# 8 Appendices
## 8.1 GSMNP Database Description

### Brief overview of database

The Great Smoky Mountains National Park (GSMNP) critical loads database was created to support the calculation and analysis of critical loads for acidity (S+N) and nutrient N for three sites within the GSMNP. It includes descriptive data for the four sites as well as climate, deposition, and throughfall data, soil physical and chemical data, soil lysimeter data, and surface water data. The database is not intended to be an exhaustive collection of datasets for the GSMNP as many data sets were identified but not included. Examples of data excluded from this database are the understory vegetation data from the Integrated Forest Study (IFS) study, ozone data, deposition data from the Clean Air Status and Trends Network (CASTNET) and Mountain Acid Deposition Program (MADPro), Aluminum in Streams Study (ALSS) data, and soil and stream data for GSMNP sites not included in the Critical Loads study (e.g., data for Ravenfork). These data sets were excluded either because they did not pertain to the Critical Loads project, or because they were not in the format required, e.g. the MADPro data were expressed as air concentrations and not deposition rates, as is required for calculating critical loads. All of the data assembled at the outset of this project, but excluded from this database, are provided in a separate folder titled "Additional GSMNP Data".

The primary sources of data for the database are IFS, Natural Resources Conservation Service (NRCS), the Tennessee Valley Authority, the Resource Management & Science Division of Great Smoky Mountains National Park, and the University of Tennessee. The sources are identified for each piece of data in the database and there is a Data Source table which provides full references and/or contact information for the data providers. The tables that make up the Microsoft ACCESS relational database are shown in Figure 8.1, as are the relationships that link the tables. Eight of the database tables are connected by *CL Site ID* while four of these tables have additional "child" tables that provide data at a finer resolution (Figure 8.1). An alphabetized list of parameter descriptions is attached as Appendix A.

### Database Table Descriptions

#### *Site Description table*

The *Site Description* table provides the following information: A unique identifier used for the Critical Load study, the names of the sites, names of other sites related to those used in the Critical Load study, descriptions of the site locations, latitude, longitude, elevation, dominant forest type, extended forest type, understory species, and the source for the site description information.

The unique identifier, *CL_Site_ID*, relates this table to all of the other tables in the GSMNP Database in a "one to many" relationship (Figure 8.1).

#### *Long-Term Mean Climate Data table*

The *Long-Term Mean Climate Data* table provides the summary climate inputs used to calculate critical loads. The parameters included in this table are: long-term mean annual precipitation volume, percent of precipitation that falls as snow, modeled evapotranspiration and runoff, and data sources for each of the parameters.

The *Long-Term Mean Climate Data* table is related to the *Site Description* table in a "one to one" relationship through the *CL_Site_ID* parameter (Figure 8.1).

***Annual Deposition Data table***

The Annual Deposition Data table provides annual precipitation volume and wet and dry deposition data for S, N, base cations, $Cl^-$, and $H^+$ for the low elevation Mixed Hardwood site. Also included in this table are data sources, number of days the data were collected, and start and end dates.

The *Annual Deposition Data* table is related to the *Site Description* table in a "many to one" relationship through the *CL_Site_ID* parameter and in a "one to many" relationship with the *Monthly Deposition Data* table through the *Location_ID* and *Year* parameters (Figure 8.1).

***Monthly Deposition Data table***

The *Monthly Deposition Data* table provides monthly precipitation volume, conductivity, and wet deposition data for S, N, base cations, $Cl^-$, and $H^+$ for the low elevation Mixed Hardwood site. Also included in this table are data sources, number of days the data were collected, and start and end dates.

The *Monthly Deposition Data* table is related to the *Annual Deposition Data* table in a "many to one" relationship through the *Location_ID* and *Year* parameters (Figure 8.1).

***Volume-Weighted Mean Throughfall Rates table***

The *Volume-weighted Mean Throughfall* table provides volume-weighted annual throughfall rates from under-canopy and open collectors for S, N, base cations, and $Cl^-$ for the high elevation Lower Spruce-Fir site.

The *Volume-weighted Mean Throughfall Rates* table is connected to the *Site Description* table in a "many to one" relationship through the *CL_Site_ID* parameter and in a "one to many" relationship with the *Throughfall Raw Data* table through the *Collector_Placement* and *TF_Year* parameters (Figure 8.1).

***Throughfall Raw Data table***

The *Throughfall Raw Data* table provides throughfall and open collector sample volume, conductivity, S, N, base cations, and $Cl^-$ concentrations from individual samples for the high elevation Lower Spruce-Fir site.

The *Throughfall Raw Data* table is connected to the *Volume-weighted Mean Throughfall Rates* table in a "many to one" relationship through the *Collector_Placement* and *TF_Year* parameters (Figure 8.1).

***Deposition Scenario table***

The *Deposition Scenario* table provides mean S, $NO_3^-$, and $NH_4^+$ deposition rates for the 11 deposition scenarios used in the Critical Load study (Table 8.1). The data are presented as kg $ha^{-1}$ $yr^{-1}$, eq $ha^{-1}$ $yr^{-1}$, and eq $m^{-2}$ $yr^{-1}$ because different units are required for the different Critical Loads models.

**Table 8.1. Deposition Scenarios used in the Critical Loads study.**

| Scenario | Total S | $NO_3^-$ | $NH_4^+$ | Deposition reductions |
|---|---|---|---|---|
| **1** | No change | No change | No change | Current deposition (1999-2004 mean) |
| **2** | -50% | -48% | +9% | Deposition reductions evenly distributed from 2002 - 2018 |
| **3** | -48% | -56% | +5% | Deposition reductions evenly distributed from 2002 - 2015 |
| **4a** | -70% | -70% | +9% | Deposition reductions evenly distributed from 2002 - 2015 |
| **4b** | -70% | -70% | +9% | Scenario 3 reductions were used through 2015, the remainder of the deposition reductions are evenly distributed from 2015 - 2050 |
| **5** | -80% | -80% | +9% | Deposition reductions evenly distributed from 2002 - 2015 |
| **6** | -90% | -90% | +9% | Deposition reductions evenly distributed from 2002 - 2015 |
| **7** | -90% | -90% | No change | Deposition reductions evenly distributed from 2002 - 2015 |
| **8** | -90% | -90% | -20% | Deposition reductions evenly distributed from 2002 - 2015 |
| **9** | -90% | -90% | -40% | Deposition reductions evenly distributed from 2002 - 2015 |
| **10** | -90% | -90% | -60% | Deposition reductions evenly distributed from 2002 - 2015 |
| **11a** | -90% | -90% | -80% | Deposition reductions evenly distributed from 2002 - 2015 |
| **11b** | -90% | -90% | -80% | Scenario 3 reductions were used through 2015, the remainder of the deposition reductions are evenly distributed from 2015 - 2050 |

The *Deposition Scenario* table is connected to the *Site Description* table in a “many to one” relationship through the *CL_Site_ID* parameter (Figure 8.1).

***Historic Deposition table***

The *Historic Deposition* table provides the modeled annual deposition rates for each site from 1860 - 1999 for S, $NO_3^-$, $NH_4^+$, base actions, and $Cl^-$ used in the Critical Load study.

The *Historic Deposition* table is connected to the *Site Description* table in a "many to one" relationship through the *CL_Site_ID* parameter (Figure 8.1).

***Depth-Weighted Soil Pedon Data table***

The *Depth-weighted Soil Pedon Data* table provides soil series and soil taxonomy for the soils associated with each site. In addition, soil depth and depth-weighted values for clay percent, bulk density, soil water content, cation exchange capacity (CEC), base saturation, C pool, C:N ratio and soil mineral weathering rates are included in this table.

The *Depth-weighted Soil Pedon Data* table is connected to the *Site Description* table in a "many to one" relationship through the *CL_Site_ID* parameter and to the *Soil Horizon Data* table through a "one to many" relationship through the *Pedon_Key* parameter (Figure 8.1).

***Soil Horizon Data table***

The *Soil Horizon Data* table provides soil horizon data from individual soil pits. The parameters included are: top and bottom of horizons, horizon designation, bulk density, C %, N% S%, C:N ratio, extractable cations, acidity, cation exchange capacity (CEC), effective, CEC, Al saturation, base saturation, pH, organic C%, organic N%, organic C:N ratio, organic pH, full particle size and coarse fragment analysis, $NO_3^-$ concentration, soluble salts, and organic matter %. Additionally, information on data sources is included.

The *Soil Horizon Data* table is connected in a "many to one" relationship to the *Depth-weighted Soil Pedon Data* table through the *Pedon_Key* parameter (Figure 8.1).

***Volume-Weighted Mean Lysimeter Data table***

The *Volume-weighted Mean Lysimeter Data* table provides volume-weighted mean conductivity, pH, $SO_4^{-2}$, $NO_3^-$, $NH_4^+$, base cations, $Cl^-$, and ANC for the high elevation Lower Spruce-Fir site.

The *Volume-weighted Mean Lysimeter Data* table is connected to the *Site Description* table in a "many to one" relationship through the *CL_Site_ID* parameter and to the *Lysimeter Raw Data* table through a "one to many" relationship through the *CL_Site_ID* and *Lysimeter Year* parameters (Figure 8.1).

***Lysimeter Raw Data table***

The *Lysimeter Raw Data* table provides sample volume, conductivity, pH, $SO_4^{-2}$, $NO_3^-$, $NH_4^+$, base cations, $Cl^-$, $Al^{3+}$, and data source information for individual lysimeter samples for the high elevation Lower Spruce-Fir site.

The *Lysimeter Raw Data* table is connected to the *Volume-weighted Mean Lysimeter Data* table in a "many to one" relationship through the *CL_Site_ID* and *Lysimeter Year* parameters (Figure 8.1).

### *Mean Surface Water Data table*

The *Mean Surface Water Data* table provides annual pH, $SO_4^{-2}$, $NO_3^-$, $NH_4^+$, base cations, $Cl^-$, and ANC values for northeast and southwest streamlets near the high elevation Lower Spruce-Fir site. Note that, due to lake of flow data, the means presented in this table are not volume-weighted.

The *Mean Surface Water Data* table is connected to the *Site Description* table in a “many to one” relationship through the *CL_Site_ID* parameter and to the *Surface Water Raw Data* table through a “one to many” relationship through the *Surface_Water_ID* parameter (Figure 8.1).

### *Surface Water Raw Data table*

The *Surface Water Raw Data* table provides annual pH, $SO_4^{-2}$, $NO_3^-$, $NH_4^+$, base cations, $Cl^-$, and ANC values for individual samples from the northeast and southwest streamlets near the high elevation Lower Spruce-Fir site.

The *Surface Water Raw Data* table is connected to the *Mean Surface Water Data* table in a “many to one” relationship through the *Surface_Water_ID* parameter (Figure 8.1).

### *Data Sources table*

The *Data Sources* table provides full references and/or contact information for the data providers that are referenced throughout all of the other database tables. This table is a stand-alone table and is intended for reference only.

**Acknowledgments**

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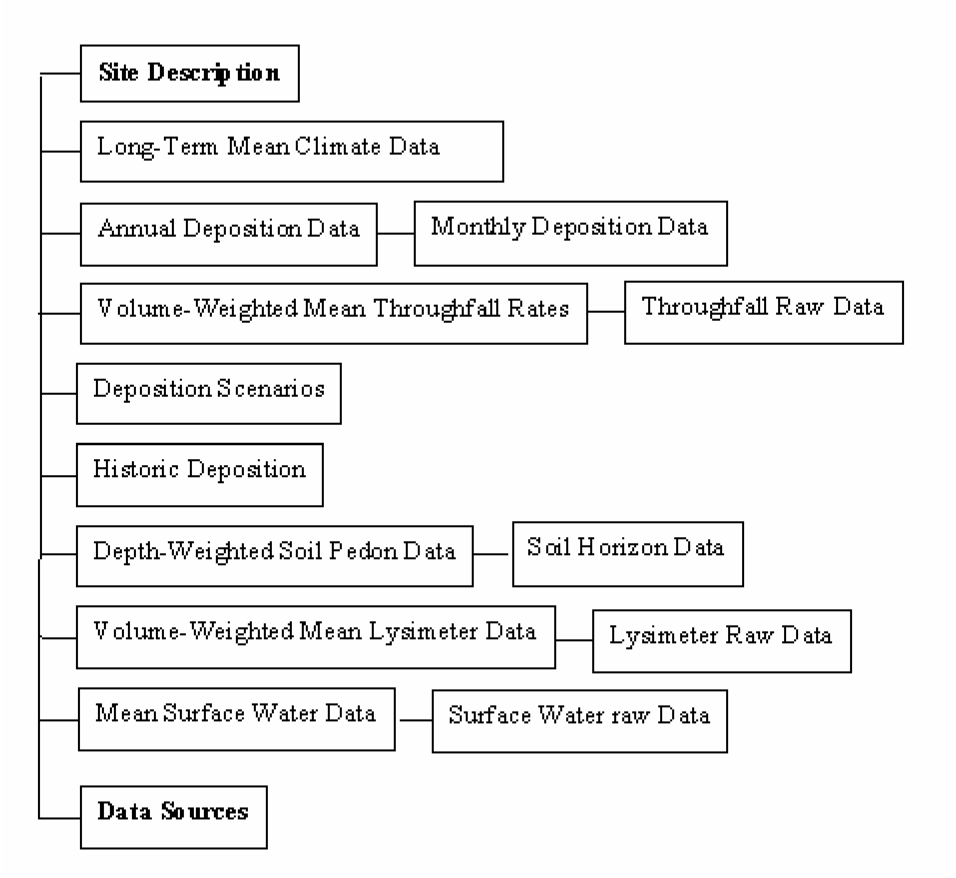


**Figure 8.1. GSMNP Database Structure**

## 8.2 GSMNP Database Parameter Descriptions, by Database Table

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **CL_Site_ID** | Site Description | Number | | Site ID for sites used in Critical Load assessment |
| **CL_Site_Name** | Site Description | Text | | Site name for sites used in Critical Load assessment |
| **Related_Site** | Site Description | Text | | Sites from which data were used for CL site |
| **Site Location** | Site Description | Text | | Descriptive location |
| **Latitude_dd** | Site Description | Number | Decimal Degrees | |
| **Longitude_dd** | Site Description | Number | Decimal Degrees | |
| **Elevation_m** | Site Description | Number | m | |
| **Forest Type** | Site Description | Text | | Dominant forest type |
| **Extended_FT** | Site Description | Text | | Extended forest type |
| **Understory** | Site Description | Text | | Dominant understory vegetation |
| **Site Description Data Source** | Site Description | Text | | |
| | | | | |
| **Climate_ID** | Long-Term Mean Climate Data | Number | | |
| **CL_Site_ID** | Long-Term Mean Climate Data | Number | | |
| **Long-term_mean_an_ppt_cm** | Long-Term Mean Climate Data | Number | cm | Long-term mean annual precipitation volume |
| **Long-term_mean_an_ppt_Source** | Long-Term Mean Climate Data | Text | | |
| **%_snow** | Long-Term Mean Climate Data | Number | % | % of precipitation volume received as snow |
| **%_snow_Source** | Long-Term Mean Climate Data | Text | | |
| **Modeled_ET_cm** | Long-Term Mean Climate Data | Number | cm | Modeled evapotranspiration |
| **Modeled_ET_Source** | Long-Term Mean Climate Data | Text | | |

| **Parameter** | **Table** | **Data Type** | **Units** | **Description** |
|---|---|---|---|---|
| **Modeled_runoff_cm** | Long-Term Mean Climate Data | Number | cm | |
| **Modeled_runoff_Source** | Long-Term Mean Climate Data | Text | | |
| | | | | |
| **Annual_dep_ID** | Annual Deposition Rates | Number | | |
| **CL_Site_ID** | Annual Deposition Rates | Number | | |
| **DepositionSource** | Annual Deposition Rates | Text | | |
| **Location_ID** | Annual Deposition Rates | Text | | |
| **Location_Name** | Annual Deposition Rates | Text | | |
| **Dep_Year** | Annual Deposition Rates | Number | | |
| **Precip_Vol_cm** | Annual Deposition Rates | Number | cm | |
| **SO4_WET_S_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **SO2_DRY_S_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **SO4_DRY_S_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **S_DRY_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **NO3_WET_N_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **NH4_WET_N_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **InorgN_Wet_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **HNO3_DRY_N_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **NO3_DRY_N_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **NH4_DRY_N_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **N_WET_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **N_DRY_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **N_Wet+Dry_kg/h/yr a** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Ca_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Mg_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **K_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Na_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Cl_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **H_lab_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | H+ measured in lab |
| **H_field_kg/ha/yr** | Annual Deposition Rates | Number | kg $ha^{-1}$ $yr^{-1}$ | H+ measured in field |
| **Deposition Units** | Annual Deposition Rates | Text | | |
| **Days** | Annual Deposition Rates | Number | | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **StartDate** | Annual Deposition Rates | Number | | |
| **EndDate** | Annual Deposition Rates | Number | | |
| | | | | |
| **Monthly_Wet_Dep_ID** | Monthly Wet Deposition Rates | Number | | |
| **Location_ID** | Monthly Wet Deposition Rates | Text | | |
| **Location_Name** | Monthly Wet Deposition Rates | Text | | |
| **Month** | Monthly Wet Deposition Rates | Number | | |
| **Deposition_Year** | Monthly Wet Deposition Rates | Number | | |
| **Ca_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **Mg_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **K_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **Na_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **NH4_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **NO3_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **Cl_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **SO4_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **H_wet_kg/ha/mo** | Monthly Wet Deposition Rates | Number | kg $ha^{-1}$ $mo^{-1}$ | |
| **Conductivity_µmhos/cm** | Monthly Wet Deposition Rates | Number | µmhos $cm^{-1}$ | |
| **Precipitation_cm** | Monthly Wet Deposition Rates | Number | cm | |
| **Days** | Monthly Wet Deposition Rates | Number | | |
| **StartDate** | Monthly Wet Deposition Rates | Number | | |
| **EndDate** | Monthly Wet Deposition Rates | Number | | |
| | | | | |
| **Mean_Annual_TF_ID** | Mean Annual Throughfall Rates | Number | | |
| **CL_Site_ID** | Mean Annual Throughfall Rates | Number | | |
| **Collector Placement** | Mean Annual Throughfall Rates | Text | | Open field or canopy throughfall |
| **Throughfall_Year** | Mean Annual Throughfall Rates | Number | | |
| **SampleVolume_cm** | Mean Annual Throughfall Rates | Number | cm | |
| **Cl_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **NO3_eq.ha.yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **So4_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **Na_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **NH4_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **Total Inorganic N_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **K_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **IC Mg_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | Simples analyzed with IC |
| **IC Ca_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | Simples analyzed with IC |
| **F_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **AA or ICP Mg_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | Simples analyzed with AA or ICP |
| **AA or ICP Ca_eq/ha/yr** | Mean Annual Throughfall Rates | Number | eq $ha^{-1}$ $yr^{-1}$ | Simples analyzed with AA or ICP |
| **Throughfall Comment** | Mean Annual Throughfall Rates | Text | | |
| **Throughfall Data Source** | Mean Annual Throughfall Rates | Text | | |
| | | | | |
| **TF_Raw_Data_ID** | Throughfall Raw Data | Number | | |
| **CL_Site_ID** | Throughfall Raw Data | Number | | |
| **CollectorPlacement** | Throughfall Raw Data | Text | | Open field or canopy throughfall |
| **TF_Year** | Throughfall Raw Data | Number | | |
| **Sample_Date** | Throughfall Raw Data | Number | | |

