United States Department of Agriculture

NEON Site-Level Plot Summary
Teakettle (TEAK)

Document Information

Date
January 2022

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Site Background

This NEON site is located in Major Land Resource Area 22A (Sierra Nevada Mountains) and is 12,697 acres in size. It is located in Fresno County, California in the Sierra National Forest. Over 90 percent of the area falls within the *Southern Sierra Upper Montane Forest* ecoregion and the rest falls into the *Southern Sierra Mid Montane* ecoregion, as defined by the EPA.

The Sierra National Forest soil survey (Sierra National Forest Area, Parts of Fresno, California) was completed in 1983 and serves as the TEAK site base map seen in Figure 1. The mapping in this survey area was done at the family or higher level (as opposed to series). This means that there may be significant differences such as depth, particle size, fragment volume, surface horizon, etc., within a component of a map unit.

Site Information

Climatic information about the site was obtained from PRISM (Parameter-elevation Regressions on Independent Slopes Model). Data that fed the chosen model was collected from 1981 to 2010. Elevation and slope were derived using a 10 meter DEM (Digital Elevation Model) obtained from the Natural Resources Conservation Service's Geospatial Data Gateway.

Summary statistics for the climatic and topographic properties listed below were derived from raster data extracted from fixed-density sampling of the TEAK project area (5 points per acre, Table 1).

Table 1. Median physical and climatological data for the NEON TEAK site. Effective precipitation = relative quantity of precipitation stored in the soil.

Annual air temperature (degrees C)	Annual precipitation (mm)	Effective precipitation (mm)	Frost-free days	Growing degree days (degrees C)	Elevation (m)	Slope gradient (%)
7	1230	698	112	1006	2304	18

Elevation: 2006 to 2805 meters (6581 to 9203 feet)

Parent Materials: Slope alluvium, colluvium, outwash and residuum derived from Permian to Tertiary aged intrusive igneous rocks, most of which is either granodiorite or quartz monzonite.

Geology: The northern portion of the study area is primarily Pleistocene aged glacial drift that extends south through the lowlands that are then bounded in the west, south and east by uplands comprised of Permian to Tertiary aged granodiorite and quartz monzonite. In the very SW corner of the study area early Proterozoic to Cretaceous schists and gneisses were mapped.

Land Use: Habitat for wildlife, , outdoor recreation, timber production, livestock grazing and as part of the Sierra Nevada watershed which provides over 60 percent of California's developed water supply..

Vegetation: Evergreen forest and shrub/scrub are dominant land cover types. Tree species include *Abies magnifica*, *Pinus contorta*, and *Abies Iowiana*. Shrub species include *Ceanothus cordulatus*, *Arctostaphylos spp.* and *Chrysolepis sempervirens*.

Landforms and Climate: Landforms in this mountainous area include mountains, mountain slopes, summits, ridges, spurs, mountain valleys, and drainageways. Mean Annual Air Temperature (MAAT) is 7 degrees C (45 Fahrenheit) and Mean Annual Precipitation (MAP) is 1230 mm (48 inches).

Soils: Soil map units that occur within the TEAK site were certified in 1983 with the publication of the Soil Survey of Sierra National Forest Area, California (Giger and Schmitt, 1983). Map unit components are comprised of soil families and subgroups (meaning there may be significant differences such as depth, particle size, fragment volume, surface horizon, etc., within a named component of a map unit). Components include: Cagwin family (Mixed, frigid Dystric Xeropsamments), Cannell family (Coarse-loamy, mixed, superactive, frigid Typic Dystroxerepts), Entic Cryumbrepts, Gerle family (Coarse-loamy, mixed, superactive, frigid Humic Dystroxerepts) Lithic Xeropsamments, Sirretta (Sandy-skeletal, mixed, frigid Dystric Xerorthents) and Stecum (Sandy-skeletal, mixed Typic Cryorthents) families, and Umpa family (Loamy-skeletal, isotic, frigid Andic Dystroxerepts) (Table 2).

