, Nitrogen and Sulphur – 2015 Data and Descriptive Statistics

Sub-site	Subplot/ Layer	pHc *	Total C (%)	Total N (%)	Total S (%)	C:N Ratio	C:S Ratio	N:S Ratio
West	**A2/LFH**	4.2	36.7	1.15	0.103	32	356	11
West	**B2/LFH**	4.0	36.8	1.11	0.111	33	332	10
West	**C2/LFH**	4.2	20.0	0.60	0.052	34	385	11
West	**D2/LFH**	4.4	13.7	0.38	0.041	36	338	9
West	**E2/LFH**	4.2	42.2	1.12	0.097	38	435	12
West	**F2/LFH**	4.3	29.4	0.89	0.087	33	338	10
West	**G2/LFH**	4.4	23.7	0.66	0.065	36	365	10
West	**H2/LFH**	4.3	28.9	0.96	0.086	30	336	11
West	**I2/LFH**	4.4	23.3	0.70	0.064	33	364	11
West	**J2/LFH**	4.4	31.3	0.94	0.083	33	377	11
West	**K2/LFH**	4.6	42.2	1.21	0.097	35	435	12
West	**L2/LFH**	4.3	34.6	1.04	0.092	33	376	11
	Mean	4.3	30.2	0.90	0.08	33.8	370	10.9
	SD	0.2	8.9	0.26	0.02	2.0	35.3	0.8
	CV	0.035	0.29	0.29	0.26	0.059	0.095	0.076
East	**A2/LFH**	4.5	13.7	0.42	0.044	33	311	9
East	**B2/LFH**	4.3	15.9	0.43	0.048	37	331	9
East	**C2/LFH**	4.9	34.7	1.07	0.088	32	394	12
East	**D2/LFH**	4.4	20.2	0.61	0.063	33	321	10
East	**E2/LFH**	4.3	20.7	0.60	0.067	35	309	9
East	**F2/LFH**	4.4	16.2	0.50	0.048	32	338	10
East	**G2/LFH**	4.6	13.8	0.47	0.044	29	314	11
East	**H2/LFH**	4.3	24.7	0.90	0.089	27	278	10
East	**I2/LFH**	4.6	18.6	0.51	0.047	37	396	11
East	**J2/LFH**	4.2	32.1	0.96	0.082	34	391	12
East	**K2/LFH**	4.3	29.2	0.73	0.065	40	449	11
East	**L2/LFH**	4.1	21.3	0.61	0.061	35	349	10
	Mean	4.4	21.8	0.65	0.06	33.7	348.4	10.3
	SD	0.2	7.0	0.22	0.02	3.3	49.3	1.0
	CV	0.049	0.32	0.34	0.27	0.10	0.14	0.10

* pHc data are presented for the LFH layer; pHc for all other layers are repeated here from Appendix Table A1

Appendix Table A3. Total Carbon, Nitrogen and Sulphur – 2015 Data and Descriptive Statistics (continued)

