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NEON Site-Level Plot Summary
Rocky Mountain National Park (RMNP)

Document Information

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Site Background

The Rocky Mountain National Park (RMNP) NEON site is mountainous and rugged with high relief and occurs within the Front Range Mountains section of MLRA 48 (Southern Rocky Mountains). Elevations range between 8,100 and 9,700 feet. While named as the "Rocky Mountain National Park" NEON site, most of the sample plots occur outside the National Park boundary on the Roosevelt National Forest.

Site Information

The RMNP site is characterized by metamorphic and igneous geology that is typical of mid-elevation montane forests of the Colorado Front Range. The state-wide geology map identifies all the NEON sample plots as occurring in the Yg unit – granitic rocks of Mesoproterozoic age (1.4 billion years ago).

Soil parent materials consist chiefly of colluvium and residuum, with minor areas of glacial till. The site consists of 23 unique soil map units with 10 of those map units containing NEON sample plots (Table 1 and Figure 2). The soils are approximately 51% Inceptisols, 34% Mollisols, 10% Alfisols, and 5% Entisols. Approximately 93% of the soil components are in a loamy-skeletal particle size class, meaning they contain an ample quantity of rock fragments.

Vegetation consists of the following, as defined by the Colorado Vegetation Model:

- Closed canopy Ponderosa Pine (Pinus Ponderosa) and open Ponderosa Pine Savanna
- Douglas Fir forest (*Pseudotsuga menziesii* var. glauca)
- Lodgepole Pine (*Pinus contorta*)
- Lodgepole Pine (*Pinus contorta*) - Aspen (*Populus tremuloides*) mix
- Lodgepole Pine mixed with Englemann Spruce and Subalpine Fir

According to the soil survey for this area (CO645 Arapahoe-Roosevelt National Forest Area), the Ponderosa Pine areas tend to be Mollisols with some Haplustalfs; the Douglas Fir areas tend to be Haplocryepts; and the Lodgepole Pine areas tend to be dominated by Dystrocryepts. Differences from these general associations that we observed in the field will be outlined in the summary section.

Analysis of Plots for Sampling

Because the geologic parent materials are relatively homogenous, sample plots were selected to cover the major landscape positions, taxonomic soil subgroups, and major vegetation types (Table 2).

- Lodgepole Pine with Spruce-Fir plots (Cryic, Typic Udic) (7 total plots)
    - Dystrocryepts derived from residuum & slope alluvium (3 plots).
    - Dystrocryepts derived from glacial till & alluvium (3 plots)
    - Cryorthents derived from glacial fluvial & residuum (1 plot)
- Ponderosa Pine plots (Frigid, Typic Ustic) on Haplustolls derived from colluvium & residuum (4 plots total).
- Douglas Fir plots (Cryic, Ustic Udic) on Haplocryepts derived from colluvium & residuum (3 plots total).

Fourteen plots were selected for sampling (Figure 1). In addition, 8 alternate plots were selected as backup plots in case any of the selected plots could not be sampled. The only major soil/geomorphic/ecologic niches omitted by this sampling plan were the drainageways and narrow floodplains that occur in soil map units 7102A and 6101A. However, since these map units do not have NEON plots, it was not possible to sample these areas.