| **Parameter** | **Table** | **Data Type** | **Units** | **Description** |
|---|---|---|---|---|
| **Total_wedge_cm** | Throughfall Raw Data | Number | cm | |
| **Total_bucket_cm** | Throughfall Raw Data | Number | cm | |
| **Total_Belfort_cm** | Throughfall Raw Data | Number | cm | |
| **Precipitation_cm** | Throughfall Raw Data | Number | cm | |
| **Conductivity_uS/cm2** | Throughfall Raw Data | Number | uS $cm^{-2}$ | |
| **Cl_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **NO3_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **SO4_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Na_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **NH4_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **K_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **ICP K_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with ICP |
| **H_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **AA Mg_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with AA |
| **AA or ICP Mg** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with AA or ICP |
| **AA Ca_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with AA |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **AA or ICP Ca_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with AA or ICP |
| **ICP Na_ueq/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | Simples analyzed with ICP |
| **Al_umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Cu_ umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Fe_ umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Mn_ umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Si_umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Zn_ umol/L** | Throughfall Raw Data | Number | ueq $L^{-1}$ | |
| **Throughfall_Comments** | Throughfall Raw Data | Text | | |
| **Throughfall Data Source** | Throughfall Raw Data | Text | | |
| | | | | |
| **Depostion_Scenario_ID** | Deposition Scenario | Number | | |
| **CL_Site_ID** | Deposition Scenario | Number | | |
| **Scenario** | Deposition Scenario | Text | | |
| **Deposition Changes** | Deposition Scenario | Text | | Description of Deposition Scenario |
| **Total S_kg/ha/yr** | Deposition Scenario | Number | kg $ha^{-1}$ $yr^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **NO3-N_kg/ha/yr** | Deposition Scenario | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **NH4-N_kg/ha/yr** | Deposition Scenario | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Total N_kg/ha/yr** | Deposition Scenario | Number | kg $ha^{-1}$ $yr^{-1}$ | |
| **Total S_eq/ha/yr** | Deposition Scenario | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **NO3-N_eq/ha/yr** | Deposition Scenario | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **NH4-N_eq/ha/yr** | Deposition Scenario | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **Total N_eq/ha/yr** | Deposition Scenario | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **Total S_eq/m2/yr** | Deposition Scenario | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **NO3-N_ eq/m2/yr** | Deposition Scenario | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **NH4-N_ eq/m2/yr** | Deposition Scenario | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **Total N_ eq/m2/yr** | Deposition Scenario | Number | eq $m^{-2}$ $yr^{-1}$ | |
| | | | | |
| **Historic_dep_ID** | Historic Deposition | Number | | |
| **CL_Site_ID** | Historic Deposition | Number | | |
| **Year** | Historic Deposition | Number | | |
| **Total S_eq/ha/yr** | Historic Deposition | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **Total NO3_eq/ha/yr** | Historic Deposition | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **Total NH4_eq/ha/yr** | Historic Deposition | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **Total BC_eq/ha/yr** | Historic Deposition | Number | eq $m^{-2}$ $yr^{-1}$ | |
| **Total Cl_eq/ha/yr** | Historic Deposition | Number | eq $m^{-2}$ $yr^{-1}$ | |
| | | | | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **Soil_Pedon_ID** | Depth-weighted Soil Pedon Data | Number | | |
| **CL_Site_ID** | Depth-weighted Soil Pedon Data | Number | | |
| **Pit Lat_dd** | Depth-weighted Soil Pedon Data | Number | decimal degrees | |
| **Pit lon_dd** | Depth-weighted Soil Pedon Data | Number | decimal degrees | |
| **Pit Elevation_m** | Depth-weighted Soil Pedon Data | Number | m | |
| **Pedon_key** | Depth-weighted Soil Pedon Data | Number | | Unique soil pit identifier |
| **User_pedon_id** | Depth-weighted Soil Pedon Data | Number | | For NRCS pits, link to NRCS database |
| **Sampled_taxon_name** | Depth-weighted Soil Pedon Data | Text | | Soil taxonomic name |
| **Sampled_class_name** | Depth-weighted Soil Pedon Data | Text | | Soil series name |
| **Depth_m** | Depth-weighted Soil Pedon Data | Number | m | |
| **Clay%** | Depth-weighted Soil Pedon Data | Number | % | |
| **BulkDensity_g/cm3** | Depth-weighted Soil Pedon Data | Number | g $cm^{-3}$ | |
| **SoilWaterContent_m/m** | Depth-weighted Soil Pedon Data | Number | m /$m^{-1}$ | |
| **CEC_meq/kg** | Depth-weighted Soil Pedon Data | Number | meq $kg^{-1}$ | |
| **BaseSaturation%** | Depth-weighted Soil Pedon Data | Number | % | |
| **Cpool_g/m2** | Depth-weighted Soil Pedon Data | Number | g $m^2$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **TotalC%** | Depth-weighted Soil Pedon Data | Number | % | |
| **C:N** | Depth-weighted Soil Pedon Data | Number | | |
| **Soil Data Source** | Depth-weighted Soil Pedon Data | Text | | |
| **SoilWeatheringRates_eq/ha/yr** | Depth-weighted Soil Pedon Data | Number | eq $ha^{-1}$ $yr^{-1}$ | |
| **Weathering_Source** | Depth-weighted Soil Pedon Data | Text | | |
| **Weathering_Comments** | Depth-weighted Soil Pedon Data | Text | | |
| | | | | |
| **NRCS_Soil_Horizon_ID** | Soil Horizon Data | Number | | |
| **Pedon_key** | Soil Horizon Data | Number | | Unique soil pit identifier |
| **Soil_Source** | Soil Horizon Data | Text | | |
| **Layer_key** | Soil Horizon Data | Number | | Unique soil horizon identifier within pedon |
| **Layer_sequence** | Soil Horizon Data | Number | | |
| **Hzn_top_cm** | Soil Horizon Data | Number | cm | Top of horizon layer |
| **Hzn_bot_cm** | Soil Horizon Data | Number | cm | Bottom of horizon layer |
| **Hzn_desgn** | Soil Horizon Data | Text | | Horizon designation |
| **Bulk Density_g/cm3** | Soil Horizon Data | Number | g $cm^{-3}$ | Oven dry soil bulk density |
| **Bulk Density_g/cm3_Method** | Soil Horizon Data | Text | | |
| **Carbon%** | Soil Horizon Data | Number | % | Carbon% |
| **Carbon%_Method** | Soil Horizon Data | Text | | |
| **Nitrogen%** | Soil Horizon Data | Number | % | Nitrogen% |
| **Nitrogen%_Method** | Soil Horizon Data | Text | | |
| **Sulfur%** | Soil Horizon Data | Number | % | Sulfur% |
| **Sulfur%_Method** | Soil Horizon Data | Text | | |
| **CN_ratio** | Soil Horizon Data | Number | ratio | Ratio of Carbon to Nitrogen |
| **Calcium_extractable** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Extractable Calcium |

| **Parameter** | **Table** | **Data Type** | **Units** | **Description** |
|---|---|---|---|---|
| **Calcium_extractable_Method** | Soil Horizon Data | Text | | |
| **Magnesium_extractable** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Extractable Magnesium |
| **Magnesium_extractable_Method** | Soil Horizon Data | Text | | |
| **Sodium_extractable** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Extractable Sodium |
| **Sodium_extractable_Method** | Soil Horizon Data | Text | | |
| **Potasium_extractable** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Extractable Potassium |
| **Potasium_extractable_Method** | Soil Horizon Data | Text | | |
| **Sum_Extractable_Bases** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Sum of Extractable Bases |
| **Sum_Extractable_Bases_Method** | Soil Horizon Data | Text | | |
| **Acidity_cmol/kg** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Acidity_cmol/kg, BaCl2-TEA Extractable, pH 8.2 |
| **Acidity_cmol/kg_Method** | Soil Horizon Data | Text | | |
| **Aluminum_cmol/kg** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Extractable Aluminum |
| **Aluminum_cmol/kg** | Soil Horizon Data | Text | | |
| **Manganese_mg/kg** | Soil Horizon Data | Number | mg $kg^{-1}$ | Extractable Manganese |
| **Manganese_mg/kg_Method** | Soil Horizon Data | Text | | |
| **CECt_cmol/kg** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Total Cation Exchange Capacity, standard preparation |
| **CEC_pH7_cmol/kg** | Soil Horizon Data | Number | cmol $kg^{-1}$ | CEC_cmol/kg, NH4OAc, pH 7.0 |
| **CECe_cmol/kg** | Soil Horizon Data | Number | cmol $kg^{-1}$ | Effective Cation Exchange Capacity |
| **AluminiumSaturation_%** | Soil Horizon Data | Number | % | Aluminum Saturation%, CMS derived value default, standard prep |
| **Base Saturation %_pH8.2** | Soil Horizon Data | Number | % | Base Saturation% at pH 8.2 |
| **Base Saturation %_pH8.2_Method** | Soil Horizon Data | Text | | |
| **Base Saturation %_pH7.0** | Soil Horizon Data | Number | % | Base Saturation% at pH 7.0 |
| **Base Saturation %_pH7.0_Method** | Soil Horizon Data | Text | | |
| **Soil_pH_w** | Soil Horizon Data | Number | pH units | Soil pH in water extraction |
| **Soil_pH_s** | Soil Horizon Data | Number | pH units | Soil pH in salt extraction |
| **OrgCarbon_%** | Soil Horizon Data | Number | % | Organic Carbon% |
| **OrgCarbon_%_Method** | Soil Horizon Data | Text | | |
| **OrgNitrogen_%** | Soil Horizon Data | Number | % | Organic Nitrogen% |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **OrgNitrogen_%_Method** | Soil Horizon Data | Text | | |
| **Org_CN_ratio** | Soil Horizon Data | Number | ratio | Ratio of Organic Carbon to Nitrogen |
| **Org_pH** | Soil Horizon Data | Number | pH units | Organic pH |
| **Org_pH_Method** | Soil Horizon Data | Text | | |
| **Clay%_total** | Soil Horizon Data | Number | % | Total Clay% |
| **Silt%_total** | Soil Horizon Data | Number | % | Total Silt% |
| **Sand%_total** | Soil Horizon Data | Number | % | Total Sand% |
| **Clay%_fine** | Soil Horizon Data | Number | % | Fine Clay% |
| **Silt%_fine** | Soil Horizon Data | Number | % | Fine Silt% |
| **Silt%_coarse** | Soil Horizon Data | Number | % | Coarse Silt% |
| **Sand%_very fine** | Soil Horizon Data | Number | % | Very Fine Sand% |
| **Sand%_fine** | Soil Horizon Data | Number | % | Fine Sand% |
| **Sand%_medium** | Soil Horizon Data | Number | % | Medium Sand% |
| **Sand%_coarse** | Soil Horizon Data | Number | % | Coarse Sand% |
| **Sand%_very coarse** | Soil Horizon Data | Number | % | Very Coarse Sand% |
| **Coarse Frag_%_2-5mm** | Soil Horizon Data | Number | % | % Coarse Fragments, 2-5mm |
| **Coarse Frag_%_2-5mm_Method** | Soil Horizon Data | Text | | |
| **Coarse Frag_%_5-20mm** | Soil Horizon Data | Number | % | % Coarse Fragments, 5-20mm |
| **Coarse Frag_%_5-20mm_Method** | Soil Horizon Data | Text | | |
| **Coarse Frag_%_20-75mm** | Soil Horizon Data | Number | % | % Coarse Fragments, 20-75mm |
| **Coarse Frag_%_20-75mm_Method** | Soil Horizon Data | Text | | |
| **CF_Weight%, 0.1-75mm** | Soil Horizon Data | Number | % | % Coarse Fragments Weight Percentage, 0.1-75mm |
| **CF_Weight%, 0.1-75mm_Method** | Soil Horizon Data | Text | | |
| **CF_Weight %, >2mm** | Soil Horizon Data | Number | % | % Coarse Fragments Weight Percentage, >2mm |
| **CF_Weight %, >2mm_Method** | Soil Horizon Data | Text | | |
| | | | | |
| **Lysimeter_Mean_ID** | Lysimeter Volume-weighted means | Number | | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **CL_Site_ID** | Lysimeter Volume-weighted means | Number | | |
| **Number of Samples** | Lysimeter Volume-weighted means | Number | | |
| **Lysimeter_Year** | Lysimeter Volume-weighted means | Number | | |
| **Conductivity_uS/cm$^2$** | Lysimeter Volume-weighted means | Number | uS $cm^{-2}$ | |
| **pH** | Lysimeter Volume-weighted means | Number | | |
| **Cl_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **NO3_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **SO4_ ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **Na_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **NH4_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **K_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **H_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **AA Mg_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **AA Ca_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |
| **Lysimeter Source** | Lysimeter Volume-weighted means | Text | | |
| **ANC_ueq/L** | Lysimeter Volume-weighted means | Number | ueq $L^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **ANC Comment** | Lysimeter Volume-weighted means | Text | | |
| | | | | |
| **Lysimeter_Raw_Data_ID** | Lysimeter Raw Data | Number | | |
| **CL_Site_ID** | Lysimeter Raw Data | Number | | |
| **SiteName** | Lysimeter Raw Data | Text | | |
| **Plot** | Lysimeter Raw Data | Number | | |
| **Lysimeter_Year** | Lysimeter Raw Data | Number | | |
| **Date** | Lysimeter Raw Data | Number | | |
| **Forest_Type** | Lysimeter Raw Data | Text | | |
| **Volume_ml** | Lysimeter Raw Data | Number | mL | Sample volume |
| **pH** | Lysimeter Table | Number | | |
| **Conductivity_uS/cm$^2$** | Lysimeter Table | Number | uS $cm^{-2}$ | |
| **NH4_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **NO3_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **SO4_ ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **Na_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **Cl_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **K_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **H_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **Mg_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **Ca_ueq/L** | Lysimeter Table | Number | ueq $L^{-1}$ | |
| **Aluminum_ppm** | Lysimeter Table | Number | ppm | |

| Parameter | Table | Data Type | Units | Description |
| --- | --- | --- | --- | --- |
| **Lysimeter Source** | Lysimeter Table | Text | | |
| **Lysimeter Comments** | Lysimeter Table | Text | | |
| | | | | |
| **Surface_Water_ID** | Surface Water Mean Data | Number | | |
| **CL_Site_ID** | Surface Water Mean Data | Number | | |
| **SW_Year** | Surface Water Mean Data | Number | | |
| **Streamlet Location** | Surface Water Mean Data | Text | | |
| **pH** | Surface Water Mean Data | Number | | |
| **Conductivity_µS/cm2** | Surface Water Mean Data | Number | uS $cm^{-2}$ | |
| **ANC_µeq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **Cl_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **NO3-N_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **SO4_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **Na_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **NH4-N meq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **K_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **H_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **AA Ca_ueq/L** | Surface Water Mean Data | Number | ueq $L^{-1}$ | |
| **SW Source** | Surface Water Mean Data | Text | | |
| **SW Comment** | Surface Water Mean Data | Text | | |
| | | | | |
| **Surface_Water_Raw_Data_ID** | Surface Water Raw Data | Number | | |
| **Surface_Water_ID** | Surface Water Raw Data | Number | | |
| **CL_Site_ID** | Surface Water Raw Data | Number | | |
| **Site Name** | Surface Water Raw Data | Text | | |
| **Streamlet Location** | Surface Water Raw Data | Text | | |
| **SW_Year** | Surface Water Raw Data | Number | | |
| **cfs** | Surface Water Raw Data | Number | Cf $s^{-1}$ | Flow: |
| **L/s** | Surface Water Raw Data | Number | L $s^{-1}$ | Flow |
| **pH** | Surface Water Raw Data | Number | | |
| **Conductivity_µS/cm2** | Surface Water Raw Data | Number | uS $cm^{-2}$ | |
| **ANC_µeq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **Cl_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **NO3-N_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **SO4_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **Na_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **IC Na_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **ICP Na_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **NH4-N meq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **K_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **IC K_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **ICP K_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **H_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **AA or ICP Mg_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **AA Ca_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **ICP Ca_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | |
| **Estimated Ca_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | Based on regression models |
| **Estimated Mg_ueq/L** | Surface Water Raw Data | Number | ueq $L^{-1}$ | Based on regression models |
| **Al_umol** | Surface Water Raw Data | Number | umol | |

| Parameter | Table | Data Type | Units | Description |
|---|---|---|---|---|
| **Al_ umol** | Surface Water Raw Data | Number | umol | |
| **Si_umol** | Surface Water Raw Data | Number | umol | |
| **Si_ umol** | Surface Water Raw Data | Number | umol | |
| **Zn_ umol** | Surface Water Raw Data | Number | umol | |
| **SurfaceWater_Comment** | Surface Water Raw Data | Text | | |
| **Surface Water Source** | Surface Water Raw Data | Text | | |
| | | | | |
| **Source_ID** | Data Source | Number | | |
| **Reference** | Data Source | Text | | |
| **Contact Name** | Data Source | Text | | |
| **Contact Affiliation** | Data Source | Text | | |
| **Contact Email** | Data Source | Text | | |

## 8.3 Input and Output Tables from VSD

Table 8.2 provides the basic VSD input requirements for each of the four GSMNP sites. Deposition inputs for the Current Deposition Scenario (Scenario 1), as described in section 3 of the report, are provided in Table 8.3. VSD modeled soil solution outputs for the Current Deposition Scenario are provided in tables 8.4 – 8.7.

**Table 8.2 Input Data for VSD Calculations.**

| Parameters | Units | High Elevation: Noland Divide | | Beech Gap | Mixed Hardwood |
|---|---|---|---|---|---|
| | | Upper Spruce-Fir | Lower Spruce-Fir | | |
| **Time frame** | | 1945 - 2150 | 1945 - 2150 | 1945 - 2150 | 1945 - 2150 |
| **Soil Depth** | M | 0.46 | 0.57 | 0.74 | 0.83 |
| **Bulk density** | g $cm^{-3}$ | 0.92 | 0.92 | 1.13 | 1.09 |
| **Soil Moisture** | M $m^{-1}$ | 0.12 | 0.12 | 0.12 | 0.15 |
| **CEC** | meq $kg^{-1}$ | 180 | 293 | 239 | 132 |
| **Base saturation (obs)** | % | 7.6 | 9 | 21 | 11 |
| **Base sat. obs year** | year | 1985 | 1985 | 1985 | 2001 |
| **C pool (obs)** | g $m^{-2}$ | 5500 | 9500 | 9250 | 2409 |
| **C:N (obs)** | | 10 | 12 | 11 | 16 |
| **C pool, C:N obs. year** | year | 1985 | 1985 | 1985 | 2001 |
| **Q** | M | 1.16 | 1.16 | 1.16 | 0.79 |
| **Soil Weathering** | eq $m^{-3}$ $yr^{-1}$ | 0.0770 | 0.2632 | 0.0682 | 0.0971 |
| **lgKAlBC** | | -0.48188 | 1.245 | -0.6579 | 1.3242 |
| **lgKHBC** | | 3.9325 | 4.7959 | 3.8444 | 4.8355 |
| **lgKAlox** | | 8.77 | 8.77 | 8.77 | 8.77 |
| **soil solution pCO2** | | 17 | 17 | 17 | 17 |
| **Nim_acc** | eq $m^{-2}$ $yr^{-1}$ | 0.0036 | 0.0036 | 0.0036 | 0.0036 |

**Table 8.3 Deposition Inputs for the Base Deposition Scenarios.**

| Year | S deposition (eq $m^{-2}$ $yr^{-1}$) | $NO_3$ deposition (eq $m^{-2}$ $yr^{-1}$) | $NH_4$ deposition (eq $m^{-2}$ $yr^{-1}$) | Bc deposition (eq $m^{-2}$ $yr^{-1}$) | Cl deposition (eq $m^{-2}$ $yr^{-1}$) |
|---|---|---|---|---|---|
| **Upper and Lower Spruce-Fir Sites** | | | | | |
| 1945 | 0.2287 | 0.0871 | 0.0562 | 0.2000 | 0.0330 |
| 1946 | 0.2250 | 0.0888 | 0.0573 | 0.1968 | 0.0325 |
| 1947 | 0.2213 | 0.0904 | 0.0583 | 0.1936 | 0.0320 |
| 1948 | 0.2176 | 0.0921 | 0.0594 | 0.1904 | 0.0314 |
| 1949 | 0.2139 | 0.0937 | 0.0605 | 0.1871 | 0.0309 |
| 1950 | 0.2102 | 0.0954 | 0.0615 | 0.1839 | 0.0304 |
| 1951 | 0.2147 | 0.0988 | 0.0637 | 0.1878 | 0.0310 |
| 1952 | 0.2192 | 0.1022 | 0.0659 | 0.1917 | 0.0317 |
| 1953 | 0.2237 | 0.1056 | 0.0681 | 0.1957 | 0.0323 |
| 1954 | 0.2281 | 0.1090 | 0.0703 | 0.1996 | 0.0330 |
| 1955 | 0.2326 | 0.1124 | 0.0725 | 0.2035 | 0.0336 |
| 1956 | 0.2371 | 0.1158 | 0.0747 | 0.2074 | 0.0343 |
| 1957 | 0.2416 | 0.1192 | 0.0769 | 0.2114 | 0.0349 |

| Year | S deposition (eq $m^{-2}$ $yr^{-1}$) | $NO_3$ deposition (eq $m^{-2}$ $yr^{-1}$) | $NH_4$ deposition (eq $m^{-2}$ $yr^{-1}$) | Bc deposition (eq $m^{-2}$ $yr^{-1}$) | Cl deposition (eq $m^{-2}$ $yr^{-1}$) |
|---|---|---|---|---|---|
| **Upper and Lower Spruce-Fir Sites** | | | | | |
| 1958 | 0.2461 | 0.1226 | 0.0791 | 0.2153 | 0.0356 |
| 1959 | 0.2505 | 0.1260 | 0.0813 | 0.2192 | 0.0362 |
| 1960 | 0.2550 | 0.1294 | 0.0835 | 0.2231 | 0.0369 |
| 1961 | 0.2489 | 0.1311 | 0.0845 | 0.2177 | 0.0360 |
| 1962 | 0.2427 | 0.1327 | 0.0856 | 0.2123 | 0.0351 |
| 1963 | 0.2365 | 0.1343 | 0.0866 | 0.2069 | 0.0342 |
| 1964 | 0.2304 | 0.1359 | 0.0877 | 0.2015 | 0.0333 |
| 1965 | 0.2242 | 0.1375 | 0.0887 | 0.1961 | 0.0324 |
| 1966 | 0.2318 | 0.1409 | 0.0909 | 0.2028 | 0.0335 |
| 1967 | 0.2394 | 0.1444 | 0.0931 | 0.2094 | 0.0346 |
| 1968 | 0.2470 | 0.1478 | 0.0953 | 0.2161 | 0.0357 |
| 1969 | 0.2546 | 0.1512 | 0.0976 | 0.2227 | 0.0368 |
| 1970 | 0.2622 | 0.1547 | 0.0998 | 0.2294 | 0.0379 |
| 1971 | 0.2698 | 0.1581 | 0.1020 | 0.2360 | 0.0390 |
| 1972 | 0.2774 | 0.1615 | 0.1042 | 0.2427 | 0.0401 |
| 1973 | 0.2850 | 0.1650 | 0.1064 | 0.2494 | 0.0412 |
| 1974 | 0.2926 | 0.1684 | 0.1086 | 0.2560 | 0.0423 |
| 1975 | 0.3002 | 0.1718 | 0.1108 | 0.2627 | 0.0434 |
| 1976 | 0.2976 | 0.1709 | 0.1102 | 0.2604 | 0.0430 |
| 1977 | 0.2951 | 0.1699 | 0.1096 | 0.2581 | 0.0426 |
| 1978 | 0.2925 | 0.1689 | 0.1090 | 0.2559 | 0.0423 |
| 1979 | 0.2899 | 0.1680 | 0.1084 | 0.2536 | 0.0419 |
| 1980 | 0.2873 | 0.1670 | 0.1077 | 0.2514 | 0.0415 |
| 1981 | 0.2847 | 0.1661 | 0.1071 | 0.2491 | 0.0412 |
| 1982 | 0.2822 | 0.1651 | 0.1065 | 0.2469 | 0.0408 |
| 1983 | 0.2796 | 0.1641 | 0.1059 | 0.2446 | 0.0404 |
| 1984 | 0.2770 | 0.1632 | 0.1053 | 0.2423 | 0.0400 |
| 1985 | 0.2744 | 0.1622 | 0.1046 | 0.2401 | 0.0397 |
| 1986 | 0.2743 | 0.1628 | 0.1050 | 0.2400 | 0.0396 |
| 1987 | 0.2742 | 0.1635 | 0.1054 | 0.2399 | 0.0396 |
| 1988 | 0.2741 | 0.1641 | 0.1059 | 0.2398 | 0.0396 |
| 1989 | 0.2740 | 0.1647 | 0.1063 | 0.2397 | 0.0396 |
| 1990 | 0.2739 | 0.1653 | 0.1067 | 0.2396 | 0.0396 |
| 1991 | 0.2647 | 0.1623 | 0.1047 | 0.2316 | 0.0383 |
| 1992 | 0.2554 | 0.1592 | 0.1027 | 0.2235 | 0.0369 |
| 1993 | 0.2462 | 0.1561 | 0.1007 | 0.2154 | 0.0356 |
| 1994 | 0.2369 | 0.1530 | 0.0987 | 0.2073 | 0.0342 |
| 1995 | 0.2277 | 0.1499 | 0.0967 | 0.1992 | 0.0329 |
| 1996 | 0.2184 | 0.1468 | 0.0947 | 0.1911 | 0.0316 |
| 1997 | 0.2092 | 0.1437 | 0.0927 | 0.1830 | 0.0302 |
| 1998 | 0.1999 | 0.1406 | 0.0907 | 0.1749 | 0.0289 |
| 1999 | 0.1958 | 0.1406 | 0.0907 | 0.1713 | 0.0283 |
| 2150[1] | 0.1958 | 0.1406 | 0.0907 | 0.1713 | 0.0283 |
| **Beech Gap Site** | | | | | |
| 1945 | 0.1143 | 0.0436 | 0.0281 | 0.1001 | 0.0166 |
| 1946 | 0.1125 | 0.0444 | 0.0286 | 0.0985 | 0.0163 |