There are two discrepancies to note with the 1983 soil survey that pertain to field conditions reported. First, the soil polygons on the imagery display some spatial displacement. This most likely happened during the georectification of the hardcopy soil maps and is most noticeable in the northern third of the study area where delineations of rock outcrop (map unit symbol 147) are south and east of the actual area on the ground (Figure 1). Second, two of the above-mentioned soils, Entic Cryumbrepts, and Stecum family, have cryic soil temperature regimes. However, recent work in the surrounding area as well as modern temperature models do not support cryic regimes within the TEAK study area. All soils correlated at the TEAK site have frigid soil temperatures.

NEON TEAK Site

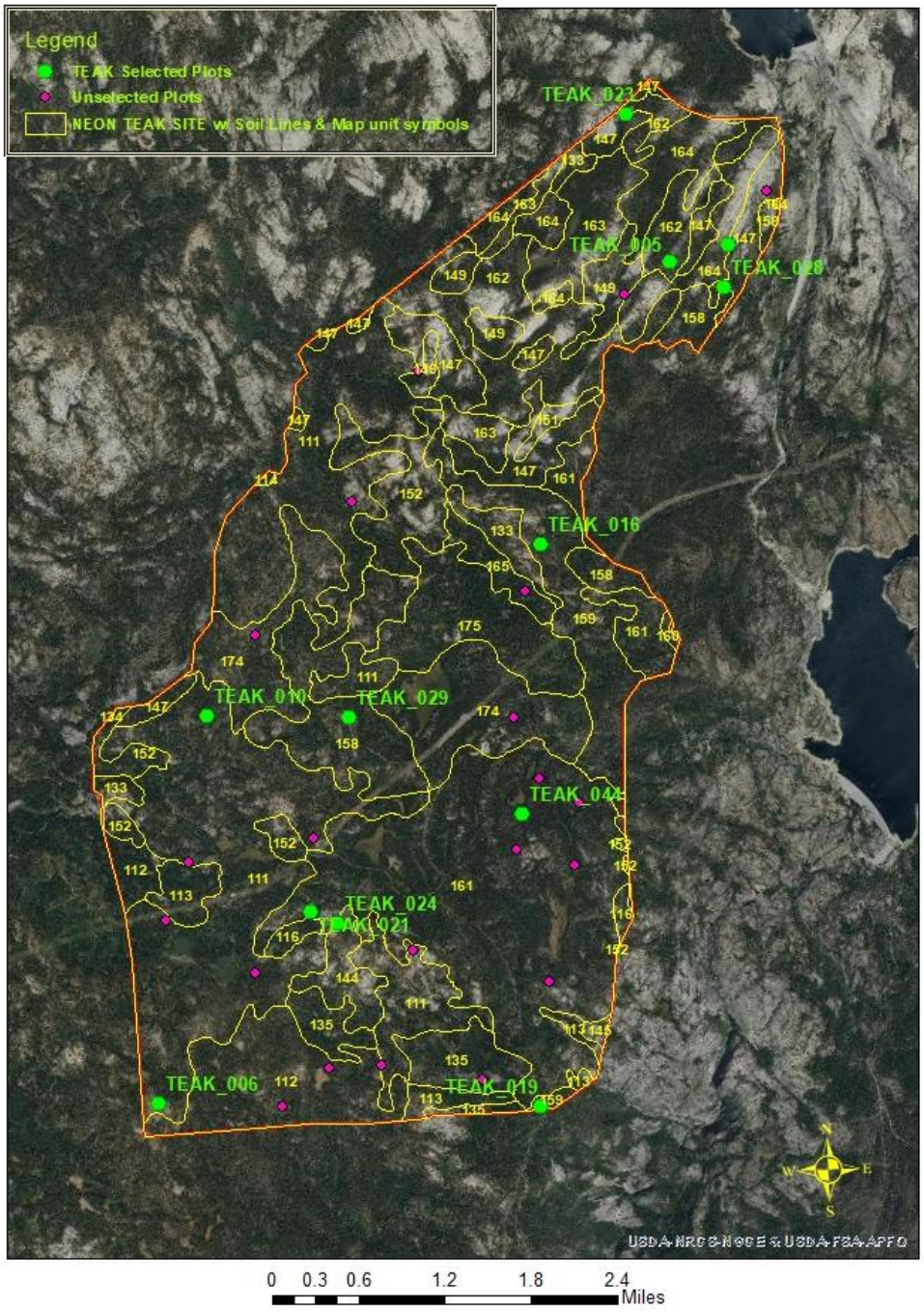

Figure 1. TEAK study area with 200-300 meter SE polygon displacement noticeable in the northern portion of the study area. The yellow numbers are soil map unit symbols, see Table 2 for more information about these.

Table 2. Soil map units and acreage on the NEON TEAK site. AOI = area of interest.

Sierra National Forest Area Parts of Fresno, California (CA750)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
160	Sirretta family-Rock outcrop complex, 45 to 65 percent slopes	9.8	0.1%
161	Sirretta family and Umpa family, wet, 2 to 25 percent slopes	2,279.5	18.0%
162	Stecum family, 3 to 35 percent slopes	760.3	6.0%
163	Stecum family-Aquic Cryumbrepts association, 1 to 25 percent slopes	387.0	3.0%
164	Stecum family-Rock outcrop complex, 5 to 45 percent slopes	529.6	4.2%
165	Stecum family-Rock outcrop association, 45 to 65 percent slopes	108.8	0.9%
174	Umpa family, 5 to 35 percent slopes	895.5	7.1%
175	Umpa family, 35 to 55 percent slopes	480.6	3.8%
Totals for Area of Interest		**12,696.6**	**100.0%**

Analysis of Plots for Sampling