Sub-site	Subplot/ Layer	pHc *	Total C (%)	Total N (%)	Total S (%)	C:N Ratio	C:S Ratio	N:S Ratio
West	**A2/0-2**	4.3	2.16	0.08	0.009	26	240	9
West	**B2/0-2**	4.2	4.13	0.12	0.012	34	344	10
West	**C2/0-2**	4.4	1.99	0.06	0.005	33	398	12
West	**D2/0-2**	5.0	1.64	0.06	0.006	27	273	10
West	**E2/0-2**	4.8	3.14	0.10	0.012	32	262	8
West	**F2/0-2**	4.9	1.06	0.04	0.006	27	177	7
West	**G2/0-2**	4.6	2.34	0.08	0.007	30	334	11
West	**H2/0-2**	4.5	2.27	0.09	0.009	25	252	10
West	**I2/0-2**	4.7	3.68	0.11	0.010	34	368	11
West	**J2/0-2**	5.1	1.60	0.06	0.006	29	267	9
West	**K2/0-2**	5.0	3.08	0.11	0.007	28	440	16
West	**L2/0-2**	5.0	3.22	0.12	0.009	27	358	13
	Mean	4.7	2.53	0.085	0.008	29.3	309	10.6
	SD	0.3	0.92	0.03	0.002	3.2	76.0	2.4
	CV	0.065	0.37	0.32	0.29	0.11	0.25	0.23
East	**A2/0-2**	5.0	2.01	0.08	0.009	25	223	9
East	**B2/0-2**	5.0	1.53	0.07	0.007	23	219	9
East	**C2/0-2**	5.7	8.39	0.36	0.023	23	365	16
East	**D2/0-2**	4.8	3.99	0.15	0.008	27	499	18
East	**E2/0-2**	4.6	4.35	0.15	0.014	28	310	11
East	**F2/0-2**	4.7	2.79	0.12	0.010	24	279	12
East	**G2/0-2**	5.1	4.42	0.18	0.014	25	316	13
East	**H2/0-2**	5.3	2.24	0.10	0.011	23	204	9
East	**I2/0-2**	4.6	3.86	0.14	0.016	28	241	9
East	**J2/0-2**	4.3	3.09	0.10	0.012	30	258	9
East	**K2/0-2**	4.9	4.08	0.14	0.016	30	255	9
East	**L2/0-2**	4.3	2.49	0.10	0.011	25	226	9
	Mean	4.9	3.60	0.14	0.013	26.0	282.9	10.9
	SD	0.4	1.79	0.08	0.004	2.7	82.8	3.2
	CV	0.08	0.50	0.55	0.35	0.10	0.29	0.29

Appendix Table A3. Total Carbon, Nitrogen and Sulphur – 2015 Data and Descriptive Statistics (continued)

Sub-site	Subplot/ Layer	pHc *	Total C (%)	Total N (%)	Total S (%)	C:N Ratio	C:S Ratio	N:S Ratio
West	**A2/2-5**	4.5	1.60	0.06	0.007	27	229	9
West	**B2/2-5**	4.7	1.62	0.05	0.007	34	231	7
West	**C2/2-5**	4.7	1.39	0.04	0.004	33	348	11
West	**D2/2-5**	4.9	1.99	0.08	0.008	26	249	10
West	**E2/2-5**	5.0	1.62	0.05	0.005	30	324	11
West	**F2/2-5**	5.0	0.99	0.03	0.001	33	987	30
West	**G2/2-5**	4.9	1.53	0.05	0.005	30	306	10
West	**H2/2-5**	4.9	1.55	0.06	0.004	27	388	15
West	**I2/2-5**	5.0	1.26	0.04	0.007	35	180	5
West	**J2/2-5**	5.3	2.32	0.08	0.001	31	2320	76
West	**K2/2-5**	4.9	1.59	0.06	0.006	29	265	9
West	**L2/2-5**	5.0	1.61	0.05	0.006	30	268	9
	Mean	4.9	1.59	0.05	0.01	30.3	508	16.7
	SD	0.2	0.33	0.01	0.00	3.0	609	19.7
	CV	0.04	0.21	0.26	0.45	0.10	1.20	1.18
East	**A2/2-5**	4.8	0.77	0.03	0.005	27	153	6
East	**B2/2-5**	5.1	1.03	0.04	0.005	26	206	8
East	**C2/2-5**	5.6	2.64	0.11	0.011	24	240	10
East	**D2/2-5**	4.6	2.12	0.09	0.005	25	454	18
East	**E2/2-5**	4.9	1.81	0.06	0.002	29	905	31
East	**F2/2-5**	4.9	0.92	0.04	0.005	24	184	8
East	**G2/2-5**	5.2	1.25	0.05	0.002	25	625	25
East	**H2/2-5**	5.2	2.30	0.10	0.009	24	256	11
East	**I2/2-5**	4.7	1.27	0.04	0.001	31	1270	41
East	**J2/2-5**	4.3	2.14	0.08	0.007	27	306	11
East	**K2/2-5**	5.1	1.25	0.04	0.005	31	250	8
East	**L2/2-5**	4.5	1.38	0.04	0.005	33	275	8
	Mean	4.9	1.57	0.06	0.01	27.2	427	15.4
	SD	0.4	0.61	0.03	0.00	3.1	343	11.2
	CV	0.07	0.39	0.45	0.56	0.11	0.80	0.73