| Year | S deposition (eq $m^{-2}$ $yr^{-1}$) | $NO_3$ deposition (eq $m^{-2}$ $yr^{-1}$) | $NH_4$ deposition (eq $m^{-2}$ $yr^{-1}$) | Bc deposition (eq $m^{-2}$ $yr^{-1}$) | Cl deposition (eq $m^{-2}$ $yr^{-1}$) |
|---|---|---|---|---|---|
| **Beech Gap Site** | | | | | |
| 1947 | 0.1106 | 0.0452 | 0.0291 | 0.0969 | 0.0160 |
| 1948 | 0.1088 | 0.0460 | 0.0297 | 0.0952 | 0.0158 |
| 1949 | 0.1069 | 0.0469 | 0.0302 | 0.0936 | 0.0155 |
| 1950 | 0.1051 | 0.0477 | 0.0307 | 0.0920 | 0.0152 |
| 1951 | 0.1073 | 0.0494 | 0.0318 | 0.0940 | 0.0156 |
| 1952 | 0.1096 | 0.0511 | 0.0329 | 0.0959 | 0.0159 |
| 1953 | 0.1118 | 0.0528 | 0.0340 | 0.0979 | 0.0162 |
| 1954 | 0.1141 | 0.0545 | 0.0351 | 0.0999 | 0.0165 |
| 1955 | 0.1163 | 0.0562 | 0.0362 | 0.1018 | 0.0169 |
| 1956 | 0.1186 | 0.0579 | 0.0373 | 0.1038 | 0.0172 |
| 1957 | 0.1208 | 0.0596 | 0.0384 | 0.1057 | 0.0175 |
| 1958 | 0.1230 | 0.0613 | 0.0395 | 0.1077 | 0.0178 |
| 1959 | 0.1253 | 0.0630 | 0.0406 | 0.1097 | 0.0182 |
| 1960 | 0.1275 | 0.0647 | 0.0417 | 0.1116 | 0.0185 |
| 1961 | 0.1244 | 0.0655 | 0.0422 | 0.1089 | 0.0180 |
| 1962 | 0.1213 | 0.0663 | 0.0427 | 0.1062 | 0.0176 |
| 1963 | 0.1183 | 0.0671 | 0.0433 | 0.1035 | 0.0172 |
| 1964 | 0.1152 | 0.0679 | 0.0438 | 0.1008 | 0.0167 |
| 1965 | 0.1121 | 0.0688 | 0.0443 | 0.0981 | 0.0163 |
| 1966 | 0.1159 | 0.0705 | 0.0454 | 0.1015 | 0.0168 |
| 1967 | 0.1197 | 0.0722 | 0.0465 | 0.1048 | 0.0174 |
| 1968 | 0.1235 | 0.0739 | 0.0476 | 0.1081 | 0.0179 |
| 1969 | 0.1273 | 0.0756 | 0.0487 | 0.1114 | 0.0185 |
| 1970 | 0.1311 | 0.0773 | 0.0498 | 0.1148 | 0.0190 |
| 1971 | 0.1349 | 0.0790 | 0.0509 | 0.1181 | 0.0196 |
| 1972 | 0.1387 | 0.0808 | 0.0520 | 0.1214 | 0.0201 |
| 1973 | 0.1425 | 0.0825 | 0.0531 | 0.1247 | 0.0207 |
| 1974 | 0.1463 | 0.0842 | 0.0543 | 0.1281 | 0.0212 |
| 1975 | 0.1501 | 0.0859 | 0.0554 | 0.1314 | 0.0218 |
| 1976 | 0.1488 | 0.0854 | 0.0550 | 0.1303 | 0.0216 |
| 1977 | 0.1475 | 0.0849 | 0.0547 | 0.1291 | 0.0214 |
| 1978 | 0.1462 | 0.0845 | 0.0544 | 0.1280 | 0.0212 |
| 1979 | 0.1449 | 0.0840 | 0.0541 | 0.1269 | 0.0210 |
| 1980 | 0.1437 | 0.0835 | 0.0538 | 0.1258 | 0.0208 |
| 1981 | 0.1424 | 0.0830 | 0.0535 | 0.1246 | 0.0206 |
| 1982 | 0.1411 | 0.0825 | 0.0532 | 0.1235 | 0.0205 |
| 1983 | 0.1398 | 0.0821 | 0.0529 | 0.1224 | 0.0203 |
| 1984 | 0.1385 | 0.0816 | 0.0526 | 0.1212 | 0.0201 |
| 1985 | 0.1372 | 0.0811 | 0.0523 | 0.1201 | 0.0199 |
| 1986 | 0.1372 | 0.0814 | 0.0525 | 0.1201 | 0.0199 |
| 1987 | 0.1371 | 0.0817 | 0.0527 | 0.1200 | 0.0199 |
| 1988 | 0.1371 | 0.0820 | 0.0529 | 0.1200 | 0.0199 |
| 1989 | 0.1370 | 0.0824 | 0.0531 | 0.1199 | 0.0199 |
| 1990 | 0.1370 | 0.0827 | 0.0533 | 0.1199 | 0.0199 |
| 1991 | 0.1323 | 0.0811 | 0.0523 | 0.1158 | 0.0192 |
| 1992 | 0.1277 | 0.0796 | 0.0513 | 0.1118 | 0.0185 |

| Year | S deposition (eq $m^{-2}$ $yr^{-1}$) | $NO_3$ deposition (eq $m^{-2}$ $yr^{-1}$) | $NH_4$ deposition (eq $m^{-2}$ $yr^{-1}$) | Bc deposition (eq $m^{-2}$ $yr^{-1}$) | Cl deposition (eq $m^{-2}$ $yr^{-1}$) |
|---|---|---|---|---|---|
| **Beech Gap Site** | | | | | |
| 1993 | 0.1231 | 0.0780 | 0.0503 | 0.1077 | 0.0179 |
| 1994 | 0.1185 | 0.0765 | 0.0493 | 0.1037 | 0.0172 |
| 1995 | 0.1138 | 0.0749 | 0.0483 | 0.0996 | 0.0165 |
| 1996 | 0.1092 | 0.0734 | 0.0473 | 0.0956 | 0.0158 |
| 1997 | 0.1046 | 0.0718 | 0.0463 | 0.0915 | 0.0152 |
| 1998 | 0.1000 | 0.0703 | 0.0453 | 0.0875 | 0.0145 |
| 1999 | 0.0979 | 0.0703 | 0.0453 | 0.0857 | 0.0142 |
| 2150[1] | 0.0979 | 0.0703 | 0.0453 | 0.0857 | 0.0142 |
| **Mixed Hardwood Site** | | | | | |
| 1945 | 0.0730 | 0.0265 | 0.0110 | 0.0202 | 0.0047 |
| 1946 | 0.0718 | 0.0270 | 0.0112 | 0.0199 | 0.0046 |
| 1947 | 0.0706 | 0.0275 | 0.0114 | 0.0196 | 0.0045 |
| 1948 | 0.0695 | 0.0280 | 0.0117 | 0.0192 | 0.0044 |
| 1949 | 0.0683 | 0.0285 | 0.0119 | 0.0189 | 0.0044 |
| 1950 | 0.0671 | 0.0290 | 0.0121 | 0.0186 | 0.0043 |
| 1951 | 0.0685 | 0.0301 | 0.0125 | 0.0190 | 0.0044 |
| 1952 | 0.0700 | 0.0311 | 0.0129 | 0.0194 | 0.0045 |
| 1953 | 0.0714 | 0.0322 | 0.0134 | 0.0198 | 0.0046 |
| 1954 | 0.0728 | 0.0332 | 0.0138 | 0.0202 | 0.0047 |
| 1955 | 0.0743 | 0.0342 | 0.0142 | 0.0206 | 0.0048 |
| 1956 | 0.0757 | 0.0353 | 0.0147 | 0.0209 | 0.0048 |
| 1957 | 0.0771 | 0.0363 | 0.0151 | 0.0213 | 0.0049 |
| 1958 | 0.0785 | 0.0373 | 0.0155 | 0.0217 | 0.0050 |
| 1959 | 0.0800 | 0.0384 | 0.0160 | 0.0221 | 0.0051 |
| 1960 | 0.0814 | 0.0394 | 0.0164 | 0.0225 | 0.0052 |
| 1961 | 0.0794 | 0.0399 | 0.0166 | 0.0220 | 0.0051 |
| 1962 | 0.0775 | 0.0404 | 0.0168 | 0.0214 | 0.0050 |
| 1963 | 0.0755 | 0.0409 | 0.0170 | 0.0209 | 0.0048 |
| 1964 | 0.0735 | 0.0414 | 0.0172 | 0.0204 | 0.0047 |
| 1965 | 0.0716 | 0.0419 | 0.0174 | 0.0198 | 0.0046 |
| 1966 | 0.0740 | 0.0429 | 0.0178 | 0.0205 | 0.0047 |
| 1967 | 0.0764 | 0.0439 | 0.0183 | 0.0212 | 0.0049 |
| 1968 | 0.0788 | 0.0450 | 0.0187 | 0.0218 | 0.0050 |
| 1969 | 0.0813 | 0.0460 | 0.0191 | 0.0225 | 0.0052 |
| 1970 | 0.0837 | 0.0471 | 0.0196 | 0.0232 | 0.0054 |
| 1971 | 0.0861 | 0.0481 | 0.0200 | 0.0238 | 0.0055 |
| 1972 | 0.0886 | 0.0492 | 0.0204 | 0.0245 | 0.0057 |
| 1973 | 0.0910 | 0.0502 | 0.0209 | 0.0252 | 0.0058 |
| 1974 | 0.0934 | 0.0513 | 0.0213 | 0.0259 | 0.0060 |
| 1975 | 0.0958 | 0.0523 | 0.0218 | 0.0265 | 0.0061 |
| 1976 | 0.0950 | 0.0520 | 0.0216 | 0.0263 | 0.0061 |
| 1977 | 0.0942 | 0.0517 | 0.0215 | 0.0261 | 0.0060 |
| 1978 | 0.0934 | 0.0514 | 0.0214 | 0.0258 | 0.0060 |
| 1979 | 0.0925 | 0.0511 | 0.0213 | 0.0256 | 0.0059 |
| 1980 | 0.0917 | 0.0508 | 0.0211 | 0.0254 | 0.0059 |
| 1981 | 0.0909 | 0.0505 | 0.0210 | 0.0252 | 0.0058 |

| Year | S deposition ($eq\ m^{-2}\ yr^{-1}$) | $NO_3$ deposition ($eq\ m^{-2}\ yr^{-1}$) | $NH_4$ deposition ($eq\ m^{-2}\ yr^{-1}$) | Bc deposition ($eq\ m^{-2}\ yr^{-1}$) | Cl deposition ($eq\ m^{-2}\ yr^{-1}$) |
|---|---|---|---|---|---|
| **Mixed Hardwood Site** | | | | | |
| 1982 | 0.0901 | 0.0503 | 0.0209 | 0.0249 | 0.0058 |
| 1983 | 0.0892 | 0.0500 | 0.0208 | 0.0247 | 0.0057 |
| 1984 | 0.0884 | 0.0497 | 0.0207 | 0.0245 | 0.0057 |
| 1985 | 0.0876 | 0.0494 | 0.0205 | 0.0242 | 0.0056 |
| 1986 | 0.0876 | 0.0496 | 0.0206 | 0.0242 | 0.0056 |
| 1987 | 0.0875 | 0.0498 | 0.0207 | 0.0242 | 0.0056 |
| 1988 | 0.0875 | 0.0500 | 0.0208 | 0.0242 | 0.0056 |
| 1989 | 0.0875 | 0.0501 | 0.0209 | 0.0242 | 0.0056 |
| 1990 | 0.0874 | 0.0503 | 0.0209 | 0.0242 | 0.0056 |
| 1991 | 0.0845 | 0.0494 | 0.0205 | 0.0234 | 0.0054 |
| 1992 | 0.0815 | 0.0484 | 0.0201 | 0.0226 | 0.0052 |
| 1993 | 0.0786 | 0.0475 | 0.0198 | 0.0218 | 0.0050 |
| 1994 | 0.0756 | 0.0466 | 0.0194 | 0.0209 | 0.0048 |
| 1995 | 0.0727 | 0.0456 | 0.0190 | 0.0201 | 0.0047 |
| 1996 | 0.0697 | 0.0447 | 0.0186 | 0.0193 | 0.0045 |
| 1997 | 0.0668 | 0.0437 | 0.0182 | 0.0185 | 0.0043 |
| 1998 | 0.0638 | 0.0428 | 0.0178 | 0.0177 | 0.0041 |
| 1999 | 0.0625 | 0.0428 | 0.0178 | 0.0173 | 0.0040 |
| 2150[1] | 0.0625 | 0.0428 | 0.0178 | 0.0173 | 0.0040 |

[1]The "Current Deposition" Scenario assumes that deposition inputs remain constant through the year 2150. VSD does not require deposition inputs for each year when no changes occur.