Prior to sampling, an analysis of the entire site was undertaken to select the NEON plots that would best represent differences in map units, as well as capture the full range in variation according to hillslope profile position, slope gradient and slope aspect. The dominant hillslope profile positions identified at TEAK are shoulders, backslopes, and footslopes. It was also important to sample both evergreen forest and shrub-scrub cover types. Twelve plots (of 34 total) were selected for field description, sampling, and lab characterization. Table 3 lists the 12 selected plots with their NASIS user site ID, map unit symbol as found on Web Soil Survey (Soil Survey Staff, 2022), and the associated map unit name. The 22 plots not sampled either occurred in non-typical settings or had similar characteristics to one of the chosen plots. The TEAK_030 plot was originally designated as an alternate. TEAK_027 was one of the original 12 but was found to be inaccessible and so the decision was made to replace TEAK_027 with TEAK_030.

Table 3. TEAK NEON plots sampled, NASIS User ID, vegetation type and uncorrected map unit.

plotID	usersiteid	Land Cover	MUSYM	Map Unit Name
TEAK_006	S2021CA019011	evergreenForest	111	Cagwin family, 25 to 60 % slopes
TEAK_010	S2021CA019006	evergreenForest	111	Cagwin family, 25 to 60 % slopes
TEAK_024	S2021CA019010	shrubScrub	144	Lithic Xeropsamments-Rock outcrop association, 5 to 40 % slopes
TEAK_023	S2021CA019001	evergreenForest	147	Rock outcrop
TEAK_028	S2021CA019004	shrubScrub	147	Rock outcrop
TEAK_029	S2021CA019007	shrubScrub	158	Sirretta family, 25 to 50 % slopes
TEAK_016	S2021CA019005	evergreenForest	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes
TEAK_019	S2021CA019012	evergreenForest	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes
TEAK_021	S2021CA019009	evergreenForest	161	Sirretta family and Umpa family, wet, 2 to 25 % slopes
TEAK_044	S2021CA019008	evergreenForest	161	Sirretta family and Umpa family, wet, 2 to 25 % slopes
TEAK_005	S2021CA019003	evergreenForest	162	Stecum family, 3 to 35 % slopes
TEAK_030	S2021CA019002	shrubScrub	164	Stecum family-Rock outcrop complex, 5 to 45 % slopes