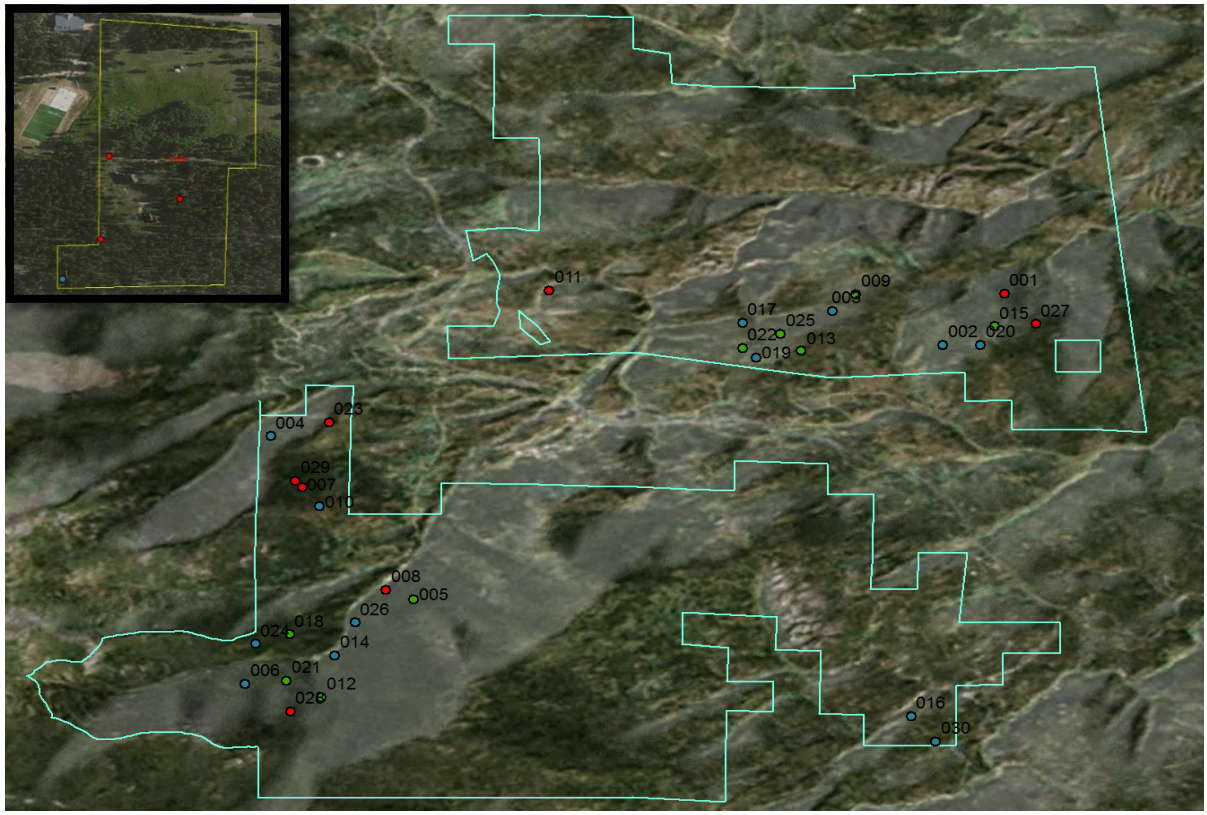

Figure 1. RMNP plots overlaying an aerial image and hillshade. Blue plots were selected sample plots, green plots are alternates (backups), and red plots were not chosen. The 4 plots surrounding the NEON tower are shown as an inset in the upper left of this figure. The tower plots are located on a small site (approximately 10 acres) 5 km to the north of this area.