Appendix Table A3. Total Carbon, Nitrogen and Sulphur – 2015 Data and Descriptive Statistics (continued)

Sub-site	Subplot/ Layer	pHc *	Total C (%)	Total N (%)	Total S (%)	C:N Ratio	C:S Ratio	N:S Ratio
West	**A2/5-10**	4.8	0.74	0.02	0.005	31	148	5
West	**B2/5-10**	4.6	0.66	0.02	0.004	32	166	5
West	**C2/5-10**	4.9	0.56	0.02	0.001	31	563	18
West	**D2/5-10**	5.0	1.37	0.05	0.005	25	274	11
West	**E2/5-10**	4.9	0.51	0.01	0.001	46	511	11
West	**F2/5-10**	4.7	0.33	0.02	0.001	21	331	16
West	**G2/5-10**	4.9	0.57	0.02	0.002	27	284	11
West	**H2/5-10**	4.9	0.79	0.03	0.005	29	159	5
West	**I2/5-10**	5.0	0.70	0.02	0.001	47	699	15
West	**J2/5-10**	5.5	1.02	0.03	0.001	32	1020	32
West	**K2/5-10**	4.5	0.64	0.02	0.004	38	160	4
West	**L2/5-10**	4.8	0.72	0.02	0.005	31	144	5
	Mean	4.9	0.72	0.02	0.003	32.5	371.5	11.5
	SD	0.2	0.26	0.01	0.002	7.7	275.9	8.1
	CV	0.05	0.37	0.48	0.65	0.24	0.74	0.71
East	**A2/5-10**	4.6	0.36	0.01	0.002	33	179	6
East	**B2/5-10**	4.9	0.52	0.02	0.004	32	130	4
East	**C2/5-10**	5.5	0.69	0.03	0.004	28	173	6
East	**D2/5-10**	4.5	0.65	0.01	0.004	50	163	3
East	**E2/5-10**	5.2	0.66	0.02	0.001	41	661	16
East	**F2/5-10**	4.7	0.45	0.01	0.003	56	149	3
East	**G2/5-10**	4.9	0.53	0.02	0.001	35	526	15
East	**H2/5-10**	5.4	0.79	0.02	0.006	39	131	3
East	**I2/5-10**	4.8	0.50	0.01	0.002	42	251	6
East	**J2/5-10**	4.5	0.32	<0.01	0.002	65	162	3
East	**K2/5-10**	5.0	0.46	0.01	0.004	46	116	3
East	**L2/5-10**	4.7	0.75	0.02	0.004	39	187	5
	Mean	4.9	0.56	0.0	0.0	42.2	235.5	6.0
	SD	0.3	0.15	0.0	0.0	10.7	173.1	4.6
	CV	0.07	0.27	0.33	0.49	0.25	0.74	0.78

Appendix Table A3. Total Carbon, Nitrogen and Sulphur – 2015 Data and Descriptive Statistics – (concluded)