**Table 8.4 VSD Soil Solution Output for the Upper Spruce-Fir Site, using the Current Deposition Scenario.**

| Year | Base Sat. | pH | $[NO_3^-]$ ($eq\ m^{-3}$) | [ANC] ($eq\ m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ ($eq\ m^{-3}$) |
|---|---|---|---|---|---|---|
| 1945 | 8% | 4.4 | 0.0928 | -0.1638 | 0.54 | 0.1254 |
| 1946 | 8% | 4.4 | 0.0951 | -0.1632 | 0.54 | 0.1249 |
| 1947 | 8% | 4.4 | 0.0974 | -0.1625 | 0.54 | 0.1242 |
| 1948 | 8% | 4.4 | 0.0998 | -0.1618 | 0.54 | 0.1237 |
| 1949 | 8% | 4.4 | 0.1021 | -0.1612 | 0.54 | 0.1231 |
| 1950 | 8% | 4.4 | 0.1045 | -0.1607 | 0.54 | 0.1226 |
| 1951 | 8% | 4.4 | 0.1092 | -0.1659 | 0.55 | 0.1273 |
| 1952 | 8% | 4.4 | 0.1140 | -0.1715 | 0.56 | 0.1324 |
| 1953 | 8% | 4.4 | 0.1188 | -0.1771 | 0.56 | 0.1374 |
| 1954 | 8% | 4.4 | 0.1237 | -0.1828 | 0.57 | 0.1425 |
| 1955 | 8% | 4.4 | 0.1285 | -0.1885 | 0.58 | 0.1476 |
| 1956 | 8% | 4.4 | 0.1333 | -0.1942 | 0.59 | 0.1529 |
| 1957 | 8% | 4.3 | 0.1382 | -0.2000 | 0.60 | 0.1581 |
| 1958 | 8% | 4.3 | 0.1430 | -0.2058 | 0.61 | 0.1634 |
| 1959 | 8% | 4.3 | 0.1478 | -0.2116 | 0.61 | 0.1687 |
| 1960 | 8% | 4.3 | 0.1527 | -0.2175 | 0.62 | 0.1740 |
| 1961 | 8% | 4.3 | 0.1551 | -0.2160 | 0.62 | 0.1726 |
| 1962 | 8% | 4.3 | 0.1574 | -0.2141 | 0.62 | 0.1709 |
| 1963 | 8% | 4.3 | 0.1597 | -0.2122 | 0.62 | 0.1692 |
| 1964 | 8% | 4.3 | 0.1620 | -0.2105 | 0.62 | 0.1677 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1965 | 8% | 4.3 | 0.1643 | -0.2087 | 0.62 | 0.1660 |
| 1966 | 8% | 4.3 | 0.1690 | -0.2164 | 0.64 | 0.1730 |
| 1967 | 8% | 4.3 | 0.1739 | -0.2245 | 0.65 | 0.1804 |
| 1968 | 8% | 4.3 | 0.1787 | -0.2326 | 0.66 | 0.1879 |
| 1969 | 7% | 4.3 | 0.1836 | -0.2408 | 0.67 | 0.1954 |
| 1970 | 7% | 4.3 | 0.1885 | -0.2490 | 0.68 | 0.2030 |
| 1971 | 7% | 4.3 | 0.1934 | -0.2572 | 0.69 | 0.2106 |
| 1972 | 7% | 4.3 | 0.1982 | -0.2654 | 0.70 | 0.2181 |
| 1973 | 7% | 4.3 | 0.2031 | -0.2737 | 0.71 | 0.2258 |
| 1974 | 7% | 4.3 | 0.2080 | -0.2818 | 0.72 | 0.2334 |
| 1975 | 7% | 4.3 | 0.2128 | -0.2900 | 0.73 | 0.2410 |
| 1976 | 7% | 4.3 | 0.2118 | -0.2883 | 0.73 | 0.2394 |
| 1977 | 7% | 4.3 | 0.2104 | -0.2862 | 0.73 | 0.2374 |
| 1978 | 7% | 4.3 | 0.2090 | -0.2840 | 0.73 | 0.2354 |
| 1979 | 7% | 4.3 | 0.2077 | -0.2819 | 0.73 | 0.2334 |
| 1980 | 7% | 4.3 | 0.2063 | -0.2796 | 0.73 | 0.2313 |
| 1981 | 7% | 4.3 | 0.2050 | -0.2775 | 0.73 | 0.2294 |
| 1982 | 7% | 4.3 | 0.2036 | -0.2754 | 0.73 | 0.2274 |
| 1983 | 7% | 4.3 | 0.2022 | -0.2732 | 0.73 | 0.2254 |
| 1984 | 7% | 4.3 | 0.2009 | -0.2711 | 0.73 | 0.2234 |
| 1985 | 7% | 4.3 | 0.1995 | -0.2689 | 0.73 | 0.2214 |
| 1986 | 7% | 4.3 | 0.2002 | -0.2696 | 0.73 | 0.2220 |
| 1987 | 7% | 4.3 | 0.2012 | -0.2705 | 0.74 | 0.2228 |
| 1988 | 7% | 4.3 | 0.2021 | -0.2714 | 0.74 | 0.2237 |
| 1989 | 7% | 4.3 | 0.2030 | -0.2722 | 0.74 | 0.2245 |
| 1990 | 7% | 4.3 | 0.2038 | -0.2731 | 0.75 | 0.2252 |
| 1991 | 7% | 4.3 | 0.1998 | -0.2653 | 0.74 | 0.2180 |
| 1992 | 7% | 4.3 | 0.1954 | -0.2570 | 0.73 | 0.2104 |
| 1993 | 7% | 4.3 | 0.1910 | -0.2489 | 0.73 | 0.2028 |
| 1994 | 7% | 4.3 | 0.1866 | -0.2407 | 0.72 | 0.1953 |
| 1995 | 7% | 4.3 | 0.1822 | -0.2326 | 0.72 | 0.1879 |
| 1996 | 7% | 4.3 | 0.1778 | -0.2245 | 0.71 | 0.1805 |
| 1997 | 7% | 4.3 | 0.1734 | -0.2165 | 0.70 | 0.1731 |
| 1998 | 7% | 4.3 | 0.1690 | -0.2085 | 0.70 | 0.1659 |
| 1999 | 7% | 4.3 | 0.1688 | -0.2063 | 0.70 | 0.1638 |
| 2000 | 7% | 4.3 | 0.1688 | -0.2068 | 0.70 | 0.1642 |
| 2001 | 7% | 4.3 | 0.1688 | -0.2073 | 0.71 | 0.1648 |
| 2002 | 7% | 4.3 | 0.1688 | -0.2079 | 0.71 | 0.1653 |
| 2003 | 7% | 4.3 | 0.1688 | -0.2084 | 0.72 | 0.1658 |
| 2004 | 7% | 4.3 | 0.1688 | -0.2090 | 0.72 | 0.1663 |
| 2005 | 7% | 4.3 | 0.1688 | -0.2095 | 0.73 | 0.1668 |
| 2006 | 7% | 4.3 | 0.1688 | -0.2101 | 0.73 | 0.1672 |
| 2007 | 7% | 4.3 | 0.1688 | -0.2106 | 0.74 | 0.1677 |
| 2008 | 6% | 4.3 | 0.1688 | -0.2111 | 0.74 | 0.1682 |
| 2009 | 6% | 4.3 | 0.1688 | -0.2116 | 0.75 | 0.1686 |
| 2010 | 6% | 4.3 | 0.1688 | -0.2120 | 0.75 | 0.1691 |
| 2011 | 6% | 4.3 | 0.1688 | -0.2125 | 0.76 | 0.1695 |
| 2012 | 6% | 4.3 | 0.1688 | -0.2130 | 0.76 | 0.1699 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2013 | 6% | 4.3 | 0.1688 | -0.2134 | 0.76 | 0.1703 |
| 2014 | 6% | 4.3 | 0.1688 | -0.2139 | 0.77 | 0.1707 |
| 2015 | 6% | 4.3 | 0.1688 | -0.2143 | 0.77 | 0.1711 |
| 2016 | 6% | 4.3 | 0.1688 | -0.2147 | 0.78 | 0.1715 |
| 2017 | 6% | 4.3 | 0.1688 | -0.2152 | 0.78 | 0.1719 |
| 2018 | 6% | 4.3 | 0.1688 | -0.2156 | 0.78 | 0.1723 |
| 2019 | 6% | 4.3 | 0.1688 | -0.2160 | 0.79 | 0.1726 |
| 2020 | 6% | 4.3 | 0.1688 | -0.2164 | 0.79 | 0.1730 |
| 2021 | 6% | 4.3 | 0.1688 | -0.2167 | 0.79 | 0.1733 |
| 2022 | 6% | 4.3 | 0.1688 | -0.2171 | 0.80 | 0.1737 |
| 2023 | 6% | 4.3 | 0.1688 | -0.2175 | 0.80 | 0.1740 |
| 2024 | 6% | 4.3 | 0.1688 | -0.2178 | 0.81 | 0.1743 |
| 2025 | 6% | 4.3 | 0.1688 | -0.2182 | 0.81 | 0.1747 |
| 2026 | 6% | 4.3 | 0.1688 | -0.2185 | 0.81 | 0.1750 |
| 2027 | 6% | 4.3 | 0.1688 | -0.2189 | 0.82 | 0.1753 |
| 2028 | 6% | 4.3 | 0.1688 | -0.2192 | 0.82 | 0.1756 |
| 2029 | 6% | 4.3 | 0.1688 | -0.2195 | 0.82 | 0.1759 |
| 2030 | 6% | 4.3 | 0.1688 | -0.2198 | 0.83 | 0.1762 |
| 2031 | 6% | 4.3 | 0.1688 | -0.2201 | 0.83 | 0.1764 |
| 2032 | 6% | 4.3 | 0.1688 | -0.2204 | 0.83 | 0.1767 |
| 2033 | 6% | 4.3 | 0.1688 | -0.2207 | 0.83 | 0.1770 |
| 2034 | 6% | 4.3 | 0.1688 | -0.2210 | 0.84 | 0.1772 |
| 2035 | 6% | 4.3 | 0.1688 | -0.2213 | 0.84 | 0.1775 |
| 2036 | 6% | 4.3 | 0.1688 | -0.2215 | 0.84 | 0.1777 |
| 2037 | 6% | 4.3 | 0.1688 | -0.2218 | 0.85 | 0.1780 |
| 2038 | 6% | 4.3 | 0.1688 | -0.2221 | 0.85 | 0.1782 |
| 2039 | 6% | 4.3 | 0.1688 | -0.2223 | 0.85 | 0.1784 |
| 2040 | 6% | 4.3 | 0.1688 | -0.2226 | 0.85 | 0.1787 |
| 2041 | 6% | 4.3 | 0.1688 | -0.2228 | 0.86 | 0.1789 |
| 2042 | 6% | 4.3 | 0.1688 | -0.2230 | 0.86 | 0.1791 |
| 2043 | 6% | 4.3 | 0.1688 | -0.2233 | 0.86 | 0.1793 |
| 2044 | 6% | 4.3 | 0.1688 | -0.2235 | 0.86 | 0.1795 |
| 2045 | 6% | 4.3 | 0.1688 | -0.2237 | 0.87 | 0.1797 |
| 2046 | 6% | 4.3 | 0.1688 | -0.2239 | 0.87 | 0.1799 |
| 2047 | 6% | 4.3 | 0.1688 | -0.2241 | 0.87 | 0.1801 |
| 2048 | 6% | 4.3 | 0.1688 | -0.2243 | 0.87 | 0.1803 |
| 2049 | 6% | 4.3 | 0.1688 | -0.2245 | 0.87 | 0.1805 |
| 2050 | 6% | 4.3 | 0.1688 | -0.2247 | 0.88 | 0.1806 |
| 2051 | 6% | 4.3 | 0.1688 | -0.2249 | 0.88 | 0.1808 |
| 2052 | 6% | 4.3 | 0.1688 | -0.2251 | 0.88 | 0.1810 |
| 2053 | 6% | 4.3 | 0.1688 | -0.2253 | 0.88 | 0.1811 |
| 2054 | 6% | 4.3 | 0.1688 | -0.2254 | 0.88 | 0.1813 |
| 2055 | 6% | 4.3 | 0.1688 | -0.2256 | 0.89 | 0.1815 |
| 2056 | 6% | 4.3 | 0.1688 | -0.2258 | 0.89 | 0.1816 |
| 2057 | 6% | 4.3 | 0.1688 | -0.2259 | 0.89 | 0.1818 |
| 2058 | 6% | 4.3 | 0.1688 | -0.2261 | 0.89 | 0.1819 |
| 2059 | 6% | 4.3 | 0.1688 | -0.2262 | 0.89 | 0.1820 |
| 2060 | 6% | 4.3 | 0.1688 | -0.2264 | 0.89 | 0.1822 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2061 | 6% | 4.3 | 0.1688 | -0.2265 | 0.90 | 0.1823 |
| 2062 | 6% | 4.3 | 0.1688 | -0.2267 | 0.90 | 0.1824 |
| 2063 | 6% | 4.3 | 0.1688 | -0.2268 | 0.90 | 0.1826 |
| 2064 | 6% | 4.3 | 0.1688 | -0.2270 | 0.90 | 0.1827 |
| 2065 | 6% | 4.3 | 0.1688 | -0.2271 | 0.90 | 0.1828 |
| 2066 | 6% | 4.3 | 0.1688 | -0.2272 | 0.90 | 0.1829 |
| 2067 | 6% | 4.3 | 0.1688 | -0.2273 | 0.91 | 0.1831 |
| 2068 | 6% | 4.3 | 0.1688 | -0.2275 | 0.91 | 0.1832 |
| 2069 | 6% | 4.3 | 0.1688 | -0.2276 | 0.91 | 0.1833 |
| 2070 | 5% | 4.3 | 0.1688 | -0.2277 | 0.91 | 0.1834 |
| 2071 | 5% | 4.3 | 0.1688 | -0.2278 | 0.91 | 0.1835 |
| 2072 | 5% | 4.3 | 0.1688 | -0.2279 | 0.91 | 0.1836 |
| 2073 | 5% | 4.3 | 0.1688 | -0.2280 | 0.91 | 0.1837 |
| 2074 | 5% | 4.3 | 0.1688 | -0.2281 | 0.91 | 0.1838 |
| 2075 | 5% | 4.3 | 0.1688 | -0.2282 | 0.92 | 0.1839 |
| 2076 | 5% | 4.3 | 0.1688 | -0.2283 | 0.92 | 0.1840 |
| 2077 | 5% | 4.3 | 0.1688 | -0.2284 | 0.92 | 0.1841 |
| 2078 | 5% | 4.3 | 0.1688 | -0.2285 | 0.92 | 0.1841 |
| 2079 | 5% | 4.3 | 0.1688 | -0.2286 | 0.92 | 0.1842 |
| 2080 | 5% | 4.3 | 0.1688 | -0.2287 | 0.92 | 0.1843 |
| 2081 | 5% | 4.3 | 0.1688 | -0.2288 | 0.92 | 0.1844 |
| 2082 | 5% | 4.3 | 0.1688 | -0.2289 | 0.92 | 0.1845 |
| 2083 | 5% | 4.3 | 0.1688 | -0.2290 | 0.92 | 0.1845 |
| 2084 | 5% | 4.3 | 0.1688 | -0.2291 | 0.92 | 0.1846 |
| 2085 | 5% | 4.3 | 0.1688 | -0.2291 | 0.93 | 0.1847 |
| 2086 | 5% | 4.3 | 0.1688 | -0.2292 | 0.93 | 0.1848 |
| 2087 | 5% | 4.3 | 0.1688 | -0.2293 | 0.93 | 0.1848 |
| 2088 | 5% | 4.3 | 0.1688 | -0.2294 | 0.93 | 0.1849 |
| 2089 | 5% | 4.3 | 0.1688 | -0.2294 | 0.93 | 0.1850 |
| 2090 | 5% | 4.3 | 0.1688 | -0.2295 | 0.93 | 0.1850 |
| 2091 | 5% | 4.3 | 0.1688 | -0.2296 | 0.93 | 0.1851 |
| 2092 | 5% | 4.3 | 0.1688 | -0.2296 | 0.93 | 0.1851 |
| 2093 | 5% | 4.3 | 0.1688 | -0.2297 | 0.93 | 0.1852 |
| 2094 | 5% | 4.3 | 0.1688 | -0.2298 | 0.93 | 0.1853 |
| 2095 | 5% | 4.3 | 0.1688 | -0.2298 | 0.93 | 0.1853 |
| 2096 | 5% | 4.3 | 0.1688 | -0.2299 | 0.93 | 0.1854 |
| 2097 | 5% | 4.3 | 0.1688 | -0.2299 | 0.94 | 0.1854 |
| 2098 | 5% | 4.3 | 0.1688 | -0.2300 | 0.94 | 0.1855 |
| 2099 | 5% | 4.3 | 0.1688 | -0.2300 | 0.94 | 0.1855 |
| 2100 | 5% | 4.3 | 0.1688 | -0.2301 | 0.94 | 0.1856 |
| 2101 | 5% | 4.3 | 0.1688 | -0.2301 | 0.94 | 0.1856 |
| 2102 | 5% | 4.3 | 0.1688 | -0.2302 | 0.94 | 0.1857 |
| 2103 | 5% | 4.3 | 0.1688 | -0.2302 | 0.94 | 0.1857 |
| 2104 | 5% | 4.3 | 0.1688 | -0.2303 | 0.94 | 0.1858 |
| 2105 | 5% | 4.3 | 0.1688 | -0.2303 | 0.94 | 0.1858 |
| 2106 | 5% | 4.3 | 0.1688 | -0.2304 | 0.94 | 0.1858 |
| 2107 | 5% | 4.3 | 0.1688 | -0.2304 | 0.94 | 0.1859 |
| 2108 | 5% | 4.3 | 0.1688 | -0.2305 | 0.94 | 0.1859 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2109 | 5% | 4.3 | 0.1688 | -0.2305 | 0.94 | 0.1860 |
| 2110 | 5% | 4.3 | 0.1688 | -0.2306 | 0.94 | 0.1860 |
| 2111 | 5% | 4.3 | 0.1688 | -0.2306 | 0.94 | 0.1860 |
| 2112 | 5% | 4.3 | 0.1688 | -0.2306 | 0.94 | 0.1861 |
| 2113 | 5% | 4.3 | 0.1688 | -0.2307 | 0.94 | 0.1861 |
| 2114 | 5% | 4.3 | 0.1688 | -0.2307 | 0.94 | 0.1861 |
| 2115 | 5% | 4.3 | 0.1688 | -0.2307 | 0.94 | 0.1862 |
| 2116 | 5% | 4.3 | 0.1688 | -0.2308 | 0.95 | 0.1862 |
| 2117 | 5% | 4.3 | 0.1688 | -0.2308 | 0.95 | 0.1862 |
| 2118 | 5% | 4.3 | 0.1688 | -0.2308 | 0.95 | 0.1863 |
| 2119 | 5% | 4.3 | 0.1688 | -0.2309 | 0.95 | 0.1863 |
| 2120 | 5% | 4.3 | 0.1688 | -0.2309 | 0.95 | 0.1863 |
| 2121 | 5% | 4.3 | 0.1688 | -0.2309 | 0.95 | 0.1863 |
| 2122 | 5% | 4.3 | 0.1688 | -0.2310 | 0.95 | 0.1864 |
| 2123 | 5% | 4.3 | 0.1688 | -0.2310 | 0.95 | 0.1864 |
| 2124 | 5% | 4.3 | 0.1688 | -0.2310 | 0.95 | 0.1864 |
| 2125 | 5% | 4.3 | 0.1688 | -0.2311 | 0.95 | 0.1865 |
| 2126 | 5% | 4.3 | 0.1688 | -0.2311 | 0.95 | 0.1865 |
| 2127 | 5% | 4.3 | 0.1688 | -0.2311 | 0.95 | 0.1865 |
| 2128 | 5% | 4.3 | 0.1688 | -0.2311 | 0.95 | 0.1865 |
| 2129 | 5% | 4.3 | 0.1688 | -0.2312 | 0.95 | 0.1866 |
| 2130 | 5% | 4.3 | 0.1688 | -0.2312 | 0.95 | 0.1866 |
| 2131 | 5% | 4.3 | 0.1688 | -0.2312 | 0.95 | 0.1866 |
| 2132 | 5% | 4.3 | 0.1688 | -0.2312 | 0.95 | 0.1866 |
| 2133 | 5% | 4.3 | 0.1688 | -0.2312 | 0.95 | 0.1866 |
| 2134 | 5% | 4.3 | 0.1688 | -0.2313 | 0.95 | 0.1867 |
| 2135 | 5% | 4.3 | 0.1688 | -0.2313 | 0.95 | 0.1867 |
| 2136 | 5% | 4.3 | 0.1688 | -0.2313 | 0.95 | 0.1867 |
| 2137 | 5% | 4.3 | 0.1688 | -0.2313 | 0.95 | 0.1867 |
| 2138 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1867 |
| 2139 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1867 |
| 2140 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1868 |
| 2141 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1868 |
| 2142 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1868 |
| 2143 | 5% | 4.3 | 0.1688 | -0.2314 | 0.95 | 0.1868 |
| 2144 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1868 |
| 2145 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1868 |
| 2146 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1868 |
| 2147 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1869 |
| 2148 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1869 |
| 2149 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1869 |
| 2150 | 5% | 4.3 | 0.1688 | -0.2315 | 0.95 | 0.1869 |