Taxonomic Classification, Series and Map Unit Correlation

After describing and sampling the soils in the field they were brought back to the Sonora CA office for preliminary classification (which may be adjusted according to lab characterization results), and series correlation. Three of the correlations were taxadjuncts, meaning there were minimal taxonomic differences in the soil as compared to the named series, but these differences are slight and do not affect the interpretive aspects of the named soil (Table 4).

Table 4. TEAK NEON plots preliminary pedon classification and series correlation.

plotID	Pedon Field Classification	Series	Lithology
TEAK_006	Sandy, isotic, frigid Vitrandic Humixerepts	Hockett	quartzite
TEAK_010	Coarse-loamy, isotic, frigid Vitrandic Humixerepts	Cannell Taxadjunct	granodiorite
TEAK_024	Sandy-skeletal, isotic, frigid Vitrandic Humixerepts	Halstead	granodiorite
TEAK_023	Sandy-skeletal, isotic, frigid Vitrandic Humixerepts	Sirretta Taxadjunct	glacial till
TEAK_028	Sandy-skeletal, isotic, frigid Vitrandic Humixerepts	Windowpeak	glacial till
TEAK_029	Coarse-loamy, isotic, frigid Vitrandic Humixerepts	Hockett Taxadjunct	granodiorite
TEAK_016	Sandy, isotic, frigid Vitrandic Humixerepts	Hockett	quartz monzonite
TEAK_019	Sandy, isotic, frigid Humic Dystroxerepts	Badgerpass	granodiorite
TEAK_021	Mixed, frigid Lithic Xeropsamments	Dorst Taxadjunct	granodiorite
TEAK_044	Coarse-loamy, isotic, frigid Vitrandic Humixerepts	Beetlerock	glacial till
TEAK_005	Sandy-skeletal, isotic, frigid Vitrandic Xerorthents	Lackey	glacial till
TEAK_030	Sandy-skeletal, isotic, frigid Vitrandic Humixerepts	Windowpeak	glacial till

Table 5 depicts the map unit that each of the selected plots occurs in. The map unit symbol and name on the left is the map unit designation without accounting for the offset and the map unit symbol and name on the right indicates the map unit when the offset is corrected. Highlighted plots are those that are in a different map unit than was originally assigned.

Table 5. TEAK NEON plots and map unit correlation when accounting for polygon offset. Yellow cells indicate plots where map units changed when displacement was accounted for.

plotID	MUSYM	Map Unit Name	MUSYM w/offset	Map Unit Name
TEAK_010	111	Cagwin family, 25 to 60 % slopes	111	Cagwin family, 25 to 60 % slopes
TEAK_006	111	Cagwin family, 25 to 60 % slopes	112	Cagwin-Cannell families complex, 2 to 25 percent slopes
TEAK_021	161	Sirretta family and Umpa family, wet, 2 to 25 % slopes	116	Cagwin family-Rock outcrop complex, 35 to 65 % slopes
TEAK_024	144	Lithic Xeropsamments-Rock outcrop association, 5 to 40 % slopes	144	Lithic Xeropsamments-Rock outcrop association, 5 to 40 % slopes
TEAK_028	147	Rock outcrop	147	Rock outcrop
TEAK_030	164	Stecum family-Rock outcrop complex, 5 to 45 % slopes	147	Rock outcrop
TEAK_029	158	Sirretta family, 25 to 50 % slopes	158	Sirretta family, 25 to 50 % slopes
TEAK_016	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes
TEAK_019	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes	159	Sirretta family-Rock outcrop complex, 15 to 45 % slopes
TEAK_044	161	Sirretta family and Umpa family, wet, 2 to 25 % slopes	161	Sirretta family and Umpa family, wet, 2 to 25 % slopes
TEAK_023	147	Rock outcrop	162	Stecum family, 3 to 35 % slopes
TEAK_005	162	Stecum family, 3 to 35 % slopes	164	Stecum family-Rock outcrop complex, 5 to 45 % slopes