Sub-site	Subplot/ Layer	pHc *	Total C (%)	Total N (%)	Total S (%)	C:N Ratio	C:S Ratio	N:S Ratio
West	**A2/10-15**	5.1	0.18	<0.01	0.003	35	59	2
West	**B2/10-15**	4.5	0.29	<0.01	0.002	57	144	3
West	**C2/10-15**	5.0	0.22	<0.01	0.002	44	109	3
West	**D2/10-15**	5.1	0.51	0.02	0.001	22	505	23
West	**E2/10-15**	5.0	0.18	<0.01	0.001	37	184	5
West	**F2/10-15**	4.7	0.16	0.01	0.001	27	159	6
West	**G2/10-15**	4.8	0.20	<0.01	0.001	40	200	5
West	**H2/10-15**	5.0	0.45	0.02	0.003	30	150	5
West	**I2/10-15**	4.8	0.19	<0.01	0.001	38	189	5
West	**J2/10-15**	5.3	0.28	<0.01	0.001	56	280	5
West	**K2/10-15**	4.4	0.31	0.01	0.002	62	155	3
West	**L2/10-15**	4.7	0.22	<0.01	0.002	44	110	3
	Mean	4.9	0.27	0.005	0.002	41.0	187	5.5
	SD	0.3	0.11	0.000	0.001	12.4	114	5.7
	CV	0.05	0.42	0.00	0.47	0.30	0.61	1.04
East	**A2/10-15**	4.5	0.18	<0.01	0.002	35	88	3
East	**B2/10-15**	4.8	0.33	0.01	0.002	36	164	5
East	**C2/10-15**	5.4	0.33	<0.01	0.003	67	111	2
East	**D2/10-15**	4.5	0.29	<0.01	0.002	57	143	3
East	**E2/10-15**	5.3	0.42	0.01	0.003	46	139	3
East	**F2/10-15**	4.7	0.26	<0.01	0.002	52	129	3
East	**G2/10-15**	4.9	0.29	<0.01	0.001	59	293	5
East	**H2/10-15**	5.3	0.43	<0.01	0.004	86	123	1
East	**I2/10-15**	5.0	0.33	0.01	0.003	47	111	2
East	**J2/10-15**	4.6	0.16	<0.01	0.001	32	161	5
East	**K2/10-15**	5.1	0.19	<0.01	0.003	38	63	2
East	**L2/10-15**	4.9	0.27	<0.01	0.003	53	89	2
	Mean	4.9	0.29	0.005	0.002	50.7	134.4	2.8
	SD	0.3	0.09	0.000	0.001	15.4	58.4	1.3
	CV	0.06	0.30	0.14	0.35	0.30	0.44	0.47

APPENDIX B

SAMPLE IDENTIFICATION

WHITNEY LAKES SOIL MONITORING SITE - 2015

Table B1. Lab Report - Sample Identification

Project: Permanent Site -Acid Deposition -Whitney Lake
Project Leader: Salim Abboud; Project Contact: Larry Turchenek
Date Received: Oct. 13, 2015

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	West	A2/LFH	361	1		1	1	1	
	Whitney Lake	West	A2/0-2	362	1	1	1	1	1	1
	Whitney Lake	West	A2/2-5	363	1	1	1	1	1	1
	Whitney Lake	West	A2/5-10	364	1	1	1	1	1	1
	Whitney Lake	West	A2/10-15	365	1	1	1	1	1	1
	Whitney Lake	West	A2/15-30	366						
	Whitney Lake	West	A2/30-45	367						
	Whitney Lake	West	A2/45-60	368						
	Whitney Lake	West	B2/LFH	369	1		1	1	1	
	Whitney Lake	West	B2/0-2	370	1	1	1	1	1	1
	Whitney Lake	West	B2/2-5	371	1	1	1	1	1	1
	Whitney Lake	West	B2/5-10	372	1	1	1	1	1	1
	Whitney Lake	West	B2/10-15	373	1	1	1	1	1	1
	Whitney Lake	West	B2/15-30	374						
	Whitney Lake	West	B2/30-45	375						
	Whitney Lake	West	B2/45-60	376						
	Whitney Lake	West	C2/LFH	377	1		1	1	1	
	Whitney Lake	West	C2/0-2	378	1	1	1	1	1	1
	Whitney Lake	West	C2/2-5	379	1	1	1	1	1	1
	Whitney Lake	West	C2/5-10	380	1	1	1	1	1	1
	Whitney Lake	West	C2/10-15	381	1	1	1	1	1	1
	Whitney Lake	West	C2/15-30	382						
	Whitney Lake	West	C2/30-45	383						
	Whitney Lake	West	C2/45-60	384						
	Whitney Lake	West	D2/LFH	385	1		1	1	1	
	Whitney Lake	West	D2/0-2	386	1	1	1	1	1	1
	Whitney Lake	West	D2/2-5	387	1	1	1	1	1	1
	Whitney Lake	West	D2/5-10	388	1	1	1	1	1	1
	Whitney Lake	West	D2/10-15	389	1	1	1	1	1	1
	Whitney Lake	West	D2/15-30	390						