### Table 8.5 VSD Soil Solution Output for the Lower Spruce-Fir Site, using the Current Deposition Scenario

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1945 | 11% | 4.6 | 0.1167 | -0.0472 | 0.06 | 0.0273 |
| 1946 | 11% | 4.6 | 0.1189 | -0.0470 | 0.06 | 0.0272 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1947 | 11% | 4.6 | 0.1212 | -0.0468 | 0.06 | 0.0270 |
| 1948 | 11% | 4.6 | 0.1236 | -0.0466 | 0.06 | 0.0269 |
| 1949 | 11% | 4.6 | 0.1259 | -0.0464 | 0.06 | 0.0268 |
| 1950 | 11% | 4.6 | 0.1282 | -0.0462 | 0.06 | 0.0266 |
| 1951 | 11% | 4.6 | 0.1329 | -0.0477 | 0.06 | 0.0277 |
| 1952 | 11% | 4.6 | 0.1378 | -0.0492 | 0.06 | 0.0288 |
| 1953 | 10% | 4.6 | 0.1426 | -0.0508 | 0.06 | 0.0300 |
| 1954 | 10% | 4.6 | 0.1474 | -0.0524 | 0.06 | 0.0312 |
| 1955 | 10% | 4.6 | 0.1523 | -0.0540 | 0.07 | 0.0324 |
| 1956 | 10% | 4.6 | 0.1571 | -0.0557 | 0.07 | 0.0337 |
| 1957 | 10% | 4.6 | 0.1619 | -0.0574 | 0.07 | 0.0350 |
| 1958 | 10% | 4.6 | 0.1668 | -0.0591 | 0.07 | 0.0363 |
| 1959 | 10% | 4.6 | 0.1716 | -0.0609 | 0.07 | 0.0377 |
| 1960 | 10% | 4.6 | 0.1764 | -0.0627 | 0.07 | 0.0391 |
| 1961 | 10% | 4.6 | 0.1789 | -0.0625 | 0.07 | 0.0389 |
| 1962 | 10% | 4.6 | 0.1812 | -0.0621 | 0.07 | 0.0386 |
| 1963 | 10% | 4.6 | 0.1835 | -0.0617 | 0.07 | 0.0383 |
| 1964 | 10% | 4.6 | 0.1858 | -0.0613 | 0.07 | 0.0380 |
| 1965 | 10% | 4.6 | 0.1880 | -0.0609 | 0.07 | 0.0377 |
| 1966 | 10% | 4.6 | 0.1927 | -0.0632 | 0.07 | 0.0395 |
| 1967 | 10% | 4.5 | 0.1976 | -0.0657 | 0.08 | 0.0415 |
| 1968 | 10% | 4.5 | 0.2025 | -0.0683 | 0.08 | 0.0435 |
| 1969 | 10% | 4.5 | 0.2074 | -0.0709 | 0.08 | 0.0456 |
| 1970 | 10% | 4.5 | 0.2123 | -0.0737 | 0.08 | 0.0478 |
| 1971 | 10% | 4.5 | 0.2171 | -0.0764 | 0.08 | 0.0501 |
| 1972 | 10% | 4.5 | 0.2220 | -0.0793 | 0.08 | 0.0524 |
| 1973 | 10% | 4.5 | 0.2269 | -0.0822 | 0.09 | 0.0548 |
| 1974 | 10% | 4.5 | 0.2317 | -0.0852 | 0.09 | 0.0573 |
| 1975 | 9% | 4.5 | 0.2366 | -0.0883 | 0.09 | 0.0598 |
| 1976 | 9% | 4.5 | 0.2356 | -0.0884 | 0.09 | 0.0599 |
| 1977 | 9% | 4.5 | 0.2342 | -0.0884 | 0.09 | 0.0599 |
| 1978 | 9% | 4.5 | 0.2329 | -0.0883 | 0.09 | 0.0598 |
| 1979 | 9% | 4.5 | 0.2316 | -0.0882 | 0.09 | 0.0597 |
| 1980 | 9% | 4.5 | 0.2301 | -0.0880 | 0.09 | 0.0596 |
| 1981 | 9% | 4.5 | 0.2288 | -0.0879 | 0.09 | 0.0595 |
| 1982 | 9% | 4.5 | 0.2274 | -0.0877 | 0.09 | 0.0593 |
| 1983 | 9% | 4.5 | 0.2261 | -0.0875 | 0.10 | 0.0592 |
| 1984 | 9% | 4.5 | 0.2248 | -0.0873 | 0.10 | 0.0590 |
| 1985 | 9% | 4.5 | 0.2233 | -0.0871 | 0.10 | 0.0588 |
| 1986 | 9% | 4.5 | 0.2240 | -0.0878 | 0.10 | 0.0594 |
| 1987 | 9% | 4.5 | 0.2250 | -0.0886 | 0.10 | 0.0601 |
| 1988 | 9% | 4.5 | 0.2259 | -0.0894 | 0.10 | 0.0607 |
| 1989 | 9% | 4.5 | 0.2268 | -0.0902 | 0.10 | 0.0614 |
| 1990 | 9% | 4.5 | 0.2276 | -0.0910 | 0.10 | 0.0621 |
| 1991 | 8% | 4.5 | 0.2236 | -0.0889 | 0.10 | 0.0603 |
| 1992 | 8% | 4.5 | 0.2192 | -0.0865 | 0.10 | 0.0584 |
| 1993 | 8% | 4.5 | 0.2148 | -0.0841 | 0.10 | 0.0564 |
| 1994 | 8% | 4.5 | 0.2104 | -0.0817 | 0.10 | 0.0544 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1995 | 8% | 4.5 | 0.2060 | -0.0792 | 0.10 | 0.0523 |
| 1996 | 8% | 4.5 | 0.2016 | -0.0767 | 0.10 | 0.0503 |
| 1997 | 8% | 4.5 | 0.1972 | -0.0741 | 0.10 | 0.0482 |
| 1998 | 8% | 4.5 | 0.1928 | -0.0716 | 0.10 | 0.0461 |
| 1999 | 8% | 4.5 | 0.1926 | -0.0709 | 0.10 | 0.0456 |
| 2000 | 8% | 4.5 | 0.1926 | -0.0711 | 0.10 | 0.0458 |
| 2001 | 8% | 4.5 | 0.1926 | -0.0714 | 0.10 | 0.0460 |
| 2002 | 8% | 4.5 | 0.1926 | -0.0717 | 0.10 | 0.0463 |
| 2003 | 8% | 4.5 | 0.1926 | -0.0720 | 0.10 | 0.0465 |
| 2004 | 8% | 4.5 | 0.1926 | -0.0723 | 0.10 | 0.0467 |
| 2005 | 8% | 4.5 | 0.1926 | -0.0726 | 0.10 | 0.0470 |
| 2006 | 8% | 4.5 | 0.1926 | -0.0729 | 0.10 | 0.0472 |
| 2007 | 8% | 4.5 | 0.1926 | -0.0732 | 0.10 | 0.0474 |
| 2008 | 8% | 4.5 | 0.1926 | -0.0735 | 0.10 | 0.0477 |
| 2009 | 8% | 4.5 | 0.1926 | -0.0738 | 0.10 | 0.0479 |
| 2010 | 8% | 4.5 | 0.1926 | -0.0741 | 0.10 | 0.0482 |
| 2011 | 8% | 4.5 | 0.1926 | -0.0744 | 0.10 | 0.0484 |
| 2012 | 8% | 4.5 | 0.1926 | -0.0747 | 0.10 | 0.0486 |
| 2013 | 8% | 4.5 | 0.1926 | -0.0750 | 0.10 | 0.0489 |
| 2014 | 8% | 4.5 | 0.1926 | -0.0752 | 0.11 | 0.0491 |
| 2015 | 8% | 4.5 | 0.1926 | -0.0755 | 0.11 | 0.0493 |
| 2016 | 8% | 4.5 | 0.1926 | -0.0758 | 0.11 | 0.0496 |
| 2017 | 8% | 4.5 | 0.1926 | -0.0761 | 0.11 | 0.0498 |
| 2018 | 8% | 4.5 | 0.1926 | -0.0764 | 0.11 | 0.0501 |
| 2019 | 8% | 4.5 | 0.1926 | -0.0767 | 0.11 | 0.0503 |
| 2020 | 8% | 4.5 | 0.1926 | -0.0770 | 0.11 | 0.0505 |
| 2021 | 7% | 4.5 | 0.1926 | -0.0773 | 0.11 | 0.0508 |
| 2022 | 7% | 4.5 | 0.1926 | -0.0776 | 0.11 | 0.0510 |
| 2023 | 7% | 4.5 | 0.1926 | -0.0779 | 0.11 | 0.0512 |
| 2024 | 7% | 4.5 | 0.1926 | -0.0782 | 0.11 | 0.0515 |
| 2025 | 7% | 4.5 | 0.1926 | -0.0785 | 0.11 | 0.0517 |
| 2026 | 7% | 4.5 | 0.1926 | -0.0787 | 0.11 | 0.0520 |
| 2027 | 7% | 4.5 | 0.1926 | -0.0790 | 0.11 | 0.0522 |
| 2028 | 7% | 4.5 | 0.1926 | -0.0793 | 0.11 | 0.0524 |
| 2029 | 7% | 4.5 | 0.1926 | -0.0796 | 0.11 | 0.0527 |
| 2030 | 7% | 4.5 | 0.1926 | -0.0799 | 0.12 | 0.0529 |
| 2031 | 7% | 4.5 | 0.1926 | -0.0802 | 0.12 | 0.0531 |
| 2032 | 7% | 4.5 | 0.1926 | -0.0805 | 0.12 | 0.0534 |
| 2033 | 7% | 4.5 | 0.1926 | -0.0808 | 0.12 | 0.0536 |
| 2034 | 7% | 4.5 | 0.1926 | -0.0810 | 0.12 | 0.0538 |
| 2035 | 7% | 4.5 | 0.1926 | -0.0813 | 0.12 | 0.0541 |
| 2036 | 7% | 4.5 | 0.1926 | -0.0816 | 0.12 | 0.0543 |
| 2037 | 7% | 4.5 | 0.1926 | -0.0819 | 0.12 | 0.0545 |
| 2038 | 7% | 4.5 | 0.1926 | -0.0822 | 0.12 | 0.0548 |
| 2039 | 7% | 4.5 | 0.1926 | -0.0825 | 0.12 | 0.0550 |
| 2040 | 7% | 4.5 | 0.1926 | -0.0827 | 0.12 | 0.0552 |
| 2041 | 7% | 4.5 | 0.1926 | -0.0830 | 0.12 | 0.0555 |
| 2042 | 7% | 4.5 | 0.1926 | -0.0833 | 0.12 | 0.0557 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2043 | 7% | 4.5 | 0.1926 | -0.0836 | 0.12 | 0.0559 |
| 2044 | 7% | 4.5 | 0.1926 | -0.0839 | 0.12 | 0.0562 |
| 2045 | 7% | 4.5 | 0.1926 | -0.0841 | 0.12 | 0.0564 |
| 2046 | 7% | 4.5 | 0.1926 | -0.0844 | 0.13 | 0.0566 |
| 2047 | 7% | 4.5 | 0.1926 | -0.0847 | 0.13 | 0.0568 |
| 2048 | 7% | 4.5 | 0.1926 | -0.0850 | 0.13 | 0.0571 |
| 2049 | 7% | 4.5 | 0.1926 | -0.0852 | 0.13 | 0.0573 |
| 2050 | 7% | 4.5 | 0.1926 | -0.0855 | 0.13 | 0.0575 |
| 2051 | 7% | 4.5 | 0.1926 | -0.0858 | 0.13 | 0.0577 |
| 2052 | 7% | 4.5 | 0.1926 | -0.0861 | 0.13 | 0.0580 |
| 2053 | 7% | 4.5 | 0.1926 | -0.0863 | 0.13 | 0.0582 |
| 2054 | 7% | 4.5 | 0.1926 | -0.0866 | 0.13 | 0.0584 |
| 2055 | 7% | 4.5 | 0.1926 | -0.0869 | 0.13 | 0.0586 |
| 2056 | 7% | 4.5 | 0.1926 | -0.0871 | 0.13 | 0.0589 |
| 2057 | 7% | 4.5 | 0.1926 | -0.0874 | 0.13 | 0.0591 |
| 2058 | 7% | 4.5 | 0.1926 | -0.0877 | 0.13 | 0.0593 |
| 2059 | 7% | 4.5 | 0.1926 | -0.0879 | 0.13 | 0.0595 |
| 2060 | 7% | 4.5 | 0.1926 | -0.0882 | 0.13 | 0.0597 |
| 2061 | 7% | 4.5 | 0.1926 | -0.0884 | 0.13 | 0.0599 |
| 2062 | 6% | 4.5 | 0.1926 | -0.0887 | 0.13 | 0.0602 |
| 2063 | 6% | 4.5 | 0.1926 | -0.0890 | 0.14 | 0.0604 |
| 2064 | 6% | 4.5 | 0.1926 | -0.0892 | 0.14 | 0.0606 |
| 2065 | 6% | 4.5 | 0.1926 | -0.0895 | 0.14 | 0.0608 |
| 2066 | 6% | 4.5 | 0.1926 | -0.0897 | 0.14 | 0.0610 |
| 2067 | 6% | 4.5 | 0.1926 | -0.0900 | 0.14 | 0.0612 |
| 2068 | 6% | 4.5 | 0.1926 | -0.0902 | 0.14 | 0.0614 |
| 2069 | 6% | 4.5 | 0.1926 | -0.0905 | 0.14 | 0.0616 |
| 2070 | 6% | 4.5 | 0.1926 | -0.0907 | 0.14 | 0.0619 |
| 2071 | 6% | 4.5 | 0.1926 | -0.0910 | 0.14 | 0.0621 |
| 2072 | 6% | 4.5 | 0.1926 | -0.0912 | 0.14 | 0.0623 |
| 2073 | 6% | 4.5 | 0.1926 | -0.0915 | 0.14 | 0.0625 |
| 2074 | 6% | 4.5 | 0.1926 | -0.0917 | 0.14 | 0.0627 |
| 2075 | 6% | 4.5 | 0.1926 | -0.0919 | 0.14 | 0.0629 |
| 2076 | 6% | 4.5 | 0.1926 | -0.0922 | 0.14 | 0.0631 |
| 2077 | 6% | 4.5 | 0.1926 | -0.0924 | 0.14 | 0.0633 |
| 2078 | 6% | 4.5 | 0.1926 | -0.0927 | 0.14 | 0.0635 |
| 2079 | 6% | 4.5 | 0.1926 | -0.0929 | 0.14 | 0.0637 |
| 2080 | 6% | 4.5 | 0.1926 | -0.0931 | 0.15 | 0.0639 |
| 2081 | 6% | 4.5 | 0.1926 | -0.0934 | 0.15 | 0.0641 |
| 2082 | 6% | 4.5 | 0.1926 | -0.0936 | 0.15 | 0.0643 |
| 2083 | 6% | 4.5 | 0.1926 | -0.0938 | 0.15 | 0.0645 |
| 2084 | 6% | 4.5 | 0.1926 | -0.0941 | 0.15 | 0.0646 |
| 2085 | 6% | 4.5 | 0.1926 | -0.0943 | 0.15 | 0.0648 |
| 2086 | 6% | 4.5 | 0.1926 | -0.0945 | 0.15 | 0.0650 |
| 2087 | 6% | 4.5 | 0.1926 | -0.0947 | 0.15 | 0.0652 |
| 2088 | 6% | 4.5 | 0.1926 | -0.0950 | 0.15 | 0.0654 |
| 2089 | 6% | 4.5 | 0.1926 | -0.0952 | 0.15 | 0.0656 |
| 2090 | 6% | 4.5 | 0.1926 | -0.0954 | 0.15 | 0.0658 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2091 | 6% | 4.5 | 0.1926 | -0.0956 | 0.15 | 0.0660 |
| 2092 | 6% | 4.5 | 0.1926 | -0.0958 | 0.15 | 0.0661 |
| 2093 | 6% | 4.5 | 0.1926 | -0.0961 | 0.15 | 0.0663 |
| 2094 | 6% | 4.5 | 0.1926 | -0.0963 | 0.15 | 0.0665 |
| 2095 | 6% | 4.5 | 0.1926 | -0.0965 | 0.15 | 0.0667 |
| 2096 | 6% | 4.5 | 0.1926 | -0.0967 | 0.15 | 0.0669 |
| 2097 | 6% | 4.5 | 0.1926 | -0.0969 | 0.15 | 0.0670 |
| 2098 | 6% | 4.5 | 0.1926 | -0.0971 | 0.16 | 0.0672 |
| 2099 | 6% | 4.5 | 0.1926 | -0.0973 | 0.16 | 0.0674 |
| 2100 | 6% | 4.5 | 0.1926 | -0.0975 | 0.16 | 0.0676 |
| 2101 | 6% | 4.5 | 0.1926 | -0.0977 | 0.16 | 0.0677 |
| 2102 | 6% | 4.5 | 0.1926 | -0.0979 | 0.16 | 0.0679 |
| 2103 | 6% | 4.5 | 0.1926 | -0.0981 | 0.16 | 0.0681 |
| 2104 | 6% | 4.5 | 0.1926 | -0.0983 | 0.16 | 0.0682 |
| 2105 | 6% | 4.5 | 0.1926 | -0.0985 | 0.16 | 0.0684 |
| 2106 | 6% | 4.5 | 0.1926 | -0.0987 | 0.16 | 0.0686 |
| 2107 | 6% | 4.5 | 0.1926 | -0.0989 | 0.16 | 0.0687 |
| 2108 | 6% | 4.5 | 0.1926 | -0.0991 | 0.16 | 0.0689 |
| 2109 | 6% | 4.5 | 0.1926 | -0.0993 | 0.16 | 0.0691 |
| 2110 | 6% | 4.5 | 0.1926 | -0.0995 | 0.16 | 0.0692 |
| 2111 | 6% | 4.5 | 0.1926 | -0.0997 | 0.16 | 0.0694 |
| 2112 | 6% | 4.5 | 0.1926 | -0.0998 | 0.16 | 0.0695 |
| 2113 | 6% | 4.5 | 0.1926 | -0.1000 | 0.16 | 0.0697 |
| 2114 | 6% | 4.5 | 0.1926 | -0.1002 | 0.16 | 0.0698 |
| 2115 | 6% | 4.5 | 0.1926 | -0.1004 | 0.16 | 0.0700 |
| 2116 | 6% | 4.5 | 0.1926 | -0.1006 | 0.16 | 0.0701 |
| 2117 | 6% | 4.5 | 0.1926 | -0.1007 | 0.16 | 0.0703 |
| 2118 | 6% | 4.5 | 0.1926 | -0.1009 | 0.16 | 0.0704 |
| 2119 | 6% | 4.5 | 0.1926 | -0.1011 | 0.17 | 0.0706 |
| 2120 | 6% | 4.5 | 0.1926 | -0.1013 | 0.17 | 0.0707 |
| 2121 | 6% | 4.5 | 0.1926 | -0.1014 | 0.17 | 0.0709 |
| 2122 | 6% | 4.5 | 0.1926 | -0.1016 | 0.17 | 0.0710 |
| 2123 | 6% | 4.5 | 0.1926 | -0.1018 | 0.17 | 0.0712 |
| 2124 | 6% | 4.5 | 0.1926 | -0.1019 | 0.17 | 0.0713 |
| 2125 | 6% | 4.5 | 0.1926 | -0.1021 | 0.17 | 0.0714 |
| 2126 | 6% | 4.5 | 0.1926 | -0.1023 | 0.17 | 0.0716 |
| 2127 | 6% | 4.5 | 0.1926 | -0.1024 | 0.17 | 0.0717 |
| 2128 | 6% | 4.5 | 0.1926 | -0.1026 | 0.17 | 0.0719 |
| 2129 | 6% | 4.5 | 0.1926 | -0.1027 | 0.17 | 0.0720 |
| 2130 | 6% | 4.5 | 0.1926 | -0.1029 | 0.17 | 0.0721 |
| 2131 | 6% | 4.5 | 0.1926 | -0.1031 | 0.17 | 0.0723 |
| 2132 | 5% | 4.5 | 0.1926 | -0.1032 | 0.17 | 0.0724 |
| 2133 | 5% | 4.5 | 0.1926 | -0.1034 | 0.17 | 0.0725 |
| 2134 | 5% | 4.5 | 0.1926 | -0.1035 | 0.17 | 0.0726 |
| 2135 | 5% | 4.5 | 0.1926 | -0.1037 | 0.17 | 0.0728 |
| 2136 | 5% | 4.5 | 0.1926 | -0.1038 | 0.17 | 0.0729 |
| 2137 | 5% | 4.5 | 0.1926 | -0.1040 | 0.17 | 0.0730 |
| 2138 | 5% | 4.5 | 0.1926 | -0.1041 | 0.17 | 0.0731 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2139 | 5% | 4.5 | 0.1926 | -0.1042 | 0.17 | 0.0733 |
| 2140 | 5% | 4.5 | 0.1926 | -0.1044 | 0.17 | 0.0734 |
| 2141 | 5% | 4.5 | 0.1926 | -0.1045 | 0.17 | 0.0735 |
| 2142 | 5% | 4.5 | 0.1926 | -0.1047 | 0.17 | 0.0736 |
| 2143 | 5% | 4.5 | 0.1926 | -0.1048 | 0.17 | 0.0737 |
| 2144 | 5% | 4.5 | 0.1926 | -0.1049 | 0.18 | 0.0739 |
| 2145 | 5% | 4.5 | 0.1926 | -0.1051 | 0.18 | 0.0740 |
| 2146 | 5% | 4.5 | 0.1926 | -0.1052 | 0.18 | 0.0741 |
| 2147 | 5% | 4.5 | 0.1926 | -0.1053 | 0.18 | 0.0742 |
| 2148 | 5% | 4.5 | 0.1926 | -0.1055 | 0.18 | 0.0743 |
| 2149 | 5% | 4.5 | 0.1926 | -0.1056 | 0.18 | 0.0744 |
| 2150 | 5% | 4.5 | 0.1926 | -0.1057 | 0.18 | 0.0745 |