Plot Findings – all of the information below accounts for a 200-300 meter SE offset of the delineations

When comparing these narrative descriptions to the TEAK Pedon Descriptions, note that 200 cm is recorded as the 'Bottom Depth' of the horizon, diagnostic feature and/or restrictive feature when bedrock with a hardness class from strongly coherent to indurated was encountered within 100 cm of the soil surface. All soil pits were dug no deeper than 100 cm below the surface.

Map unit 111 (Cagwin family, 25 to 60 percent slopes):

This map unit comprises 23 percent of the TEAK site and one of the 12 sampled plots: TEAK_010 classifies as a Coarse-loamy, isotic, mesic Vitrandic Dystroxerepts and has been correlated as a Cannell taxadjunct. It differs from the Cannell series in that it has recognized volcanic material in the control section. This plot has an evergreen forest vegetation type and is well drained. Red and white fir dominate the canopy. Landform position is the upper third of a mountain flank with 9 percent slope and a 272 degree aspect. Bedrock is granodiorite and parent material is slope alluvium and colluvium derived from granitics and glacial outwash. There are approximately 10 percent boulder erratics and rock outcrop at this plot. The pit that was sampled was the second hole that was dug. The first hole appeared to be on an old forestry skid trail that runs through the plot, and the soil directly underneath it was significantly compacted.

Map unit 112 (Cagwin-Cannell families complex, 2 to 25 percent slopes):

This map unit comprises 5.3 percent of the TEAK site and, when accounting for the probable delineation offset, contains 1 sampled plot: TEAK_006. This soil was also on the upper third of a mountain flank on a 19 percent slope and an aspect of 282 degrees. It classifies as Hockett: Sandy, isotic, frigid, Vitrandic Humixerepts. The bedrock encountered at 89 cm was found to be very strongly cemented granodiorite with fractures from 50 cm to greater than 2 meters apart.

This soil also supports an evergreen forest vegetation type although the canopy density is less here than is seen at TEAK_010. This is probably due to the soils at TEAK_010 being finer in texture and deeper, allowing for a greater water holding capacity. TEAK_006 soil, Hockett, very closely resembles the Cagwin series (Mixed, frigid Dystric Xeropsamments), the only difference being the Hockett series has darker color and more organic material in the surface horizon as well as the influence of volcanic material within the profile.

Map unit 116 (Cagwin family-Rock outcrop complex, 35 to 65 percent slopes):

This map unit is only 0.5 percent of the TEAK site and at first glance does not appear to contain any of the plots within it, but when the offset is accounted for TEAK_021 is found to be within the map unit. The soil found at this location was the only shallow (less than 50 cm) soil that was described at the TEAK site. This soil was 9 cm to indurated granodiorite with fractures that are greater than 2 meters apart. Despite the shallow depth and the abundance of rock outcrop within the plot (45% recorded) this plot was recorded as having an evergreen forest vegetation type. Sugar (*Pinus lambertiana)* and Jeffery pines (*Pinus jeffreyi),* were found at the site (no doubt growing in cracks in the bedrock) but the dominant species at this location was pinemat manzanita (*Arctostaphylos nevadensis).* This somewhat excessively drained soil is found on the upper third of mountain flanks in a convex-convex position, with 42 percent slope and a 274 degree aspect. It has been classified as a Mixed, frigid Lithic Xeropsamment and is a named inclusion in map unit 116. This soil has been correlated to the Dorst series as a taxadjunct.