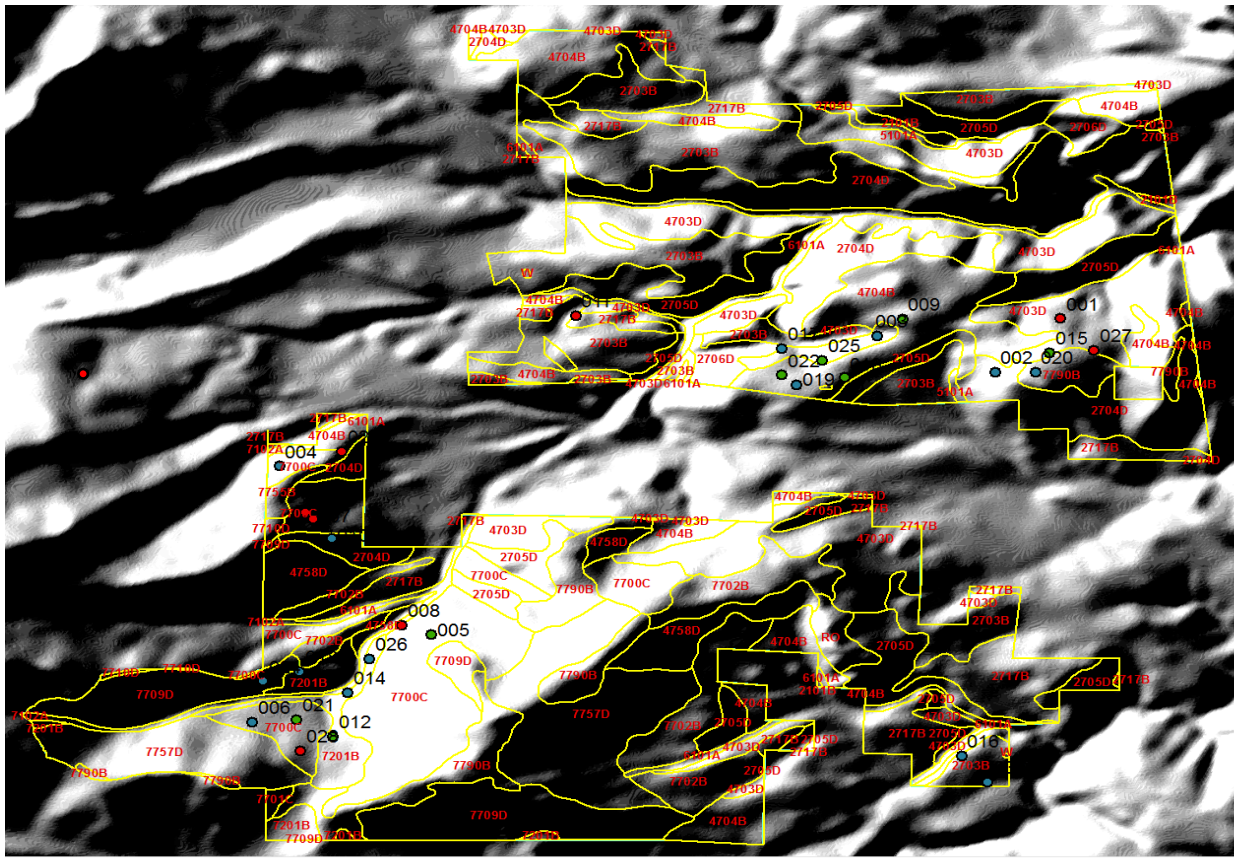

Figure 2. RMNP plots with SSURGO soil mapping. Blue plots were selected for sampling, green plots were selected as alternates (backups), and red plots were not chosen. The tower area is not shown.

Table 1. Soil map unit details and NEON plot data at RMNP. AOI: area of interest; MU: map unit. Target # plots determined using a formula based on the spatial extent of each map unit and the number of plots in the map unit; this was used to determine how many plots to select in each soil/geomorphic/ecological type.

Map Unit Symbol	Acres in AOI	Percent of AOI	# Plots in MU	Target # Plots	# Plots Selected
2101B	32	0.30%	0	0.0	0
2703B	1,457	12.70%	2	1.4	2
2704D	1,282	11.20%	2	1.3	2
2705D	877	7.60%	0	0.6	0
2706D	124	1.10%	0	0.1	0
2717B	620	5.40%	1	0.6	0
4703D	1,473	12.80%	6	2.4	2
4704B	1,148	10.00%	4	1.7	1
4758D	319	2.80%	0	0.2	0
5101A	32	0.30%	0	0.0	0
6101A	275	2.40%	0	0.2	0
7102A	38	0.30%	0	0.0	0
7201B	232	3.00%	4	1.4	3
7700C	965	8.40%	9	2.8	2
7701C	13	0.10%	0	0.0	0
7702B	535	4.60%	4	1.3	0
7709D	605	5.30%	1	0.6	1
7710D	13	0.10%	0	0.0	0
7755B	28	0.20%	0	0.0	0
7757D	866	7.50%	0	0.6	0
7790B	493	4.30%	1	0.6	1
R0	65	0.60%	0	0.0	0
W	3	0.00%	0	0.0	0
Totals	**11,497**	**100%**	**34**	**15.6**	**14**

Table 2. Soil map unit, taxonomic great group, and vegetation type for NEON plots at RMNP.