**Table 8.6 VSD Soil Solution Output for the Beech Gap Site, using the Current Deposition Scenario**

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1945 | 21% | 4.6 | 0.0588 | -0.0416 | 0.12 | 0.0233 |
| 1946 | 21% | 4.6 | 0.0598 | -0.0414 | 0.12 | 0.0232 |
| 1947 | 21% | 4.6 | 0.0609 | -0.0412 | 0.12 | 0.0230 |
| 1948 | 21% | 4.6 | 0.0621 | -0.0411 | 0.12 | 0.0229 |
| 1949 | 21% | 4.6 | 0.0633 | -0.0409 | 0.12 | 0.0228 |
| 1950 | 21% | 4.6 | 0.0645 | -0.0407 | 0.12 | 0.0227 |
| 1951 | 21% | 4.6 | 0.0668 | -0.0419 | 0.12 | 0.0235 |
| 1952 | 21% | 4.6 | 0.0692 | -0.0432 | 0.12 | 0.0244 |
| 1953 | 21% | 4.6 | 0.0716 | -0.0444 | 0.12 | 0.0253 |
| 1954 | 21% | 4.6 | 0.0740 | -0.0458 | 0.12 | 0.0263 |
| 1955 | 21% | 4.6 | 0.0764 | -0.0471 | 0.13 | 0.0272 |
| 1956 | 21% | 4.6 | 0.0789 | -0.0484 | 0.13 | 0.0282 |
| 1957 | 21% | 4.6 | 0.0813 | -0.0497 | 0.13 | 0.0292 |
| 1958 | 21% | 4.6 | 0.0837 | -0.0510 | 0.13 | 0.0302 |
| 1959 | 21% | 4.6 | 0.0861 | -0.0524 | 0.13 | 0.0312 |
| 1960 | 21% | 4.6 | 0.0885 | -0.0537 | 0.13 | 0.0322 |
| 1961 | 21% | 4.6 | 0.0897 | -0.0533 | 0.13 | 0.0319 |
| 1962 | 21% | 4.6 | 0.0909 | -0.0528 | 0.13 | 0.0315 |
| 1963 | 21% | 4.6 | 0.0921 | -0.0524 | 0.13 | 0.0312 |
| 1964 | 21% | 4.6 | 0.0932 | -0.0518 | 0.13 | 0.0308 |
| 1965 | 21% | 4.6 | 0.0944 | -0.0514 | 0.13 | 0.0304 |
| 1966 | 21% | 4.6 | 0.0967 | -0.0530 | 0.13 | 0.0316 |
| 1967 | 21% | 4.6 | 0.0991 | -0.0548 | 0.14 | 0.0330 |
| 1968 | 21% | 4.6 | 0.1015 | -0.0566 | 0.14 | 0.0344 |
| 1969 | 21% | 4.6 | 0.1040 | -0.0584 | 0.14 | 0.0358 |
| 1970 | 21% | 4.6 | 0.1064 | -0.0603 | 0.14 | 0.0372 |
| 1971 | 21% | 4.6 | 0.1088 | -0.0621 | 0.14 | 0.0387 |
| 1972 | 21% | 4.5 | 0.1113 | -0.0640 | 0.15 | 0.0401 |
| 1973 | 21% | 4.5 | 0.1137 | -0.0659 | 0.15 | 0.0416 |
| 1974 | 21% | 4.5 | 0.1162 | -0.0678 | 0.15 | 0.0431 |
| 1975 | 21% | 4.5 | 0.1186 | -0.0697 | 0.15 | 0.0447 |
| 1976 | 21% | 4.5 | 0.1181 | -0.0694 | 0.15 | 0.0444 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1977 | 21% | 4.5 | 0.1174 | -0.0689 | 0.15 | 0.0440 |
| 1978 | 21% | 4.5 | 0.1168 | -0.0684 | 0.15 | 0.0436 |
| 1979 | 21% | 4.5 | 0.1161 | -0.0679 | 0.15 | 0.0432 |
| 1980 | 21% | 4.5 | 0.1154 | -0.0674 | 0.15 | 0.0428 |
| 1981 | 21% | 4.5 | 0.1147 | -0.0669 | 0.15 | 0.0424 |
| 1982 | 21% | 4.5 | 0.1140 | -0.0664 | 0.15 | 0.0420 |
| 1983 | 21% | 4.5 | 0.1134 | -0.0659 | 0.15 | 0.0416 |
| 1984 | 21% | 4.5 | 0.1127 | -0.0653 | 0.15 | 0.0412 |
| 1985 | 21% | 4.5 | 0.1120 | -0.0648 | 0.15 | 0.0408 |
| 1986 | 21% | 4.5 | 0.1124 | -0.0649 | 0.15 | 0.0409 |
| 1987 | 21% | 4.5 | 0.1128 | -0.0651 | 0.15 | 0.0410 |
| 1988 | 21% | 4.5 | 0.1133 | -0.0653 | 0.15 | 0.0412 |
| 1989 | 21% | 4.5 | 0.1138 | -0.0655 | 0.15 | 0.0413 |
| 1990 | 21% | 4.5 | 0.1142 | -0.0657 | 0.15 | 0.0415 |
| 1991 | 20% | 4.5 | 0.1122 | -0.0639 | 0.15 | 0.0400 |
| 1992 | 20% | 4.6 | 0.1100 | -0.0619 | 0.15 | 0.0385 |
| 1993 | 20% | 4.6 | 0.1078 | -0.0600 | 0.15 | 0.0370 |
| 1994 | 20% | 4.6 | 0.1056 | -0.0580 | 0.14 | 0.0355 |
| 1995 | 20% | 4.6 | 0.1034 | -0.0561 | 0.14 | 0.0340 |
| 1996 | 20% | 4.6 | 0.1012 | -0.0541 | 0.14 | 0.0325 |
| 1997 | 20% | 4.6 | 0.0990 | -0.0522 | 0.14 | 0.0310 |
| 1998 | 20% | 4.6 | 0.0968 | -0.0503 | 0.14 | 0.0296 |
| 1999 | 20% | 4.6 | 0.0967 | -0.0496 | 0.13 | 0.0291 |
| 2000 | 20% | 4.6 | 0.0966 | -0.0496 | 0.13 | 0.0291 |
| 2001 | 20% | 4.6 | 0.0966 | -0.0496 | 0.14 | 0.0291 |
| 2002 | 20% | 4.6 | 0.0966 | -0.0497 | 0.14 | 0.0292 |
| 2003 | 20% | 4.6 | 0.0966 | -0.0497 | 0.14 | 0.0292 |
| 2004 | 20% | 4.6 | 0.0966 | -0.0497 | 0.14 | 0.0292 |
| 2005 | 20% | 4.6 | 0.0966 | -0.0498 | 0.14 | 0.0292 |
| 2006 | 20% | 4.6 | 0.0966 | -0.0498 | 0.14 | 0.0293 |
| 2007 | 20% | 4.6 | 0.0966 | -0.0499 | 0.14 | 0.0293 |
| 2008 | 20% | 4.6 | 0.0966 | -0.0499 | 0.14 | 0.0293 |
| 2009 | 20% | 4.6 | 0.0966 | -0.0499 | 0.14 | 0.0293 |
| 2010 | 20% | 4.6 | 0.0966 | -0.0500 | 0.14 | 0.0294 |
| 2011 | 20% | 4.6 | 0.0966 | -0.0500 | 0.14 | 0.0294 |
| 2012 | 20% | 4.6 | 0.0966 | -0.0500 | 0.14 | 0.0294 |
| 2013 | 20% | 4.6 | 0.0966 | -0.0501 | 0.14 | 0.0295 |
| 2014 | 20% | 4.6 | 0.0966 | -0.0501 | 0.14 | 0.0295 |
| 2015 | 20% | 4.6 | 0.0966 | -0.0501 | 0.14 | 0.0295 |
| 2016 | 20% | 4.6 | 0.0966 | -0.0502 | 0.14 | 0.0295 |
| 2017 | 20% | 4.6 | 0.0966 | -0.0502 | 0.14 | 0.0296 |
| 2018 | 20% | 4.6 | 0.0966 | -0.0503 | 0.14 | 0.0296 |
| 2019 | 20% | 4.6 | 0.0966 | -0.0503 | 0.14 | 0.0296 |
| 2020 | 20% | 4.6 | 0.0966 | -0.0503 | 0.14 | 0.0296 |
| 2021 | 20% | 4.6 | 0.0966 | -0.0504 | 0.14 | 0.0297 |
| 2022 | 20% | 4.6 | 0.0966 | -0.0504 | 0.14 | 0.0297 |
| 2023 | 20% | 4.6 | 0.0966 | -0.0504 | 0.14 | 0.0297 |
| 2024 | 20% | 4.6 | 0.0966 | -0.0505 | 0.14 | 0.0298 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2025 | 20% | 4.6 | 0.0966 | -0.0505 | 0.14 | 0.0298 |
| 2026 | 20% | 4.6 | 0.0966 | -0.0506 | 0.14 | 0.0298 |
| 2027 | 20% | 4.6 | 0.0966 | -0.0506 | 0.14 | 0.0298 |
| 2028 | 20% | 4.6 | 0.0966 | -0.0506 | 0.14 | 0.0299 |
| 2029 | 20% | 4.6 | 0.0966 | -0.0507 | 0.14 | 0.0299 |
| 2030 | 20% | 4.6 | 0.0966 | -0.0507 | 0.14 | 0.0299 |
| 2031 | 20% | 4.6 | 0.0966 | -0.0507 | 0.14 | 0.0299 |
| 2032 | 20% | 4.6 | 0.0966 | -0.0508 | 0.14 | 0.0300 |
| 2033 | 20% | 4.6 | 0.0966 | -0.0508 | 0.14 | 0.0300 |
| 2034 | 20% | 4.6 | 0.0966 | -0.0508 | 0.14 | 0.0300 |
| 2035 | 20% | 4.6 | 0.0966 | -0.0509 | 0.14 | 0.0301 |
| 2036 | 20% | 4.6 | 0.0966 | -0.0509 | 0.14 | 0.0301 |
| 2037 | 20% | 4.6 | 0.0966 | -0.0510 | 0.14 | 0.0301 |
| 2038 | 20% | 4.6 | 0.0966 | -0.0510 | 0.14 | 0.0301 |
| 2039 | 20% | 4.6 | 0.0966 | -0.0510 | 0.14 | 0.0302 |
| 2040 | 20% | 4.6 | 0.0966 | -0.0511 | 0.14 | 0.0302 |
| 2041 | 20% | 4.6 | 0.0966 | -0.0511 | 0.14 | 0.0302 |
| 2042 | 20% | 4.6 | 0.0966 | -0.0511 | 0.14 | 0.0302 |
| 2043 | 20% | 4.6 | 0.0966 | -0.0512 | 0.14 | 0.0303 |
| 2044 | 20% | 4.6 | 0.0966 | -0.0512 | 0.14 | 0.0303 |
| 2045 | 20% | 4.6 | 0.0966 | -0.0512 | 0.14 | 0.0303 |
| 2046 | 20% | 4.6 | 0.0966 | -0.0513 | 0.14 | 0.0304 |
| 2047 | 20% | 4.6 | 0.0966 | -0.0513 | 0.14 | 0.0304 |
| 2048 | 20% | 4.6 | 0.0966 | -0.0514 | 0.14 | 0.0304 |
| 2049 | 20% | 4.6 | 0.0966 | -0.0514 | 0.14 | 0.0304 |
| 2050 | 20% | 4.6 | 0.0966 | -0.0514 | 0.14 | 0.0305 |
| 2051 | 20% | 4.6 | 0.0966 | -0.0515 | 0.14 | 0.0305 |
| 2052 | 20% | 4.6 | 0.0966 | -0.0515 | 0.14 | 0.0305 |
| 2053 | 20% | 4.6 | 0.0966 | -0.0515 | 0.14 | 0.0305 |
| 2054 | 20% | 4.6 | 0.0966 | -0.0516 | 0.14 | 0.0306 |
| 2055 | 20% | 4.6 | 0.0966 | -0.0516 | 0.14 | 0.0306 |
| 2056 | 20% | 4.6 | 0.0966 | -0.0516 | 0.14 | 0.0306 |
| 2057 | 20% | 4.6 | 0.0966 | -0.0517 | 0.14 | 0.0306 |
| 2058 | 19% | 4.6 | 0.0966 | -0.0517 | 0.14 | 0.0307 |
| 2059 | 19% | 4.6 | 0.0966 | -0.0517 | 0.14 | 0.0307 |
| 2060 | 19% | 4.6 | 0.0966 | -0.0518 | 0.14 | 0.0307 |
| 2061 | 19% | 4.6 | 0.0966 | -0.0518 | 0.14 | 0.0308 |
| 2062 | 19% | 4.6 | 0.0966 | -0.0519 | 0.15 | 0.0308 |
| 2063 | 19% | 4.6 | 0.0966 | -0.0519 | 0.15 | 0.0308 |
| 2064 | 19% | 4.6 | 0.0966 | -0.0519 | 0.15 | 0.0308 |
| 2065 | 19% | 4.6 | 0.0966 | -0.0520 | 0.15 | 0.0309 |
| 2066 | 19% | 4.6 | 0.0966 | -0.0520 | 0.15 | 0.0309 |
| 2067 | 19% | 4.6 | 0.0966 | -0.0520 | 0.15 | 0.0309 |
| 2068 | 19% | 4.6 | 0.0966 | -0.0521 | 0.15 | 0.0309 |
| 2069 | 19% | 4.6 | 0.0966 | -0.0521 | 0.15 | 0.0310 |
| 2070 | 19% | 4.6 | 0.0966 | -0.0521 | 0.15 | 0.0310 |
| 2071 | 19% | 4.6 | 0.0966 | -0.0522 | 0.15 | 0.0310 |
| 2072 | 19% | 4.6 | 0.0966 | -0.0522 | 0.15 | 0.0311 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2073 | 19% | 4.6 | 0.0966 | -0.0522 | 0.15 | 0.0311 |
| 2074 | 19% | 4.6 | 0.0966 | -0.0523 | 0.15 | 0.0311 |
| 2075 | 19% | 4.6 | 0.0966 | -0.0523 | 0.15 | 0.0311 |
| 2076 | 19% | 4.6 | 0.0966 | -0.0524 | 0.15 | 0.0312 |
| 2077 | 19% | 4.6 | 0.0966 | -0.0524 | 0.15 | 0.0312 |
| 2078 | 19% | 4.6 | 0.0966 | -0.0524 | 0.15 | 0.0312 |
| 2079 | 19% | 4.6 | 0.0966 | -0.0525 | 0.15 | 0.0312 |
| 2080 | 19% | 4.6 | 0.0966 | -0.0525 | 0.15 | 0.0313 |
| 2081 | 19% | 4.6 | 0.0966 | -0.0525 | 0.15 | 0.0313 |
| 2082 | 19% | 4.6 | 0.0966 | -0.0526 | 0.15 | 0.0313 |
| 2083 | 19% | 4.6 | 0.0966 | -0.0526 | 0.15 | 0.0313 |
| 2084 | 19% | 4.6 | 0.0966 | -0.0526 | 0.15 | 0.0314 |
| 2085 | 19% | 4.6 | 0.0966 | -0.0527 | 0.15 | 0.0314 |
| 2086 | 19% | 4.6 | 0.0966 | -0.0527 | 0.15 | 0.0314 |
| 2087 | 19% | 4.6 | 0.0966 | -0.0527 | 0.15 | 0.0315 |
| 2088 | 19% | 4.6 | 0.0966 | -0.0528 | 0.15 | 0.0315 |
| 2089 | 19% | 4.6 | 0.0966 | -0.0528 | 0.15 | 0.0315 |
| 2090 | 19% | 4.6 | 0.0966 | -0.0529 | 0.15 | 0.0315 |
| 2091 | 19% | 4.6 | 0.0966 | -0.0529 | 0.15 | 0.0316 |
| 2092 | 19% | 4.6 | 0.0966 | -0.0529 | 0.15 | 0.0316 |
| 2093 | 19% | 4.6 | 0.0966 | -0.0530 | 0.15 | 0.0316 |
| 2094 | 19% | 4.6 | 0.0966 | -0.0530 | 0.15 | 0.0316 |
| 2095 | 19% | 4.6 | 0.0966 | -0.0530 | 0.15 | 0.0317 |
| 2096 | 19% | 4.6 | 0.0966 | -0.0531 | 0.15 | 0.0317 |
| 2097 | 19% | 4.6 | 0.0966 | -0.0531 | 0.15 | 0.0317 |
| 2098 | 19% | 4.6 | 0.0966 | -0.0531 | 0.15 | 0.0317 |
| 2099 | 19% | 4.6 | 0.0966 | -0.0532 | 0.15 | 0.0318 |
| 2100 | 19% | 4.6 | 0.0966 | -0.0532 | 0.15 | 0.0318 |
| 2101 | 19% | 4.6 | 0.0966 | -0.0532 | 0.15 | 0.0318 |
| 2102 | 19% | 4.6 | 0.0966 | -0.0533 | 0.15 | 0.0319 |
| 2103 | 19% | 4.6 | 0.0966 | -0.0533 | 0.15 | 0.0319 |
| 2104 | 19% | 4.6 | 0.0966 | -0.0533 | 0.15 | 0.0319 |
| 2105 | 19% | 4.6 | 0.0966 | -0.0534 | 0.15 | 0.0319 |
| 2106 | 19% | 4.6 | 0.0966 | -0.0534 | 0.15 | 0.0320 |
| 2107 | 19% | 4.6 | 0.0966 | -0.0534 | 0.15 | 0.0320 |
| 2108 | 19% | 4.6 | 0.0966 | -0.0535 | 0.15 | 0.0320 |
| 2109 | 19% | 4.6 | 0.0966 | -0.0535 | 0.15 | 0.0320 |
| 2110 | 19% | 4.6 | 0.0966 | -0.0536 | 0.15 | 0.0321 |
| 2111 | 19% | 4.6 | 0.0966 | -0.0536 | 0.15 | 0.0321 |
| 2112 | 19% | 4.6 | 0.0966 | -0.0536 | 0.15 | 0.0321 |
| 2113 | 19% | 4.6 | 0.0966 | -0.0537 | 0.15 | 0.0321 |
| 2114 | 19% | 4.6 | 0.0966 | -0.0537 | 0.15 | 0.0322 |
| 2115 | 19% | 4.6 | 0.0966 | -0.0537 | 0.15 | 0.0322 |
| 2116 | 19% | 4.6 | 0.0966 | -0.0538 | 0.15 | 0.0322 |
| 2117 | 19% | 4.6 | 0.0966 | -0.0538 | 0.15 | 0.0322 |
| 2118 | 19% | 4.6 | 0.0966 | -0.0538 | 0.15 | 0.0323 |
| 2119 | 19% | 4.6 | 0.0966 | -0.0539 | 0.15 | 0.0323 |
| 2120 | 19% | 4.6 | 0.0966 | -0.0539 | 0.15 | 0.0323 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2121 | 19% | 4.6 | 0.0966 | -0.0539 | 0.15 | 0.0324 |
| 2122 | 19% | 4.6 | 0.0966 | -0.0540 | 0.15 | 0.0324 |
| 2123 | 19% | 4.6 | 0.0966 | -0.0540 | 0.16 | 0.0324 |
| 2124 | 19% | 4.6 | 0.0966 | -0.0540 | 0.16 | 0.0324 |
| 2125 | 19% | 4.6 | 0.0966 | -0.0541 | 0.16 | 0.0325 |
| 2126 | 19% | 4.6 | 0.0966 | -0.0541 | 0.16 | 0.0325 |
| 2127 | 19% | 4.6 | 0.0966 | -0.0541 | 0.16 | 0.0325 |
| 2128 | 19% | 4.6 | 0.0966 | -0.0542 | 0.16 | 0.0325 |
| 2129 | 19% | 4.6 | 0.0966 | -0.0542 | 0.16 | 0.0326 |
| 2130 | 19% | 4.6 | 0.0966 | -0.0542 | 0.16 | 0.0326 |
| 2131 | 19% | 4.6 | 0.0966 | -0.0543 | 0.16 | 0.0326 |
| 2132 | 19% | 4.6 | 0.0966 | -0.0543 | 0.16 | 0.0326 |
| 2133 | 19% | 4.6 | 0.0966 | -0.0544 | 0.16 | 0.0327 |
| 2134 | 18% | 4.6 | 0.0966 | -0.0544 | 0.16 | 0.0327 |
| 2135 | 18% | 4.6 | 0.0966 | -0.0544 | 0.16 | 0.0327 |
| 2136 | 18% | 4.6 | 0.0966 | -0.0545 | 0.16 | 0.0327 |
| 2137 | 18% | 4.6 | 0.0966 | -0.0545 | 0.16 | 0.0328 |
| 2138 | 18% | 4.6 | 0.0966 | -0.0545 | 0.16 | 0.0328 |
| 2139 | 18% | 4.6 | 0.0966 | -0.0546 | 0.16 | 0.0328 |
| 2140 | 18% | 4.6 | 0.0966 | -0.0546 | 0.16 | 0.0328 |
| 2141 | 18% | 4.6 | 0.0966 | -0.0546 | 0.16 | 0.0329 |
| 2142 | 18% | 4.6 | 0.0966 | -0.0547 | 0.16 | 0.0329 |
| 2143 | 18% | 4.6 | 0.0966 | -0.0547 | 0.16 | 0.0329 |
| 2144 | 18% | 4.6 | 0.0966 | -0.0547 | 0.16 | 0.0330 |
| 2145 | 18% | 4.6 | 0.0966 | -0.0548 | 0.16 | 0.0330 |
| 2146 | 18% | 4.6 | 0.0966 | -0.0548 | 0.16 | 0.0330 |
| 2147 | 18% | 4.6 | 0.0966 | -0.0548 | 0.16 | 0.0330 |
| 2148 | 18% | 4.6 | 0.0966 | -0.0549 | 0.16 | 0.0331 |
| 2149 | 18% | 4.6 | 0.0966 | -0.0549 | 0.16 | 0.0331 |
| 2150 | 18% | 4.6 | 0.0966 | -0.0549 | 0.16 | 0.0331 |