Map unit 144 (Lithic Xeropsamments-Rock outcrop association, 5 to 40 % slopes):

This map unit is 1.2 percent of the TEAK site. One plot was sampled within this unit (TEAK_024). This plot is located on the upper third, or shoulder, of a mountain slope. Slope gradient at the soil pit location is 38 percent, aspect 38 degrees, and the vegetation type was recorded as shrub-scrub. Both greenleaf (*Arctostaphylos patula*) and pinemet (*Arctostaphylos nevadensis*) manzanitas, as well as bush chinquapin (*Chrysolepis sempervirens*) are found at this site. The soil was classified as Sandy-skeletal, isotic, frigid Vitrandic Humixerepts (Halstead series) which is very similar to the Sirretta series (Sandy-skeletal, mixed, frigid Dystric Xerorthents) that makes up 10% of the map unit. The main differences between the soils are slightly more development and evidence of volcanic ash in the Halstead series (e.g., in this plot). The rock content and coarse texture of the particle size control section, along with the convex-convex shoulder position make this soil somewhat excessively drained. The soil at this location was 79 cm deep. Bedrock was very strongly cemented granodiorite, with factures greater than 2 meters apart.

Map unit 147 (Rock outcrop):

This map unit comprises 5.3 percent of the TEAK site. According to the soil survey this map unit is ninety percent rock outcrop or soil less than 10 cm deep. The other ten percent of the unit are small areas of soils that are delepoed enough to support vegetation. Two plots were sampled within this map unit. TEAK_028 and TEAK_030, both were recorded as having shrub-scrub

vegetation types and both were classified as Sandy-skeletal, isotic, frigid Vitrandic Humixerepts. hese soils were both deeper than 100 cm and were correlated to the Windowpeak series which is a very deep (>150 cm) soil. The geology map lists the northern portion of the TEAK site as being glacial drift and in the area where these plots are found exposed bedrock as well as areas of glacial deposition exist. These somewhat excessively drained, highly sloped (028: 50 percent & 030: 40 percent) soils support a diverse shrub community including manzanita (both pinemat and greenleaf) *Arctostaphylos nevadensis* and *patula* respectively; chinquapin (*Chrysolepis sempervirens)*; whitethorn ceanothus, (*Ceanothus cordulatus)* and birchleaf mountain mahogany, (*Cercocarpus montanus).* A few white fir (*Abies Iowiana)* are also found in the area, rooting in either the cracks in the bedrock or in the very deep, very rocky soils.

Map unit 158 (Sirretta family, 25 to 50 percent slopes):

This map unit comprises 5.7 percent of the TEAK site. One plot was chosen within this unit (TEAK_029). The soil pit within this plot occurred on a footslope of a hill with a slope gradient of 24 percent and an aspect of 78 degrees. The soil was found to be 83 cm in depth, over moderately hard granodiorite. It is well drained, with a coarse-loamy particle size control section, and very few fragments. This soil is very similar to the Cagwin series which is a Mixed, frigid Dystric Xeropsamments (and a named inclusion in the map unit) and has been correlated as a Hockett taxadjunct. The only difference being this soil has a slightly finer particle size control section than the Hockett series. The parent material is glacial outwash and slope alluvium derived from granitics. The National Land Cover Dataset (NLCD) listed this area as a shrub/scrub vegetation type but 30 percent of the canopy at this plot is occupied by white fir *(Abies Iowiana)* and Jeffrey pine *(Pinus jeffreyi Balf).* The concave footslope position is likely influencing soil moisture and water availability; allowing trees as well as shrubs to thrive at this site.