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	West	D2/30-45	391						
	Whitney Lake	West	D2/45-60	392						
	Whitney Lake	West	E2/LFH	393	1		1	1	1	
	Whitney Lake	West	E2/0-2	394	1	1	1	1	1	1
	Whitney Lake	West	E2/2-5	395	1	1	1	1	1	1
	Whitney Lake	West	E2/5-10	396	1	1	1	1	1	1
	Whitney Lake	West	E2/10-15	397	1	1	1	1	1	1
	Whitney Lake	West	E2/15-30	398						
	Whitney Lake	West	E2/30-45	399						
	Whitney Lake	West	E2/45-60	400						
	Whitney Lake	West	F2/LFH	401	1		1	1	1	
	Whitney Lake	West	F2/0-2	402	1	1	1	1	1	1
	Whitney Lake	West	F2/2-5	403	1	1	1	1	1	1
	Whitney Lake	West	F2/5-10	404	1	1	1	1	1	1
	Whitney Lake	West	F2/10-15	405	1	1	1	1	1	1
	Whitney Lake	West	F2/15-30	406						
	Whitney Lake	West	F2/30-45	407						
	Whitney Lake	West	F2/45-60	408						
	Whitney Lake	West	G2/LFH	409	1		1	1	1	
	Whitney Lake	West	G2/0-2	410	1	1	1	1	1	1
	Whitney Lake	West	G2/2-5	411	1	1	1	1	1	1
	Whitney Lake	West	G2/5-10	412	1	1	1	1	1	1
	Whitney Lake	West	G2/10-15	413	1	1	1	1	1	1
	Whitney Lake	West	G2/15-30	414						
	Whitney Lake	West	G2/30-45	415						
	Whitney Lake	West	G2/45-60	416						
	Whitney Lake	West	H2/LFH	417	1		1	1	1	
	Whitney Lake	West	H2/0-2	418	1	1	1	1	1	1
	Whitney Lake	West	H2/2-5	419	1	1	1	1	1	1
	Whitney Lake	West	H2/5-10	420	1	1	1	1	1	1
	Whitney Lake	West	H2/10-15	421	1	1	1	1	1	1
	Whitney Lake	West	H2/15-30	422						
	Whitney Lake	West	H2/30-45	423						
	Whitney Lake	West	H2/45-60	424						
	Whitney Lake	West	I2/LFH	425	1		1	1	1	
	Whitney Lake	West	I2/0-2	426	1	1	1	1	1	1
	Whitney Lake	West	I2/2-5	427	1	1	1	1	1	1