Symbol	Map Unit Name	Taxonomic Great Group	Dominant Vegetation
2101B	Pachic Argiustolls, 5 to 25 percent slopes		
2703B	Cypher-Ratake families complex, 5 to 40percent slopes	Haplustolls	Ponderosa
2704D	Typic Haplustolls-Cathedral family-Rock outcrop complex, 40 to 150 percent slopes	Haplustolls	Ponderosa
2705D	Ratake-Cathedral families- Rock outcrop complex, 40 to 150 percent slopes		
2706D	Cypher family-Rock outcrop complex, 40 to 150percent slopes		
2717B	Cypher-Wetmore-Ratake families complex, 5 to 40percent slopes		
4703D	Bullwark-Catamount families- Rock outcrop complex, 40 to 150percent slopes	Haplocryepts	Douglas Fir
4704B	Bullwark-Catamount families- Rubble land complex, 10 to 40percent slopes	Haplocryepts	Douglas Fir
4758D	Catamount family-Rubble land- Bullwark family complex, 40 to 150percent slopes		
5101A	Pachic Argiustolls-Aquic Argiudolls complex, 0 to 15percent slopes		
6101A	Cryaquolls-Gateview family complex, 0 to 15percent slopes		
7102A	Cryaquepts-Cryaquolls complex, 0 to 1 percent slopes		
7201B	Leighcan family, till substratum, 5 to 40percent slopes	Dystrocryepts	Lodgepole
7700C	Leighcan family, 40 to 75 percent slopes	Dystrocryepts	Lodgepole
7701C	Leighcan family, 40 to 75 percent slopes, south aspects		
7702B	Frisco-Catamount, moist families complex, 5 to 40 percent slopes		
7709D	Leighcan family-Rock outcrop complex, 40 to 150 percent slopes, south aspects	Dystrocryepts	Lodgepole/ Limber
7710D	Leighcan family-Rock outcrop complex, 40 to 150 percent slopes		
7755B	Leighcan-Catamount, moist families complex, 5 to 40 percent slopes		
7757D	Leighcan-Catamount, moist families-Rock outcrop complex, 40 to 150 percent slopes		
7790B	Lithic Cryorthents, subalpine- Rubble land complex, 5 to 40 percent slopes	Cryorthents	Lodgepole
R0	Rock outcrop, 75 to 150 percent slopes		
W	Water		

Plot Findings

The 14 original plots chosen were sampled as planned. Field inspection of the plots at the beginning of sampling revealed these sites to be relatively consistent with the properties noted in the initial analysis and were not in need of moving.

The soils found were generally within the range of characteristics of mountain soils found on the granite and metamorphic basement rocks of the Northern Colorado Front Range (Table 3). Notably, all soils were in skeletal particle size families (except for one soil that was just under 35% rock fragments). Most of the soils sampled were similar to the published order 3 soil survey (CO 645 Arapahoe-Roosevelt National Forest Area) map units in terms of rock fragments, soil texture, depth class and thicknesses of the O, A and E horizons – which are characteristics that are probably of most importance for forest management and terrestrial ecosystem investigations for the Southern Rocky Mountains. However, our observations were notably different in that we found more soil development and a greater occurrence of argillic horizons and Alfisols than was found in the original mapping. In addition, two of the relatively lower elevation plots were not Mollisols as mapped but Inceptisols and Alfisols.