Map unit 159 (Sirretta family-Rock outcrop complex, 15 to 45 percent slopes)

Two of the TEAK NEON plots are located in this map unit comprising 4.2 percent of the total area. TEAK_016 was found to be a Sandy, isotic, frigid Vitrandic Humixerepts (Hockett) with indurated granodiorite encountered at 96 cm, while TEAK_019 was correlated to Badgerpass (Sandy, isotic, frigid Humic Dystroxerepts). Hockett is very similar to Cagwin, a moderately deep Mixed, frigid Dystric Xeropsamments, which is a minor component in this map unit. Badgerpass is also similar but very deep. Both of these plots are under evergreen forest vegetation types. TEAK_016 supports red fir *(Abies manifica);* while incense cedar (*Calocedrus decurrens*) and white fir *(Abies Iowiana)* can be found at TEAK_019. Both plots have significant areas of rock outcrop: TEAK_016, approximately 7 percent, and TEAK_019, 20 percent and both have stones and boulders on the soil surface.

Map unit 161 (Sirretta family and Umpa family, wet, complex, 2 to 25 percent slopes):

This map unit is 18 percent of the total TEAK NEON site and contains one sampled plot, TEAK_044. This plot was chosen during the pre-analysis because it was the flattest (8 percent gradient) and potentially wettest plot in the entire site. Site 044 is a tower plot and as such was sampled by auger only. The Siretta and Umpa soils have at least 35 percent rock fragments in the particle size control section. This soil had sandy loam textures with only 3 to 5 percent gravels to at least 100 cm. It was correlated to the Beetlerock series: Coarse-loamy, isotic, frigid Vitrandic Humixerepts. The parent material is well drained, glacial outwash and supports heavy stands of lodgepole pine (*Pinus contorta*) and white fir *(Abies Iowiana).* Although evidence of saturation was not evident within 100 cm, this site is assumed to be influenced by ground water due to the proximity of the adjacent wet meadow.

Map unit 162 (Stecum family, 3 to 35 percent slopes):

This map unit is 6 percent of the total area and contains TEAK_023 (with a recorded evergreen forest vegetation type). This soil is sandy-skeletal and granodioritic bedrock was recorded as being at 61 cm. It was noted however that this 'bedrock' may, in fact, be a very large erratic. This plot was located in a foot slope position on a mountain flank next to what appear to be several lateral moraines. The glaciation that occurred in the area make the assumption quite possible, although difficult to prove. Stands of very large, healthy Sierran lodgepole (*Pinus contorta* subsp. *Murrayana)* as well as red and white fir (*Abies magnifica and Abies concolor* respectively) indicate that if it is bedrock is has significant fractures, or perhaps, what was recorded as bedrock was, in fact, a large boulder. As was mentioned earlier the Stecum series (Sandy-skeletal, mixed Typic Cryorthents) has a cryic temperature regime which is colder than the area of TEAK. This soil was correlated to Sirretta (Sandy-skeletal, mixed, frigid Dystric Xerorthents) as a taxadjunct (sandy-skeletal, isotic, frigid Vitrandic Xerothents), due to probable andic soil properties.

Map unit 164 (Stecum family-Rock outcrop complex, 5 to 45 % slopes):

This map unit is 4.2 percent of the total area of the TEAK NEON site and contains sampled plot number TEAK_005. This plot also appears to be on a moraine with the parent material for the plot being a combination of both colluvium and till. Bedrock was not encountered within 100 cm and by the size and amount (70 percent cobbles and stones) of rock fragments it is assumed that this is a very deep soil. It has been correlated to the Lackey series: Sandy-skeletal, isotic, frigid Vitrandic Xerorthents, and supports both red and white fir (*Abies magnifica and Abies concolor*) as well as Sierran lodgepole (*Pinus contorta* subsp. *Murrayana).*

Conclusion:

The entire NEON TEAK site was much more homogenous than was expected. The effects of glaciation are evident throughout the study area and include areas of scoured bedrock, till and erratic deposition, and outwash (which is practically devoid of fragments over 2mm in size), in the lower sloping areas. Soil textures are coarse, due to the parent material and very little, if any,

development was seen in these relatively young soils. This effort cataloged the variability seen in the area with the exception of the organic rich, meadow soils.

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