## Table 8.7 VSD Soil Solution Output for the Mixed Hardwood Site, using the Current Deposition Scenario

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1945 | 12% | 4.8 | 0.0408 | -0.0114 | 0.03 | 0.0055 |
| 1946 | 12% | 4.8 | 0.0416 | -0.0113 | 0.03 | 0.0054 |
| 1947 | 12% | 4.8 | 0.0424 | -0.0112 | 0.03 | 0.0054 |
| 1948 | 12% | 4.8 | 0.0434 | -0.0111 | 0.03 | 0.0053 |
| 1949 | 12% | 4.8 | 0.0442 | -0.0110 | 0.03 | 0.0053 |
| 1950 | 12% | 4.8 | 0.0451 | -0.0109 | 0.03 | 0.0053 |
| 1951 | 12% | 4.8 | 0.0468 | -0.0113 | 0.03 | 0.0054 |
| 1952 | 12% | 4.8 | 0.0485 | -0.0118 | 0.03 | 0.0056 |
| 1953 | 12% | 4.8 | 0.0504 | -0.0124 | 0.03 | 0.0059 |
| 1954 | 12% | 4.8 | 0.0521 | -0.0128 | 0.03 | 0.0061 |
| 1955 | 12% | 4.8 | 0.0538 | -0.0133 | 0.03 | 0.0063 |
| 1956 | 12% | 4.8 | 0.0557 | -0.0139 | 0.03 | 0.0065 |
| 1957 | 12% | 4.8 | 0.0574 | -0.0143 | 0.03 | 0.0068 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 1958 | 12% | 4.8 | 0.0591 | -0.0148 | 0.03 | 0.0070 |
| 1959 | 12% | 4.8 | 0.0610 | -0.0154 | 0.03 | 0.0072 |
| 1960 | 12% | 4.8 | 0.0628 | -0.0159 | 0.03 | 0.0075 |
| 1961 | 12% | 4.8 | 0.0637 | -0.0157 | 0.03 | 0.0074 |
| 1962 | 12% | 4.8 | 0.0646 | -0.0156 | 0.03 | 0.0073 |
| 1963 | 12% | 4.8 | 0.0654 | -0.0153 | 0.03 | 0.0072 |
| 1964 | 12% | 4.8 | 0.0663 | -0.0151 | 0.03 | 0.0071 |
| 1965 | 12% | 4.8 | 0.0671 | -0.0149 | 0.03 | 0.0070 |
| 1966 | 12% | 4.8 | 0.0688 | -0.0155 | 0.03 | 0.0073 |
| 1967 | 12% | 4.8 | 0.0706 | -0.0162 | 0.03 | 0.0076 |
| 1968 | 12% | 4.8 | 0.0724 | -0.0169 | 0.03 | 0.0080 |
| 1969 | 12% | 4.8 | 0.0741 | -0.0176 | 0.03 | 0.0083 |
| 1970 | 12% | 4.8 | 0.0760 | -0.0183 | 0.03 | 0.0087 |
| 1971 | 12% | 4.8 | 0.0777 | -0.0190 | 0.03 | 0.0091 |
| 1972 | 12% | 4.8 | 0.0796 | -0.0197 | 0.04 | 0.0094 |
| 1973 | 12% | 4.8 | 0.0814 | -0.0205 | 0.04 | 0.0098 |
| 1974 | 12% | 4.7 | 0.0832 | -0.0212 | 0.04 | 0.0102 |
| 1975 | 12% | 4.7 | 0.0850 | -0.0219 | 0.04 | 0.0107 |
| 1976 | 12% | 4.7 | 0.0847 | -0.0219 | 0.04 | 0.0106 |
| 1977 | 12% | 4.7 | 0.0843 | -0.0218 | 0.04 | 0.0106 |
| 1978 | 12% | 4.7 | 0.0838 | -0.0217 | 0.04 | 0.0105 |
| 1979 | 12% | 4.7 | 0.0833 | -0.0215 | 0.04 | 0.0104 |
| 1980 | 12% | 4.7 | 0.0828 | -0.0214 | 0.04 | 0.0104 |
| 1981 | 12% | 4.7 | 0.0823 | -0.0213 | 0.04 | 0.0103 |
| 1982 | 12% | 4.7 | 0.0819 | -0.0212 | 0.04 | 0.0102 |
| 1983 | 12% | 4.7 | 0.0815 | -0.0210 | 0.04 | 0.0101 |
| 1984 | 12% | 4.7 | 0.0810 | -0.0209 | 0.04 | 0.0101 |
| 1985 | 12% | 4.8 | 0.0804 | -0.0207 | 0.04 | 0.0100 |
| 1986 | 12% | 4.7 | 0.0807 | -0.0208 | 0.04 | 0.0100 |
| 1987 | 12% | 4.7 | 0.0811 | -0.0209 | 0.04 | 0.0101 |
| 1988 | 11% | 4.7 | 0.0814 | -0.0210 | 0.04 | 0.0101 |
| 1989 | 11% | 4.7 | 0.0817 | -0.0211 | 0.04 | 0.0102 |
| 1990 | 11% | 4.7 | 0.0820 | -0.0212 | 0.04 | 0.0102 |
| 1991 | 11% | 4.8 | 0.0806 | -0.0206 | 0.04 | 0.0099 |
| 1992 | 11% | 4.8 | 0.0790 | -0.0199 | 0.04 | 0.0095 |
| 1993 | 11% | 4.8 | 0.0775 | -0.0192 | 0.04 | 0.0092 |
| 1994 | 11% | 4.8 | 0.0759 | -0.0185 | 0.04 | 0.0088 |
| 1995 | 11% | 4.8 | 0.0743 | -0.0178 | 0.04 | 0.0084 |
| 1996 | 11% | 4.8 | 0.0727 | -0.0170 | 0.04 | 0.0080 |
| 1997 | 11% | 4.8 | 0.0710 | -0.0163 | 0.04 | 0.0077 |
| 1998 | 11% | 4.8 | 0.0694 | -0.0155 | 0.03 | 0.0073 |
| 1999 | 11% | 4.8 | 0.0693 | -0.0152 | 0.03 | 0.0072 |
| 2000 | 11% | 4.8 | 0.0693 | -0.0152 | 0.03 | 0.0072 |
| 2001 | 11% | 4.8 | 0.0693 | -0.0152 | 0.03 | 0.0072 |
| 2002 | 11% | 4.8 | 0.0693 | -0.0152 | 0.03 | 0.0072 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2003 | 11% | 4.8 | 0.0693 | -0.0153 | 0.03 | 0.0072 |
| 2004 | 11% | 4.8 | 0.0693 | -0.0153 | 0.03 | 0.0072 |
| 2005 | 11% | 4.8 | 0.0693 | -0.0153 | 0.03 | 0.0072 |
| 2006 | 11% | 4.8 | 0.0693 | -0.0153 | 0.03 | 0.0072 |
| 2007 | 11% | 4.8 | 0.0693 | -0.0153 | 0.03 | 0.0072 |
| 2008 | 11% | 4.8 | 0.0693 | -0.0154 | 0.03 | 0.0072 |
| 2009 | 11% | 4.8 | 0.0693 | -0.0154 | 0.03 | 0.0072 |
| 2010 | 11% | 4.8 | 0.0693 | -0.0154 | 0.03 | 0.0072 |
| 2011 | 11% | 4.8 | 0.0694 | -0.0154 | 0.04 | 0.0073 |
| 2012 | 11% | 4.8 | 0.0694 | -0.0154 | 0.04 | 0.0073 |
| 2013 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2014 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2015 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2016 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2017 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2018 | 11% | 4.8 | 0.0694 | -0.0155 | 0.04 | 0.0073 |
| 2019 | 11% | 4.8 | 0.0694 | -0.0156 | 0.04 | 0.0073 |
| 2020 | 11% | 4.8 | 0.0694 | -0.0156 | 0.04 | 0.0073 |
| 2021 | 11% | 4.8 | 0.0695 | -0.0156 | 0.04 | 0.0073 |
| 2022 | 11% | 4.8 | 0.0695 | -0.0156 | 0.04 | 0.0074 |
| 2023 | 11% | 4.8 | 0.0695 | -0.0156 | 0.04 | 0.0074 |
| 2024 | 11% | 4.8 | 0.0695 | -0.0157 | 0.04 | 0.0074 |
| 2025 | 11% | 4.8 | 0.0695 | -0.0157 | 0.04 | 0.0074 |
| 2026 | 11% | 4.8 | 0.0695 | -0.0157 | 0.04 | 0.0074 |
| 2027 | 11% | 4.8 | 0.0695 | -0.0157 | 0.04 | 0.0074 |
| 2028 | 11% | 4.8 | 0.0695 | -0.0157 | 0.04 | 0.0074 |
| 2029 | 11% | 4.8 | 0.0695 | -0.0158 | 0.04 | 0.0074 |
| 2030 | 11% | 4.8 | 0.0695 | -0.0158 | 0.04 | 0.0074 |
| 2031 | 11% | 4.8 | 0.0695 | -0.0158 | 0.04 | 0.0074 |
| 2032 | 11% | 4.8 | 0.0695 | -0.0158 | 0.04 | 0.0074 |
| 2033 | 11% | 4.8 | 0.0696 | -0.0158 | 0.04 | 0.0075 |
| 2034 | 11% | 4.8 | 0.0696 | -0.0159 | 0.04 | 0.0075 |
| 2035 | 11% | 4.8 | 0.0696 | -0.0159 | 0.04 | 0.0075 |
| 2036 | 11% | 4.8 | 0.0696 | -0.0159 | 0.04 | 0.0075 |
| 2037 | 11% | 4.8 | 0.0696 | -0.0159 | 0.04 | 0.0075 |
| 2038 | 11% | 4.8 | 0.0696 | -0.0159 | 0.04 | 0.0075 |
| 2039 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0075 |
| 2040 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0075 |
| 2041 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0075 |
| 2042 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0075 |
| 2043 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0075 |
| 2044 | 11% | 4.8 | 0.0696 | -0.0160 | 0.04 | 0.0076 |
| 2045 | 11% | 4.8 | 0.0697 | -0.0161 | 0.04 | 0.0076 |
| 2046 | 11% | 4.8 | 0.0697 | -0.0161 | 0.04 | 0.0076 |
| 2047 | 11% | 4.8 | 0.0697 | -0.0161 | 0.04 | 0.0076 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq m$^{-3}$) | [ANC] (eq m$^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq m$^{-3}$) |
|---|---|---|---|---|---|---|
| 2048 | 11% | 4.8 | 0.0697 | -0.0161 | 0.04 | 0.0076 |
| 2049 | 11% | 4.8 | 0.0697 | -0.0161 | 0.04 | 0.0076 |
| 2050 | 11% | 4.8 | 0.0697 | -0.0162 | 0.04 | 0.0076 |
| 2051 | 11% | 4.8 | 0.0697 | -0.0162 | 0.04 | 0.0076 |
| 2052 | 11% | 4.8 | 0.0697 | -0.0162 | 0.04 | 0.0076 |
| 2053 | 11% | 4.8 | 0.0697 | -0.0162 | 0.04 | 0.0076 |
| 2054 | 11% | 4.8 | 0.0697 | -0.0162 | 0.04 | 0.0077 |
| 2055 | 11% | 4.8 | 0.0697 | -0.0163 | 0.04 | 0.0077 |
| 2056 | 11% | 4.8 | 0.0697 | -0.0163 | 0.04 | 0.0077 |
| 2057 | 11% | 4.8 | 0.0698 | -0.0163 | 0.04 | 0.0077 |
| 2058 | 11% | 4.8 | 0.0698 | -0.0163 | 0.04 | 0.0077 |
| 2059 | 11% | 4.8 | 0.0698 | -0.0163 | 0.04 | 0.0077 |
| 2060 | 11% | 4.8 | 0.0698 | -0.0164 | 0.04 | 0.0077 |
| 2061 | 11% | 4.8 | 0.0698 | -0.0164 | 0.04 | 0.0077 |
| 2062 | 11% | 4.8 | 0.0698 | -0.0164 | 0.04 | 0.0077 |
| 2063 | 11% | 4.8 | 0.0698 | -0.0164 | 0.04 | 0.0077 |
| 2064 | 11% | 4.8 | 0.0698 | -0.0164 | 0.04 | 0.0077 |
| 2065 | 11% | 4.8 | 0.0698 | -0.0165 | 0.04 | 0.0078 |
| 2066 | 11% | 4.8 | 0.0698 | -0.0165 | 0.04 | 0.0078 |
| 2067 | 11% | 4.8 | 0.0698 | -0.0165 | 0.04 | 0.0078 |
| 2068 | 11% | 4.8 | 0.0698 | -0.0165 | 0.04 | 0.0078 |
| 2069 | 11% | 4.8 | 0.0698 | -0.0165 | 0.04 | 0.0078 |
| 2070 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0078 |
| 2071 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0078 |
| 2072 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0078 |
| 2073 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0078 |
| 2074 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0078 |
| 2075 | 11% | 4.8 | 0.0699 | -0.0166 | 0.04 | 0.0079 |
| 2076 | 11% | 4.8 | 0.0699 | -0.0167 | 0.04 | 0.0079 |
| 2077 | 11% | 4.8 | 0.0699 | -0.0167 | 0.04 | 0.0079 |
| 2078 | 11% | 4.8 | 0.0699 | -0.0167 | 0.04 | 0.0079 |
| 2079 | 11% | 4.8 | 0.0699 | -0.0167 | 0.04 | 0.0079 |
| 2080 | 11% | 4.8 | 0.0699 | -0.0167 | 0.04 | 0.0079 |
| 2081 | 11% | 4.8 | 0.0699 | -0.0168 | 0.04 | 0.0079 |
| 2082 | 11% | 4.8 | 0.0699 | -0.0168 | 0.04 | 0.0079 |
| 2083 | 11% | 4.8 | 0.0699 | -0.0168 | 0.04 | 0.0079 |
| 2084 | 10% | 4.8 | 0.0700 | -0.0168 | 0.04 | 0.0079 |
| 2085 | 10% | 4.8 | 0.0700 | -0.0168 | 0.04 | 0.0080 |
| 2086 | 10% | 4.8 | 0.0700 | -0.0169 | 0.04 | 0.0080 |
| 2087 | 10% | 4.8 | 0.0700 | -0.0169 | 0.04 | 0.0080 |
| 2088 | 10% | 4.8 | 0.0700 | -0.0169 | 0.04 | 0.0080 |
| 2089 | 10% | 4.8 | 0.0700 | -0.0169 | 0.04 | 0.0080 |
| 2090 | 10% | 4.8 | 0.0700 | -0.0169 | 0.04 | 0.0080 |
| 2091 | 10% | 4.8 | 0.0700 | -0.0170 | 0.04 | 0.0080 |
| 2092 | 10% | 4.8 | 0.0700 | -0.0170 | 0.04 | 0.0080 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2093 | 10% | 4.8 | 0.0700 | -0.0170 | 0.04 | 0.0080 |
| 2094 | 10% | 4.8 | 0.0700 | -0.0170 | 0.04 | 0.0080 |
| 2095 | 10% | 4.8 | 0.0700 | -0.0170 | 0.04 | 0.0080 |
| 2096 | 10% | 4.8 | 0.0700 | -0.0171 | 0.04 | 0.0081 |
| 2097 | 10% | 4.8 | 0.0700 | -0.0171 | 0.04 | 0.0081 |
| 2098 | 10% | 4.8 | 0.0701 | -0.0171 | 0.04 | 0.0081 |
| 2099 | 10% | 4.8 | 0.0701 | -0.0171 | 0.04 | 0.0081 |
| 2100 | 10% | 4.8 | 0.0701 | -0.0171 | 0.04 | 0.0081 |
| 2101 | 10% | 4.8 | 0.0701 | -0.0172 | 0.04 | 0.0081 |
| 2102 | 10% | 4.8 | 0.0701 | -0.0172 | 0.04 | 0.0081 |
| 2103 | 10% | 4.8 | 0.0701 | -0.0172 | 0.04 | 0.0081 |
| 2104 | 10% | 4.8 | 0.0701 | -0.0172 | 0.04 | 0.0081 |
| 2105 | 10% | 4.8 | 0.0701 | -0.0172 | 0.04 | 0.0081 |
| 2106 | 10% | 4.8 | 0.0701 | -0.0173 | 0.04 | 0.0082 |
| 2107 | 10% | 4.8 | 0.0701 | -0.0173 | 0.04 | 0.0082 |
| 2108 | 10% | 4.8 | 0.0701 | -0.0173 | 0.04 | 0.0082 |
| 2109 | 10% | 4.8 | 0.0701 | -0.0173 | 0.04 | 0.0082 |
| 2110 | 10% | 4.8 | 0.0701 | -0.0173 | 0.04 | 0.0082 |
| 2111 | 10% | 4.8 | 0.0701 | -0.0174 | 0.04 | 0.0082 |
| 2112 | 10% | 4.8 | 0.0701 | -0.0174 | 0.04 | 0.0082 |
| 2113 | 10% | 4.8 | 0.0701 | -0.0174 | 0.04 | 0.0082 |
| 2114 | 10% | 4.8 | 0.0702 | -0.0174 | 0.04 | 0.0082 |
| 2115 | 10% | 4.8 | 0.0702 | -0.0174 | 0.04 | 0.0082 |
| 2116 | 10% | 4.8 | 0.0702 | -0.0175 | 0.04 | 0.0083 |
| 2117 | 10% | 4.8 | 0.0702 | -0.0175 | 0.04 | 0.0083 |
| 2118 | 10% | 4.8 | 0.0702 | -0.0175 | 0.04 | 0.0083 |
| 2119 | 10% | 4.8 | 0.0702 | -0.0175 | 0.04 | 0.0083 |
| 2120 | 10% | 4.8 | 0.0702 | -0.0175 | 0.04 | 0.0083 |
| 2121 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0083 |
| 2122 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0083 |
| 2123 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0083 |
| 2124 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0083 |
| 2125 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0083 |
| 2126 | 10% | 4.8 | 0.0702 | -0.0176 | 0.04 | 0.0084 |
| 2127 | 10% | 4.8 | 0.0702 | -0.0177 | 0.04 | 0.0084 |
| 2128 | 10% | 4.8 | 0.0702 | -0.0177 | 0.04 | 0.0084 |
| 2129 | 10% | 4.8 | 0.0702 | -0.0177 | 0.04 | 0.0084 |
| 2130 | 10% | 4.8 | 0.0703 | -0.0177 | 0.04 | 0.0084 |
| 2131 | 10% | 4.8 | 0.0703 | -0.0177 | 0.04 | 0.0084 |
| 2132 | 10% | 4.8 | 0.0703 | -0.0178 | 0.04 | 0.0084 |
| 2133 | 10% | 4.8 | 0.0703 | -0.0178 | 0.04 | 0.0084 |
| 2134 | 10% | 4.8 | 0.0703 | -0.0178 | 0.04 | 0.0084 |
| 2135 | 10% | 4.8 | 0.0703 | -0.0178 | 0.04 | 0.0084 |
| 2136 | 10% | 4.8 | 0.0703 | -0.0178 | 0.04 | 0.0085 |
| 2137 | 10% | 4.8 | 0.0703 | -0.0179 | 0.04 | 0.0085 |

| Year | Base Sat. | pH | $[NO_3^-]$ (eq $m^{-3}$) | [ANC] (eq $m^{-3}$) | molar Al/(Ca+Mg+K) ratio | $[Al^{3+}]$ (eq $m^{-3}$) |
|---|---|---|---|---|---|---|
| 2138 | 10% | 4.8 | 0.0703 | -0.0179 | 0.04 | 0.0085 |
| 2139 | 10% | 4.8 | 0.0703 | -0.0179 | 0.04 | 0.0085 |
| 2140 | 10% | 4.8 | 0.0703 | -0.0179 | 0.04 | 0.0085 |
| 2141 | 10% | 4.8 | 0.0703 | -0.0179 | 0.04 | 0.0085 |
| 2142 | 10% | 4.8 | 0.0703 | -0.0180 | 0.04 | 0.0085 |
| 2143 | 10% | 4.8 | 0.0703 | -0.0180 | 0.04 | 0.0085 |
| 2144 | 10% | 4.8 | 0.0703 | -0.0180 | 0.04 | 0.0085 |
| 2145 | 10% | 4.8 | 0.0703 | -0.0180 | 0.04 | 0.0085 |
| 2146 | 10% | 4.8 | 0.0703 | -0.0180 | 0.04 | 0.0086 |
| 2147 | 10% | 4.8 | 0.0704 | -0.0181 | 0.04 | 0.0086 |
| 2148 | 10% | 4.8 | 0.0704 | -0.0181 | 0.04 | 0.0086 |
| 2149 | 10% | 4.8 | 0.0704 | -0.0181 | 0.04 | 0.0086 |
| 2150 | 10% | 4.8 | 0.0704 | -0.0181 | 0.04 | 0.0086 |

## 8.4 Data availability at Great Smoky Mountain National Park for critical loads calculations

### List of Parameters for Calculating Nitrogen Critical Loads at Great Smoky Mtns NP

October 18, 2005 Version 1.2 JRenfro

| **A. DEPOSITION**<br>***A.1. Throughfall*** | **Mandatory/ Optional?** | **High elevation Data x/ ?** | **Mid elevation Data x/ ?** | **Low elevation Data x/ ?** |
|---|---|---|---|---|
| pH | M | x | x | |
| conductivity | M | x | x | |
| Base cations ($Na^+$, $K^+$, $Mg^{2+}$, $Ca^{2+}$) | M | x | x | |
| $NH_4^+$ | M | x | x | |
| Anions ($Cl^-$, $NO_3^-$, $SO_4^{2-}$) | M | x | x | x |
| Total Alkalinity (if annual median pH>5) | M | | | |
| Total N | M | x | x | x |
| $Al^{3+}$, $Mn^{2+}$, $Fe^{3+}$ | O | x | x | |
| Heavy metals (Cu,Zn, Hg, Pb, Cd, Co, Mo | O | x | | |
| Total P, $PO_4^{3-}$ | O | | | |
| Total alkalinity (if any sample pH>5 | O | | | |
| Total S | O | x | x | x |
| TOC, DOC | O | x | | |

| ***A.2. Wet Deposition*** | **Mandatory/ Optional?** | **High elevation Data x/ ?** | **Mid elevation Data x/ ?** | **Low elevation Data x/ ?** |
|---|---|---|---|---|
| pH | M | x | x | x |
| Base cations ($Na^+$, $K^+$, $Mg^{2+}$, $Ca^{2+}$) | M | x | x | x |
| $NH_4^+$ | M | x | x | x |
| Anions ($Cl^-$, $NO_3^-$, $SO_4^{2-}$) | M | x | x | x |
| Total Alkalinity (if annual median>5) | M | | | |
| $Al^{3+}$, $Mn^{2+}$, $Fe^{3+}$ | O | x | | |
| Heavy metals (Cu,Zn, Hg, Pb, Cd, Co, Mo | O | x | | |
| Total P, $PO_4^{3-}$ | O | | | |
| Total alkalinity (if any sample pH>5 | O | | | |
| Total S, Total N | O | x | x | x |

| **B. CLIMATE** | **Mandatory/ Optional?** | **High elevation Data x/ ?** | **Mid elevation Data x/ ?** | **Low elevation Data x/ ?** |
|---|---|---|---|---|
| Precipitation volume | M | x | x | x |
| Air temperature | M | x | x | x |
| Air humidity | M | x | x | x |

| | | | | |
|---|---|---|---|---|
| Annual evapotransporation rate | M | x | | |
| Wind speed | O | x | x | x |
| Wind direction | O | x | x | x |
| Solar radiation | O | x | x | x |
| Barometric pressure | O | | x | |
| UV-b radiation | O | | | x |
| Soil temperatures | O | x USGS | x | x |
| Soil moisture (matric potential, water content) | O | x USGS | ? | ? |
| Stand precipitation (throughfall and stem flow) | O | x | x | |

| **C. ANALYSIS OF NEEDLES AND LEAVES** | **Mandatory/ Optional?** | **High elevation Data x/ ?** | **Mid elevation Data x/ ?** | **Low elevation Data x/ ?** |
|---|---|---|---|---|
| N, S, P, Ca, Mg, K | M | x | x | x understory |
| Zn, Mn, Fe, B, Pb, Cu, Cd, C | O | x | x | |

| **D. SOIL ANALYSIS (SOLID PHASE)** | **Mandatory/ Optional?** | **High elevation Data x/ ?** | **Mid elevation Data x/ ?** | **Low elevation Data x/ ?** |
|---|---|---|---|---|
| Course fragment | M | x | | |
| Bulk density | M | x | | |
| Particle size distribution | M | | | |
| pH ($CaCl_2$) | M | x (buffer pH) | x | x |
| Organic C | M | x | | |
| Total N | M | x | x | x |
| Extractable Ca, K, Mg, Al, Na | M | x all | x | x |
| Exchangeable acidity | M | x | x | |
| Base saturation | M | x | x | |
| Cation exchange capacity | M | x | x | x |
| pH ($H_2O$) | M | x | x | x |
| Acceptable N accumulation | M | ? | ? | ? |
| *Exchange constants (lg K AlBC, lg K HBC)* | M | x | x | |
| *C pool in rooting zone* | M | x | | |
| Organic layer weight | O | x | x | x |
| Carbonates | O | | | |
| Extractable P, Mn, Cu, Pb, Cd, Zn, Fe, Cr, Ni, S, Hg | O | x most | x most | x most |
| Oxalate extractable Fe, Al | O | x | x Al | x Al |
| Total elements (Ca, Mg, K, Al, Fe, Mn) | O | x | x | x |
| Full mineralogical analysis | O | x | x | |

| E. SOIL SOLUTION ANALYSIS | Mandatory/ Optional? | High elevation Data x/ ? | Mid elevation Data x/ ? | Low elevation Data x/ ? |
|---|---|---|---|---|
| pH | M | x | x | |
| Alkalinity | M | x? | x? | |
| DOC | M | x | | |
| K, Mg, Ca, Na | M | x | x | |
| Al (Total) | M | x | x | |
| Al (Labile) | M | x | | |
| $NO_3$-N, $SO_4$-S | M | x | x | |
| $NH_4$-N | M | x | x | |
| Cl | M | x | x | |
| *$pCO_2$ (partial pressure of $CO_2$)* | M | | | |
| Fe, Mn, Zn, Cu, Cr, Ni, Pb, Cd, Si | O | x | | |
| Electrical conductivity | O | x | x | |
| total P | O | | | |

| F. FOREST HEALTH PARAMETERS - OPTIONAL | | | | |
|---|---|---|---|---|

| G. GROWTH AND YIELD | Mandatory/ Optional? | High elevation Data x/ ? | Mid elevation Data x/ ? | Low elevation Data x/ ? |
|---|---|---|---|---|
| Species composition | M | x | x | x |
| If removal of biomass via harvesting or fire occurs on the site | M | | x | x |
| DBH | M | x | x | x |
| Biomass removed by tree compartment (stem wood, stem bark, branches, foliage) | M | | | |
| Nutrient content by tree compartment (stem wood, stem bark, branches, foliage) | M | x | x foliage | x foliage |

| H. SURFACE WATER (FROM ICP WATER) | Mandatory/ Optional? | High elevation Data x/ ? | Mid elevation Data x/ ? | Low elevation Data x/ ? |
|---|---|---|---|---|
| Alkalinity | M | x | x | x |
| pH | M | x | x | x |
| Conductivity | M | x | x | x |
| Base cations ($Na^+$, $K^+$, $Mg^{2+}$, $Ca^{2+}$) | M | x | x | x |
| $NH_4^+$ | M | x | x | x |
| Al (labile) | O | | | |
| DOC or permanganate | O | x | x | x |
| Al (reactive) | O | | | |

| | | | | |
|---|---|---|---|---|
| Al (non-labile) | O | | | |
| Total Al | O | x | x | x |
| TOC | O | | | |
| Water temperature | O | x | x | x |
| Flow | O | x | | x |
| Total or soluble reactive $PO_4^{3-}$ | O | | | |
| Dissolved Oxygen | O | | | |
| Fe, Mn, Cd, Zn, Cu, Ni, Pb, F | O | x no i or F | x | x |
| Silica ($SiO_2$) | O | x | x | x |
| Color | O | | | |
| Turbidity | O | some storm event data | | |

| I. ADDITIONAL AIR QUALITY PARAMETERS | Mandatory/ Optional? | High elevation Data x/ ? | Mid elevation Data x/ ? | Low elevation Data x/ ? |
|---|---|---|---|---|
| $O_3$ | O | x | x | x |
| Trace Gases ($SO_2$, CO, NO-$NO_y$) | O | | x | x |
| Hydrocarbons | O | | x | |
| Continuous Fine Mass (TEOM) | O | | x | x |
| Dry deposition $SO_2$, $SO_4^{2-}$, $HNO_3^-$, $NO_3^-$, $NH_4^+$ (CASTNet) | O | x | x | x |
| Mercury deposition (MDN) | O | x | | x |
| Cloud deposition (MADPro) | O | x | | |
| IMPROVE ($PM_{2.5}$, $PM_{10}$, nephelometer, hi-res camera) | O | x | x | x |

## 8.5 Historic Deposition

The VSD requires an initial calibration in order to calculate the selectivity coefficients for Al:BC and H:BC exchange (log K Al:BC and log K H:BC). It is preferable to use a period of time when deposition inputs are both low and not changing rapidly, so that the assumption that the soil exchange complex is at equilibrium with the deposition is met. We estimated historical deposition in order to calibrate the model (Figure 8.2).

We used modeled historical deposition from the SAMI project (Sullivan et al., 2001; Cosby pers. comm.) with a simple regression to extend the SAMI data from 1990 to 1999. We normalized the historical data from SAMI by dividing the deposition in each year by the deposition for the current period (1999-2004). In this way, we calculated the fraction of current deposition for each (historic) year (Table 8.1). In order to estimate historical deposition at each site, we multiplied the current deposition (for S, N, and BC) by the fraction in each year. The SAMI data included wet deposition for N and S. We assumed that the BC tracked with the S deposition for our estimation. The purpose of these estimations was to calibrate the model; the accuracy of these estimates is well within the certainty of the model. However, these estimates of historical deposition at these sites should not be used for other purposes or assumed to have a high level of certainty. The resulting historical patterns of deposition we used for each site are shown below (Figure 8.2).