The soils formed principally in colluvium of granitoid igneous and high-grade metamorphic rocks of the basement complex of the Rocky Mountains. Since the parent materials are relatively consistent, much of the variation in soil properties occur due to climatic and vegetation differences that are associated with elevation, aspect and slope position. Progressing from the relatively warmer and dryer plots to cooler and wetter plots presents increasing precipitation, decreasing temperatures, decreasing fire frequencies, and changes in vegetation composition, structure and productivity. For this reason, the soils in Table 3 and the discussion following are presented in this order to more easily observe the transitions.

Generally, as one progresses in this sequence, the A horizon thickness gets thinner to nonexistent, O and E horizons get thicker, pH and base saturation gets lower and soil depths are deeper. The soil depths at the higher elevation sites may be more impacted by thicker colluvial mantles from mountains of high relief and glacial till influences than to climatic differences.

Table 3. Soil observational data for the RMNP plots sampled. Estimated effective precipitation (est. effective precip) is based on aspect, surface shape and slope position so that, for example, a north-facing concave slope would have higher effective precipitation than a south-facing convex slope. Depth class: VS- 0-25cm, SH- 25-50cm, MD- 50-100cm, DE- 100-150cm, and VD- >150cm. Presence of a particular tree species is indicated with a "y".

NEON plotID	precip mm	est. effective precip mm	elev m	moisture regime	MU SYM	Depth Class	Series	Field Determined Taxonomic Class	Ponderosa Pine	Douglas Fir	Limber Pine	Lodgepole Pine	Aspen	Engelmann Spruce	Subalpine Fir
RMNP_016	548	500	2507	Typic Ustic	2703B	SH	Not Defined	Sandy-skeletal, mixed, superactive, frigid Lithic Ustorthents	y						
RMNP_030	544	525	2465	Typic Ustic	2703B	SH	Teaspoon	Loamy-skeletal, mixed, superactive, frigid Lithic Argiustolls	y						
RMNP_019	561	525	2649	Udic Ustic	4704B	SH	Redfern	Loamy-skeletal, mixed, superactive, Lithic Haplocryalfs*	y		y	y	y	y	
RMNP_017	569	550	2570	Udic Ustic	4703D	VS	Not Defined	Loamy-skeletal, mixed, superactive Lithic Cryorthents*	y		y	y		y	y
RMNP_002	554	550	2680	Ustic Udic	2704D	DE or VD	Not Defined	Loamy-skeletal, mixed, superactive Ustic Haplocryalfs*	y	y	y	y		y	y
RMNP_020	561	600	2760	Typic Udic	7790B	MD	Not Defined	Loamy-skeletal, mixed, superactive Typic Haplocryalfs				y	y	y	y
RMNP_003	569	600	2625	Typic Udic	4703D	SH	Not Defined	Sandy-skeletal, mixed, superactive Lithic Dystrocryepts				y		y	y
RMNP_010	668	625	2860	Ustic Udic	2704D	MD	Not Defined	Sandy-skeletal, mixed, superactive Ustic Haplocryepts*	y	y	y	y	y		y
RMNP_026	706	700	2743	Typic Udic	7201B	DE or VD	Jaegie	Fine-loamy, mixed, superactive Eutric Haplocryalfs		y		y		y	y
RMNP_004	673	725	2812	Typic Udic	7700C	DE or VD	Frisco	Loamy-skeletal, mixed superactive Eutric Haplocryalfs				y		y	y
RMNP_014	731	775	2784	Typic Udic	7201B	DE or VD	Frisco	Loamy-skeletal, mixed, superactive Eutric Haplocryalfs				y		y	y
RMNP_024	768	775	2930	Typic Udic	7709D	DE or VD	Frisco	Loamy-skeletal, mixed, superactive Eutric Haplocryalfs				y			y
RMNP_018	747	800	2857	Typic Udic	7201B	DE or VD	Frisco	Loamy-skeletal, mixed, superactive Eutric Haplocryalfs				y		y	y

Asterisk (*) denotes taxon units in areas marginal to a frigid soil temperature regime.