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	West	I2/5-10	428	1	1	1	1	1	1
	Whitney Lake	West	I2/10-15	429	1	1	1	1	1	1
	Whitney Lake	West	I2/15-30	430						
	Whitney Lake	West	I2/30-45	431						
	Whitney Lake	West	I2/45-60	432						
	Whitney Lake	West	J2/LFH	433	1		1	1	1	
	Whitney Lake	West	J2/0-2	434	1	1	1	1	1	1
	Whitney Lake	West	J2/2-5	435	1	1	1	1	1	1
	Whitney Lake	West	J2/5-10	436	1	1	1	1	1	1
	Whitney Lake	West	J2/10-15	437	1	1	1	1	1	1
	Whitney Lake	West	J2/15-30	438						
	Whitney Lake	West	J2/30-45	439						
	Whitney Lake	West	J2/45-60	440						
	Whitney Lake	West	K2/LFH	441	1		1	1	1	
	Whitney Lake	West	K2/0-2	442	1	1	1	1	1	1
	Whitney Lake	West	K2/2-5	443	1	1	1	1	1	1
	Whitney Lake	West	K2/5-10	444	1	1	1	1	1	1
	Whitney Lake	West	K2/10-15	445	1	1	1	1	1	1
	Whitney Lake	West	K2/15-30	446						
	Whitney Lake	West	K2/30-45	447						
	Whitney Lake	West	K2/45-60	448						
	Whitney Lake	West	L2/LFH	449	1		1	1	1	
	Whitney Lake	West	L2/0-2	450	1	1	1	1	1	1
	Whitney Lake	West	L2/2-5	451	1	1	1	1	1	1
	Whitney Lake	West	L2/5-10	452	1	1	1	1	1	1
	Whitney Lake	West	L2/10-15	453	1	1	1	1	1	1
	Whitney Lake	West	L2/15-30	454						
	Whitney Lake	West	L2/30-45	455						
	Whitney Lake	West	L2/45-60	456						
	Whitney Lake	East	A2/LFH	457	1		1	1	1	
	Whitney Lake	East	A2/0-2	458	1	1	1	1	1	1
	Whitney Lake	East	A2/2-5	459	1	1	1	1	1	1
	Whitney Lake	East	A2/5-10	460	1	1	1	1	1	1
	Whitney Lake	East	A2/10-15	461	1	1	1	1	1	1
	Whitney Lake	East	A2/15-30	462						
	Whitney Lake	East	A2/30-45	463						
	Whitney Lake	East	A2/45-60	464						

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	East	B2/LFH	465	1		1	1	1	
	Whitney Lake	East	B2/0-2	466	1	1	1	1	1	1
	Whitney Lake	East	B2/2-5	467	1	1	1	1	1	1
	Whitney Lake	East	B2/5-10	468	1	1	1	1	1	1
	Whitney Lake	East	B2/10-15	469	1	1	1	1	1	1
	Whitney Lake	East	B2/15-30	470						
	Whitney Lake	East	B2/30-45	471						
	Whitney Lake	East	B2/45-60	472						
	Whitney Lake	East	C2/LFH	473	1		1	1	1	
	Whitney Lake	East	C2/0-2	474	1	1	1	1	1	1
	Whitney Lake	East	C2/2-5	475	1	1	1	1	1	1
	Whitney Lake	East	C2/5-10	476	1	1	1	1	1	1
	Whitney Lake	East	C2/10-15	477	1	1	1	1	1	1
	Whitney Lake	East	C2/15-30	478						
	Whitney Lake	East	C2/30-45	479						
	Whitney Lake	East	C2/45-60	480						
	Whitney Lake	East	D2/LFH	481	1		1	1	1	
	Whitney Lake	East	D2/0-2	482	1	1	1	1	1	1
	Whitney Lake	East	D2/2-5	483	1	1	1	1	1	1
	Whitney Lake	East	D2/5-10	484	1	1	1	1	1	1
	Whitney Lake	East	D2/10-15	485	1	1	1	1	1	1
	Whitney Lake	East	D2/15-30	486						
	Whitney Lake	East	D2/30-45	487						
	Whitney Lake	East	D2/45-60	488						
	Whitney Lake	East	E2/LFH	489	1		1	1	1	
	Whitney Lake	East	E2/0-2	490	1	1	1	1	1	1
	Whitney Lake	East	E2/2-5	491	1	1	1	1	1	1
	Whitney Lake	East	E2/5-10	492	1	1	1	1	1	1
	Whitney Lake	East	E2/10-15	493	1	1	1	1	1	1
	Whitney Lake	East	E2/15-30	494						
	Whitney Lake	East	E2/30-45	495						
	Whitney Lake	East	E2/45-60	496						
	Whitney Lake	East	F2/LFH	497	1		1	1	1	
	Whitney Lake	East	F2/0-2	498	1	1	1	1	1	1
	Whitney Lake	East	F2/2-5	499	1	1	1	1	1	1
	Whitney Lake	East	F2/5-10	500	1	1	1	1	1	1
	Whitney Lake	East	F2/10-15	501	1	1	1	1	1	1