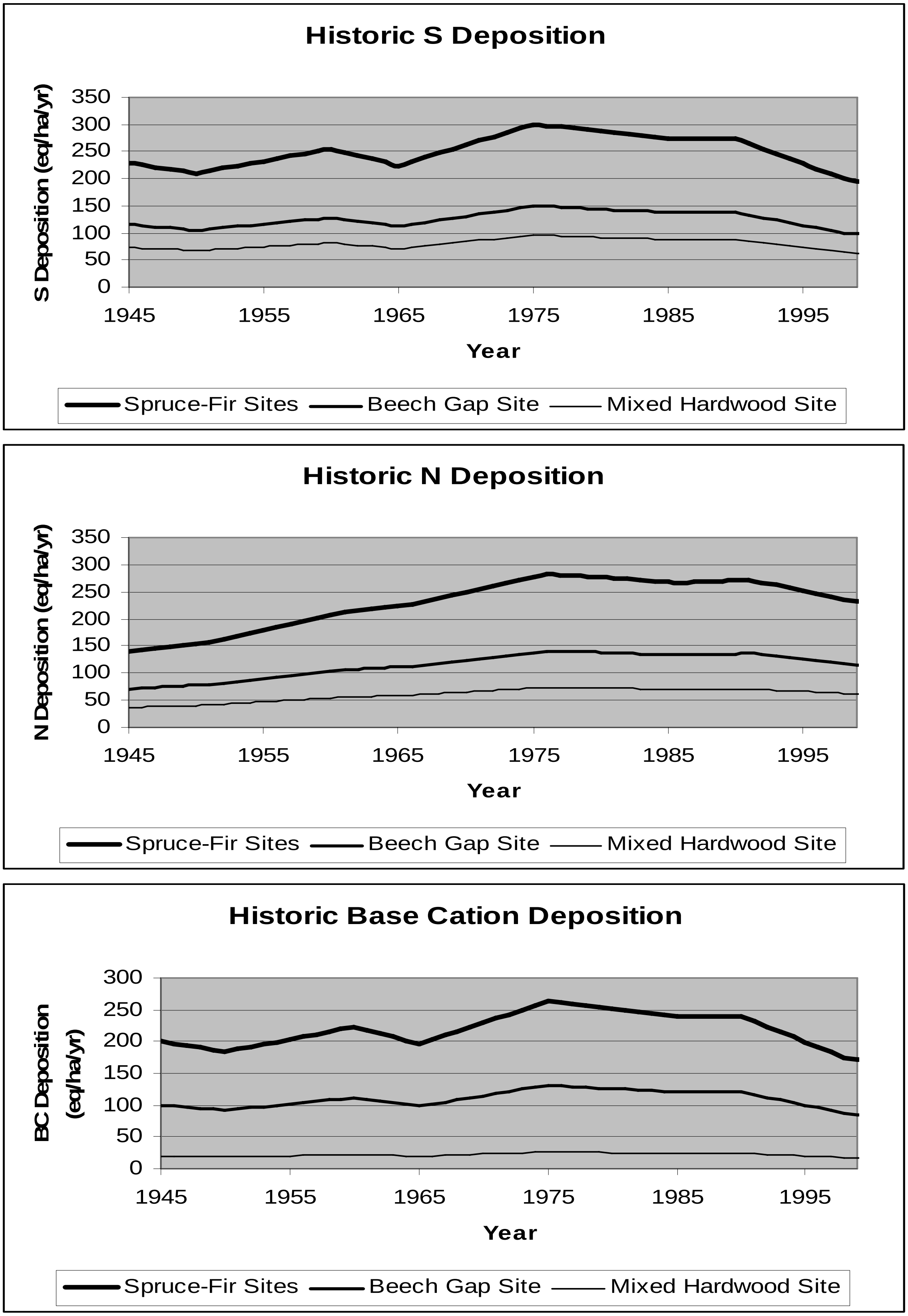


**Figure 8.2 Historic S, N, and Base Cation Deposition for the GSMNP Sites.**

**Table 8.8 Fraction of current deposition (1999-2004) for each year from 1944-2004.**

| Year | S | N | BC | Year | S | N | BC |
|---|---|---|---|---|---|---|---|
| **1944** | 1.12 | 0.60 | 1.12 | **1972** | 1.42 | 1.15 | 1.42 |
| **1945** | 1.17 | 0.62 | 1.17 | **1973** | 1.46 | 1.17 | 1.46 |
| **1946** | 1.15 | 0.63 | 1.15 | **1974** | 1.49 | 1.20 | 1.49 |
| **1947** | 1.13 | 0.64 | 1.13 | **1975** | 1.53 | 1.22 | 1.53 |
| **1948** | 1.11 | 0.65 | 1.11 | **1976** | 1.52 | 1.22 | 1.52 |
| **1949** | 1.09 | 0.67 | 1.09 | **1977** | 1.51 | 1.21 | 1.51 |
| **1950** | 1.07 | 0.68 | 1.07 | **1978** | 1.49 | 1.20 | 1.49 |
| **1951** | 1.10 | 0.70 | 1.10 | **1979** | 1.48 | 1.19 | 1.48 |
| **1952** | 1.12 | 0.73 | 1.12 | **1980** | 1.47 | 1.19 | 1.47 |
| **1953** | 1.14 | 0.75 | 1.14 | **1981** | 1.45 | 1.18 | 1.45 |
| **1954** | 1.17 | 0.78 | 1.17 | **1982** | 1.44 | 1.17 | 1.44 |
| **1955** | 1.19 | 0.80 | 1.19 | **1983** | 1.43 | 1.17 | 1.43 |
| **1956** | 1.21 | 0.82 | 1.21 | **1984** | 1.41 | 1.16 | 1.41 |
| **1957** | 1.23 | 0.85 | 1.23 | **1985** | 1.40 | 1.15 | 1.40 |
| **1958** | 1.26 | 0.87 | 1.26 | **1986** | 1.40 | 1.16 | 1.40 |
| **1959** | 1.28 | 0.90 | 1.28 | **1987** | 1.40 | 1.16 | 1.40 |
| **1960** | 1.30 | 0.92 | 1.30 | **1988** | 1.40 | 1.17 | 1.40 |
| **1961** | 1.27 | 0.93 | 1.27 | **1989** | 1.40 | 1.17 | 1.40 |
| **1962** | 1.24 | 0.94 | 1.24 | **1990** | 1.40 | 1.18 | 1.40 |
| **1963** | 1.21 | 0.96 | 1.21 | **1991** | 1.35 | 1.15 | 1.35 |
| **1964** | 1.18 | 0.97 | 1.18 | **1992** | 1.30 | 1.13 | 1.30 |
| **1965** | 1.15 | 0.98 | 1.15 | **1993** | 1.26 | 1.11 | 1.26 |
| **1966** | 1.18 | 1.00 | 1.18 | **1994** | 1.21 | 1.09 | 1.21 |
| **1967** | 1.22 | 1.03 | 1.22 | **1995** | 1.16 | 1.07 | 1.16 |
| **1968** | 1.26 | 1.05 | 1.26 | **1996** | 1.12 | 1.04 | 1.12 |
| **1969** | 1.30 | 1.08 | 1.30 | **1997** | 1.07 | 1.02 | 1.07 |
| **1970** | 1.34 | 1.10 | 1.34 | **1998** | 1.02 | 1.00 | 1.02 |
| **1971** | 1.38 | 1.12 | 1.38 | **1999** | 1.00 | 1.00 | 1.00 |

## 8.6 Literature Lists

The following lists are GSMNP publications and the additional references used in creating the Critical Thresholds Table. These references are in a ProCite database.

**Great Smoky Mountains National Park Reference List**


1. Baes, C.F. and S.B. McLaughlin. Trace Elements in Tree Rings: Evidence of Recent and Historical Air Pollution. Science **224**, 494-497 (1984).

2. Barker, M., H. Van Miegroet, N.S. Nicholas, and I. F. Creed . Variation in Overstory Nitrogen Uptake in a Small, High-Elevated Southern Appalachian Spruce-fir Watershed. Canadian Journal of Forest Research **32**, 1741-1752 (2002).

3. Bondietti, E.A., C. F. Baes III, and S. B. McLaughlin. Radial Trends in Cation ratios in Tree Rings as Indicators of the Impact of Atmospheric Deposition on Forests. Canadian Journal of Forest Research **19**, 586-594 (1989).

4. Busing R. T., E. E. C. Clebsch, C. C. Eagar, and E. F. Pauley. Two Decades of Change in a Great Smoky Mountains Spruce-Fir Forest. Bulletin of the Torrey Botanical Club **115**, 25-31 (1988).

5. Cook, R.B. and et al. Acid-Base Chemistry of Higher Elevation Streams in the Great Smoky Mountains. Water, Air, and Soil Pollution **72**, 331-356 (1994).

6. Crandall, D.L. Ground Vegetation Patterns of the Spruce-Fir Area of the Great Smoky Mountains National Park . Eclogical Monographs **28** , 337-360 (1958).

7. de Vries, W., M. Posch, and J. Kamari. Simulation of the Long-Term Soil Response to Acid Deposition in Various Buffer Ranges. Water, Air, and Soil Pollution **48**, 349-390 (1989).

8. DeWalle, D.R. , J. S. Tepp, B. R. Swistock, W. E. Sharpe, and P. J. Edwards. Tree-Ring Cation Response to Experimental watershed Acidification in West Virginia and Maine. Journal of Environmental Quality **28**, 299-309 (1999).

9. Fisher, S. Evaluating Nitrogen Critical Loads: Target Emission Levels for Policy Guidelines. Research and Technology Applications.

10. Garten, C.T. Nitrogen Saturation and Soil N Availability in a High-Elevation Spruce and Fir Forest. Water, Air, & Soil Pollution **120**, 295-313 (2000).

11. Garten, C.T. Potential Net Soil N Mineralization and Decomposition of Glycine 13C in Forest Soils Along an Elevation Gradient. Soil Biology and Biochemistry **36**, 1491-1496 (2004).

12. Garten, C. T. Relationships Among Forest Soil C Isotopic Composition, Partitioning and Turnover Times. 23. 2006.

13. Garten, C.T. , A. B. Schwab, and T. L. Shirshac. Foliar Retention of 15N Tracers:

Implications for Net Canopy Exchange in Low and High Elevation Forest Ecosystems. Forest Ecology and Management **103**, 211-216 (1998).

14. Garten, C. T. and P. J. Hanson. Estimated Forest Soil C Amounts and Turnover Along an Elevation Gradient. 21. 2006.

15. Garten, C.T. , W. M. Post, P. J. Hanson, and L. W. Cooper. Forest Soil Carbon Inventories and Dynamics Along an Elevation Gradient in the Southern Appalachian Mountains. Biogeochemistry **45**, 115-145 (1999).

16. Garten, C.T.Jr. and H, V.M. Relationships between soil nitrogen dynamics and natural 15N abundance in plant foliage from Great Smokey Mountains National Park. Canadian journal of forest research **24**, 1636-1645 (1994).

17. Garten Jr, C. Relationships between soil nitrogen dynamics and natural 15 N abundance in plant foliage from Great Smoky Mountains National Park. Canadian journal of forest research **24**, 1636 (1994).

18. Gilliam, F.S., Nichole L. Turrill, and Marey Beth Adams. Herbaceous-Layer and Overstory Species in Clear-cut and Mature Central Appalachian Hardwood Forests. Ecological Applications **5**, 947-955 (1995).

19. Golden, M.S. An Integrated Multivariate Analysis of Forest Communities of the Central Great Smoky Mountains. American Midland Naturalist **106**, 37-53 (1981).

20. Harrison, R.B., D.W. Johnson, and D.E. Todd. Sulfate Absorption and Desportion Reversibility in a Variety of Forest Soils. Journal of Environmental Quality **18**, 419-426 (189).

21. Johnson, D.W. Temporal patterns in beech forest soil solutions: field and model results compared. Soil Science Society of America journal **59**, 1732-1740 (1995).

22. Johnson, D. W., D. W. Cole, F. W. Horng, H. Van Miegroet, and D. E. Todd. Chemical Characteristics of Two Forested Ultisols and Two Forested Inceptisols Relevant to Anion Production and Mobility. Oak Ridge National Laboratory Environmental Sciences Division. 81.

23. Johnson D.W. , H. Van Miegroet , S. E. Lindberg , D.E. Todd , and R.B. Harrison. Nutrient cycling in red spruce forests of the Great Smoky Mountains. Canadian Journal of Forest Research **21**, 769-787 (1991).

24. Johnson, D.W., R. B. Susfalk, P. F. Brewer, and W. T. Swank. Simulated Effects of Reduced Sulfur, Nitrogen, and Base Cation Deposition on Soils and Solutions in Southern Appalachian Forests. Journal of Environmental Quality **28**, 1336-1346 (1999).

25. Johnson, D.W., W. Cheng, and I.C. Burke. Biotic and Abiotic Nitrogen Retention in a Variety of Forest Soils. Soil Science Society of America Journal **64**, 1503-1514.

26. Joslin, J.D. , J. M. Kelly, and H. Van Miegroet. Soil Chemistry and Nutrition of North American Spruce-Fir Stands: Evidence of Recent Change. Journal of Environmental Quality **21**, 12-30 (1992).

27. Lilleskov, E.A., T. J. Fahey, and G. M. Lovett. Ectomycorrhizal Fungal Aboveground Community Change Over an Atmospheric Nitrogen Deposition Gradient. Ecological Applications **11**, 397-410 (2001).

28. Matmon A. *et al.* Temporally and spatially uniform rates of erosion in the southern Appalachian Great Smoky Mountains. Geology **31**, 155-158 (2003).

29. May, J.D., S. D. Burdette, F. S. Gilliam, and M. B. Adams. Interspecific Divergence in Foliar Nutrient Dynamics and Stem Growth in a Temperate Forest in Response to Chronic Nitrogen Inputs. Canadian Journal of Forest Research **35**, 1023-1030 (2005).

30. McLaughlin, S.B., C. P. Andersen, P. J. Hanson, M. G. Tjoelker, and W. K. Roy. Increasted Dark Respiration and Calcium Deficiency of  Red Spruce in Relation to Acidic Deposition at High-Elevation Southern Appalachian Mountain Sites. Canadian Journal of Forest Research **21**, 1234-1244 (1991).

31. McLaughlin, S.B., C. P. Andersen, W. K. Roy, and N. T. Edwards. Seasonal Patterns of Photosynthesis and Respiration of Red Spruce Saplings from Two Elevations in Declining Southern Appalachian Stands. Journal of Canadian Forest Research **20**, 485-495 (1990).

32. Nodvin, S.C. , H. Van Miegroet, S. E. Lindberg, N. S. Nicholas, and D. W. Johnson. Acidic deposition, ecosystem processes, and nitrogen saturation in a high elevation Southern Appalachian watershed. Water, Air, & Soil Pollution **85**, 1647-1652 (1995).

33. Olszyna, K.J., S.T. Bairai, and R. L. Tanner. Effect of ambient NH3 levels on PM2.5 composition in the Great Smoky Mountains National Park.  Atmospheric Environment **39**, 4593-4606 (2005).

34. Pauley E. F. , S. C. Nodvin, N. S. Nicholas, A. K. Rose, and T. B. Coffey. Vegetation, Biomass, and Nitrogen Pools in a Spruce-Fir Forest of the Great Smoky Mountains National Park . Bulletin of the Torrey Botanical Club **123**, 318-329.

35. Pyle, C. The type and extent of anthropogenic vegetation disturbance in the Great Smoky Mountains before National Park Service acquisition. Castanea **53**, 183-196 (1988).

36. Sasser C. L.  and D. Binkley.  Nitrogen Mineralization in High-Elevation Forests of the Appalachians. II. Patterns with Stand Development in Fir Waves. Biogeochemistry **7**, 147-156 (1989).

37. Shanks, R.E.  Climates of the Great Smoky Mountains. Ecology **35**, 354-361

(1954).

38. Shubzda, J., S. E. Lindberg, C. T. Garten, and S. C. Nodvin. Elevational trends in the fluxes of sulphur and nitrogen in throughfall in the Southern Appalachian Mountains: Some surprising results. Water, Air and Soil Pollution **85**, 2265-2270 (1995).

39. Strader R.H. , D. Binkley, and C. G. Wells. Nitrogen Mineralization in High Elevation Forests of the Appalachians. I. Regional Patterns in Southern Spruce-Fir Forests. Biogeochemistry **7**, 131-145 (1989).

40. Sucoff, E., F. C. Thorton, and J. D. Joslin. Sensitivity of Tree Seedlings to Aluminum: I Honeylocust. Journal of Environmental Quality **19**, 163-171 (1990).

41. Van Meigroet , P.T. Moore, C. E. Tewksbury, and N. S. Nicholas. Are High-Elevation Spruce-Fir Forests in the Southeastern US Sources or Sinks of CO2?

42. Van Miegroet, H. *et al.* Is There Synchronicity in Nitrogen Input and Output Fluxes at the Noland Divide Watershed, a Small N-Saturated Forested Catchment in the Great Smoky Mountains National Park? The Scientific World **1**, 480-492 (2001).

43. Webster, K.L., Creed, I.F., Nicholas, N.S., and Van Miegroet, H. Exploring interactions between pollutant emissions and climatic variability in growth of red spruce in the Great Smoky Mountains National Park. Water, air, and soil pollution **159**, 225-248 (2004).

44. Weinstein D.A., B. Gollands, and W. A. Retzlaff. The Effects of Ozone on a Lower Slope Forest of the Great Smoky Mountain National Park: Simulations Linking an Individual Tree Model to a Stand Model. Forest Science **47**, 29-42 (2001).

45. Whittaker, R.H. Forest Dimensions and Production in the Great Smoky Mountains. Ecology **47**, 103-121 (1966).

**Additional Publications used for Determining Critical Thresholds**

1. Aber J. *et al.* Nitrogen Saturation in Temperate Forest Ecosystems. Bioscience **48**, 921-934 (1998).

2. Anderson, M. Toxicity and Tolerance of Aluminum in Vascular Plants. Water, Air, and Soil Pollution **39**, 439-462 (1988).

3. Avis, P.G., D. J. McLaughlin, B. C. Dentinger, and P. B. Reich. Long-term Increase in Nitrogen Supply Alters Above and Below Ground Ectomycorrhizal Communities and Increases the Dominance of Russula spp. in a Temperate Oak Savanna. New Phytologist **160**, 239-253 (2003).

4. Bowden, R.D., E. Davidson, K. Savage, C. Arabia, and P. Steudler. Chronic Nitrogen Additions Reduce total Soil Respiration and Microbial Respiration in Temperate Forest Soils at the Harvard Forest. Forest Ecology and Management **196**,

43-56 (2004).

5. Corre, M.D., F. O. Beese, and R. Brumme. Soil Nitrogen Cycle in High Nitrogen Deposition Forest: Changes Under Nitrogen Saturation and Liming. Ecological Applications **13**, 287-298 (2003).

6. Cronan, C.S. Differential Adsorption of Al, Ca, and Mg by Roots of Red Spruce (Picea rubens). Tree Physiology **8**, 227-237 (1991).

7. Cronan, C.S. and D. F. Grigal. Use of Calcium/Aluminum Ratios as Indicators of Stress in Forest Ecosystems. Journal of Environmental Quality **24**, 209-226 (1995).

8. Cronan, C.S. and et al. Aluminum Toxicity in Forests Exposed to Acidic Deposition: the Albios Results. Water, Air, and Soil Pollution **48**, 181-192 (1989).

9. Egerton-Warburton, L.M. and E. B. Allen. Shifts in Arbuscular Mycorrhizal Communitios Along an Anthropogenic Nitrogen Deposition Gradient. Ecological Applications **10**, 484-496 (2000).

10. Fisk, M.C. and T. J. Fahey. Microbial Biomass and Nitrogen Cycling Responses to Fertilization and Litter Removal in Young Northern Hardwood Forest. Biogeochemistry **53**, 201-223 (2001).

11. Gilliam F. S., B. M. Yurish, and M. B. Adams. Temporal and spatial variation of nitrogen transformations in nitrogen-saturated soils of a central Appalachian hardwood forest. Canadian Journal of Forest Research **31**, 1768-1785 (2001).

12. Joslin, J.D. and M. H. Wolfe. Red Sprice Soil Solution Chemistry and Root Distribution Across a Cloud Water Deposit Gradient. Canadian Journal of Forest Research **22**, 893-904 (1992).

13. Joslin, J.D. and M. H. Wolfe. Foliar Deficiencies of Mature Southern Appalachian Red Spruce Deterimined from Fertilizer Trials. Soil Science Society of America Journal **58**, 1572-1579 (1994).

14. Lilleskov, E.A., T. J. Fahey, T. R. Horton, and G. M. Lovett. Belowground Ectomycorrhizal Fungal Community Change Over a Nitrogen Deposition Gradient in Alaska. Ecology **83**, 104-115 (2002).

15. Peter, M., F. Ayer, and S. Egli. Nitrogen Addition in a Norway Spruce Stand Altered Macromycete Sporocarp Production and Below-ground ectomycorrhizal Species composition. New Phytologist **149**, 311-325 (2001).

16. Sverdrup, H. , P. Warfving, and D. Britt. Assessing the Potential for Forest Effects Due to Soil Acidification in Maryland. Water, Air and Soil Pollution **87**, 245-265 (1996).

17. Thompson, G.W. and Medve, R.J. Effects of Aluminum and Manganese on the

Growth of Ectomycorrhizal Fungi. Applied and Environmental Microbiology **48**, 556-560 (1984).

18. Van Meigroet, H., D. W. Johnson, and D. E. Todd. Foliar Response of Red Spruce Saplings to Fertilization with Ca and Mg in the Great Smoky Mountains National Park. Canadian Journal of Forest Research **23**, 89-95 (1993).

19. Vare, H. Aluminum Polyphosphate in the Ectomycorrhizal Fungus Suillus variegatus O. Kunze as revealed by Energy Dispersive Spectrometry. New Phytologist **116**, 663-668 (1990).

20. Wallenda, T. and I. Kottke. Nitrogen Deposition and ectomycorrhizas. New Phytologist **139**, 169-187 (1998).

21. Wallenstein, M.D., S. McNulty, I. J. Fernandez, J. Boggs, and W. H. Schlesinger. Nitrogen Fertilization decreases Forest Soil Fungal and Bacterial Biomass in Three Long-term Experiments. Forest Ecology and Management **222** , 459-458 (2006).