Summary of Soils

RMNP_016: This plot occurs in map unit 2703B - Cypher-Ratake families complex, 5 to 40 percent slopes. This soil was a shallow Sandy-skeletal, mixed, superactive, frigid Lithic Ustorthents. There is no soil series set up for this taxon. Prominent characteristics of pedon include a sandy-skeletal particle size family and an ochic epipedon. Also observed was a Bw horizon that was too thin to qualify as cambic and a lithic contact at 43 cm. This pedon was very similar to the Cypher series but with higher sand contents (sandy-skeletal rather than loamy-skeletal).

RMNP_030: This plot occurs in map unit 2703B - Cypher-Ratake families complex, 5 to 40 percent slopes. This pedon was a classified as the shallow Teaspoon series. It is a Loamy-skeletal, mixed, superactive, frigid Lithic Argiustolls. Prominent characteristics include the loamy-skeletal particle size family, a mollic epipedon, an argillic horizon, and a lithic contact at 49 cm. Overall this pedon (Teaspoon series) had similar characteristics to the mapped Cypher series except for the lower mica content and the presence of an argillic horizon.

RMNP_019: This plot occurs in map unit 4704B - Bullwark-Catamount families-Rubble land complex, 10 to 40 percent slopes. This pedon was classified as the shallow Redfern series. The Redfern series is a Loamy-skeletal, mixed, superactive, Lithic Haplocryalfs. Prominent characteristics include a loamy-skeletal particle size family, an ochric epipedon, an argillic horizon and a lithic contact at 48 cm. This pedon was somewhat similar to the Bullwark series but had more development with an argillic horizon (rather than just lamellae) and a shallow lithic contact rather than the moderately deep Bullwark series.

RMNP_017: This plot occurs in map unit 4703D - Bullwark-Catamount families-Rock outcrop complex, 40 to 150 percent slopes. This pedon was classified as a Loamy-skeletal, mixed, superactive Lithic Cryorthents. There is no existing series that fits this pedon description. Prominent characteristics include an ochric epipedon, a cambic horizon, a lithic contact at 17 cm (very shallow) and a loamy-skeletal particle size family. Also notable is that about 35% of the area surrounding the pit had rock (bedrock) outcrop. This pedon was similar to the Catamount series but lacked the high mica contents of Catamount and contained a lithic rather than paralithic contact.

RMNP_002: This plot occurs in map unit 2704D - Typic Haplustolls-Cathedral family-Rock outcrop complex, 40 to 150 percent slopes. This pedon classified as a Loamy-skeletal, mixed, superactive Ustic Haplocryalfs. There is no existing series for this taxon. Prominent characteristics included an ochric epipedon, a very thick E horizon, an argillic horizon, loamy-skeletal particle size class with 33% clay in the argillic horizon and a depth greater than 110 cm to a paralithic or lithic contact. This pedon was not similar to either of the named components for this map unit.

RMNP_020: This plot occurs in map unit 7790B - Lithic Cryorthents, subalpine- Rubble land complex, 5 to 40 percent slopes. This pedon classified as a Loamy-skeletal, mixed superactive Typic Haplocryalfs. There is no existing soil series for this pedon. Prominent characteristics

include an ochric epipedon, an argillic horizon, a loamy-skeletal (with coarse textures) particle size family and a paralithic contact at 79 cm. This pedon was very dissimilar similar to the named components for this map unit.

RMNP_003: This plot occurs in map unit 4703D - Bullwark-Catamount families-Rock outcrop complex, 40 to 150 percent slopes. This pedon classified as a Sandy-skeletal, mixed, superactive Lithic Dystrocryepts. There is no existing soil series for this taxon. Prominent characteristics include an ochric epipedon, a cambic horizon, a sandy-skeletal particle size family and a lithic contact at 79 cm. This soil is similar to the Catamount series but with slightly sandier textures, a lithic rather than paralithic contact and less mica than Catamount.