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	East	F2/15-30	502						
	Whitney Lake	East	F2/30-45	503						
	Whitney Lake	East	F2/45-60	504						
	Whitney Lake	East	G2/LFH	505	1		1	1	1	
	Whitney Lake	East	G2/0-2	506	1	1	1	1	1	1
	Whitney Lake	East	G2/2-5	507	1	1	1	1	1	1
	Whitney Lake	East	G2/5-10	508	1	1	1	1	1	1
	Whitney Lake	East	G2/10-15	509	1	1	1	1	1	1
	Whitney Lake	East	G2/15-30	510						
	Whitney Lake	East	G2/30-45	511						
	Whitney Lake	East	G2/45-60	512						
	Whitney Lake	East	H2/LFH	513	1		1	1	1	
	Whitney Lake	East	H2/0-2	514	1	1	1	1	1	1
	Whitney Lake	East	H2/2-5	515	1	1	1	1	1	1
	Whitney Lake	East	H2/5-10	516	1	1	1	1	1	1
	Whitney Lake	East	H2/10-15	517	1	1	1	1	1	1
	Whitney Lake	East	H2/15-30	518						
	Whitney Lake	East	H2/30-45	519						
	Whitney Lake	East	H2/45-60	520						
	Whitney Lake	East	I2/LFH	521	1		1	1	1	
	Whitney Lake	East	I2/0-2	522	1	1	1	1	1	1
	Whitney Lake	East	I2/2-5	523	1	1	1	1	1	1
	Whitney Lake	East	I2/5-10	524	1	1	1	1	1	1
	Whitney Lake	East	I2/10-15	525	1	1	1	1	1	1
	Whitney Lake	East	I2/15-30	526						
	Whitney Lake	East	I2/30-45	527						
	Whitney Lake	East	I2/45-60	528						
	Whitney Lake	East	J2/LFH	529	1		1	1	1	
	Whitney Lake	East	J2/0-2	530	1	1	1	1	1	1
	Whitney Lake	East	J2/2-5	531	1	1	1	1	1	1
	Whitney Lake	East	J2/5-10	532	1	1	1	1	1	1
	Whitney Lake	East	J2/10-15	533	1	1	1	1	1	1
	Whitney Lake	East	J2/15-30	534						
	Whitney Lake	East	J2/30-45	535						
	Whitney Lake	East	J2/45-60	536						
	Whitney Lake	East	K2/LFH	537	1		1	1	1	
	Whitney Lake	East	K2/0-2	538	1	1	1	1	1	1

Date Sampled	Site	Plot	Field Id.	Lab I.D. (2015)	pH ($CaCl_2$)	C.E.C. ($BaCl_2$)	Total Carbon	Total Nitrogen	Total Sulfur	Sat.Paste (pH,E.C.,Sat'n, Ca,Mg,Na,K,Al,Fe,Mn,S)
Oct. 12, 2015	Whitney Lake	East	K2/2-5	539	1	1	1	1	1	1
	Whitney Lake	East	K2/5-10	540	1	1	1	1	1	1
	Whitney Lake	East	K2/10-15	541	1	1	1	1	1	1
	Whitney Lake	East	K2/15-30	542						
	Whitney Lake	East	K2/30-45	543						
	Whitney Lake	East	K2/45-60	544						
	Whitney Lake	East	L2/LFH	545	1		1	1	1	
	Whitney Lake	East	L2/0-2	546	1	1	1	1	1	1
	Whitney Lake	East	L2/2-5	547	1	1	1	1	1	1
	Whitney Lake	East	L2/5-10	548	1	1	1	1	1	1
	Whitney Lake	East	L2/10-15	549	1	1	1	1	1	1
	Whitney Lake	East	L2/15-30	550						
	Whitney Lake	East	L2/30-45	551						
	Whitney Lake	East	L2/45-60	552						
				Total Ana=	120	96	120	120	120	96