RMNP_010: This plot occurs in map unit 2704D - Typic Haplustolls-Cathedral family-Rock outcrop complex, 40 to 150 percent slopes. This pedon classified as a Sandy-skeletal, mixed, superactive Ustic Haplocryepts. There is no existing soil series for this taxon. Prominent characteristics include an ochric epipedon, a cambic horizon, a sandy-skeletal particle size family and a lithic contact at 70 cm. This soil is dissimilar to both named components of the map unit chiefly because of the ochric rather than mollic epipedon and sandier textures.

RMNP_026: This plot occurs in map unit 7201B - Leighcan family, till substratum, 5 to 40 percent slopes. This pedon classified as the Jaegie series, a Fine-loamy, mixed, superactive Eutric Haplocryalfs. Although rock fragments were still relatively high, the fine-loamy particle size family observed in this pedon was the only non-skeletal soil described in the NEON plots. Other prominent characteristics include an ochric epipedon, an argillic horizon and a depth greater than 110 cm to a lithic or paralithic contact. This pedon differed from the Leighcan series in having more development with an argillic horizon, higher clay contents, and fewer fragments. Field observations could not definitively determine if this pedon was over a glacial till substratum. The profile was more indicative of colluvium or possibly colluvium from glacial till.

RMNP_004: This plot occurs in map unit 7700C - Leighcan family, 40 to 75 percent slopes. This pedon classified as the Frisco series, a Loamy-skeletal, mixed superactive Eutric Haplocryalfs. Prominent characteristics include an ochric epipedon, an argillic horizon, a lithic contact greater than at least 80cm (probably greater than 150 cm) and a loamy-skeletal particle size family. The pedon is similar to the Leighcan series but differed in having more development and an argillic horizon rather than a cambic horizon.

RMNP_014: This plot occurs in map unit 7201B - Leighcan family, till substratum, 5 to 40 percent slopes. This pedon classified as the Frisco series, a Loamy-skeletal, mixed superactive Eutric Haplocryalfs. Prominent characteristics are an ochric epipedon, an argillic horizon, a lithic contact greater than at least 110 cm and a loamy-skeletal particle size family. This pedon is similar to the Leighcan series but differed in having more development and an argillic horizon rather than a cambic horizon. The parent material appeared to be biotite schist colluvium without strong evidence observed of glacial till.

RMNP_024: This plot occurs in map unit 7709D - Leighcan family-Rock outcrop complex, 40 to 150 percent slopes, south aspects. This pedon classified as the Frisco series, a Loamy-skeletal,

mixed superactive Eutric Haplocryalfs. Prominent characteristics include an ochric epipedon, an argillic horizon, a lithic contact greater than at least 110 cm and a loamy-skeletal particle size family. The pedon is similar to the Leighcan series but differed in having more development and an argillic horizon rather than a cambic horizon. Also, the 2nd component, rock outcrop, was not observed at this location.

RMNP_018: This plot occurs in map unit 7201B - Leighcan family, till substratum, 5 to 40 percent slopes. This pedon classified as the Frisco series, a Loamy-skeletal, mixed superactive Eutric Haplocryalfs. Prominent characteristics include an ochric epipedon, an argillic horizon, a lithic contact greater than at least 110 cm and a loamy-skeletal particle size family. The pedon is similar to the Leighcan series but differed in having more development, more clay and an argillic horizon rather than a cambic horizon. The parent material appeared to be granodiorite colluvium without strong evidence of glacial till observable.

RMNP_006: This plot occurs in map unit 7700C - Leighcan family, 40 to 75 percent slopes. This pedon classified as the Frisco series, a Loamy-skeletal, mixed superactive Eutric Haplocryalfs. Prominent characteristics include an ochric epipedon, an argillic horizon, a lithic contact greater than at least 120 cm (probably greater than 150 cm) and a loamy-skeletal particle size family. The pedon is similar to the Leighcan series but differed in having more development and an argillic horizon rather than a cambic horizon.