Substrates in a Vernal Pool Landscape as Illustrated in the Butte Area Natural Resources Conservation Service Soil Survey

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EDITORS' COMMENTS. The following abstract was used by Andrew Conlin for his oral presentation at the vernal pool conference in March 2010. The following paper was written by the editors of this volume, with help from Barbara Castro. These comments benefitted from a recorded presentation by Andrew Conlin, expanding on the talk he gave at the conference.

ABSTRACT. Soil Surveys characterize the dominant soil or soils that occur on landforms that can be delineated at a scale of 1:24,000. Delineations of similar landforms with similar soils are given the same map unit symbol and are described in the same map unit description. Landforms containing vernal pools typically have micro-topography that consists of mounds and swales. In the map unit descriptions associated with these landforms, separate soils are identified for the two positions, and the two soils are considered major components in a complex. The soils on the mounds and the soils in the swales can be different in regard to depth, texture, hydrology and vegetation. In some cases two major soils are recognized in the swales based on these characteristics. Within these map units with micro-topography, vernal pools typically occupy small areas within the swales where water is impounded in lower areas. Due to the low percentage of vernal pools in relation to the major soil components, vernal pools are identified as minor components in the map unit description. The soils in the vernal pools are not characterized other than being named as "Soils that are frequently ponded for long periods" and are flagged as vernal pools on their associated landform in the geomorphic position entry. A soil survey user who is interested in the soils in the vernal pools can infer that the soil characteristics in the vernal pool may be similar to the soil in the adjacent swale.

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PAPER PREPARED FROM ORAL PRESENTATIONS

SOILS IN THE CHICO AREA

This paper is initiated with a brief introduction to soils in the vicinity of Chico, California and comments on sources of information about soils, and ends with an analysis of substrates in a specific vernal pool landscape.

The Butte Area Natural Resources Conservation Services Soil Survey (Burkett and Conlin, 2006) covers parts of Butte and Plumas Counties in Northern California (Figures 1 and 2). This area has an average annual precipitation ranging from 20 inches in the valley in the west, to 80 inches in the mountains, only 30 miles to the east. Soils and topography are influenced by the volcanic Cascade Range in the north and the metamorphic and granitic Sierra Nevada in the south. The geomorphic regions of the central Butte County area are described

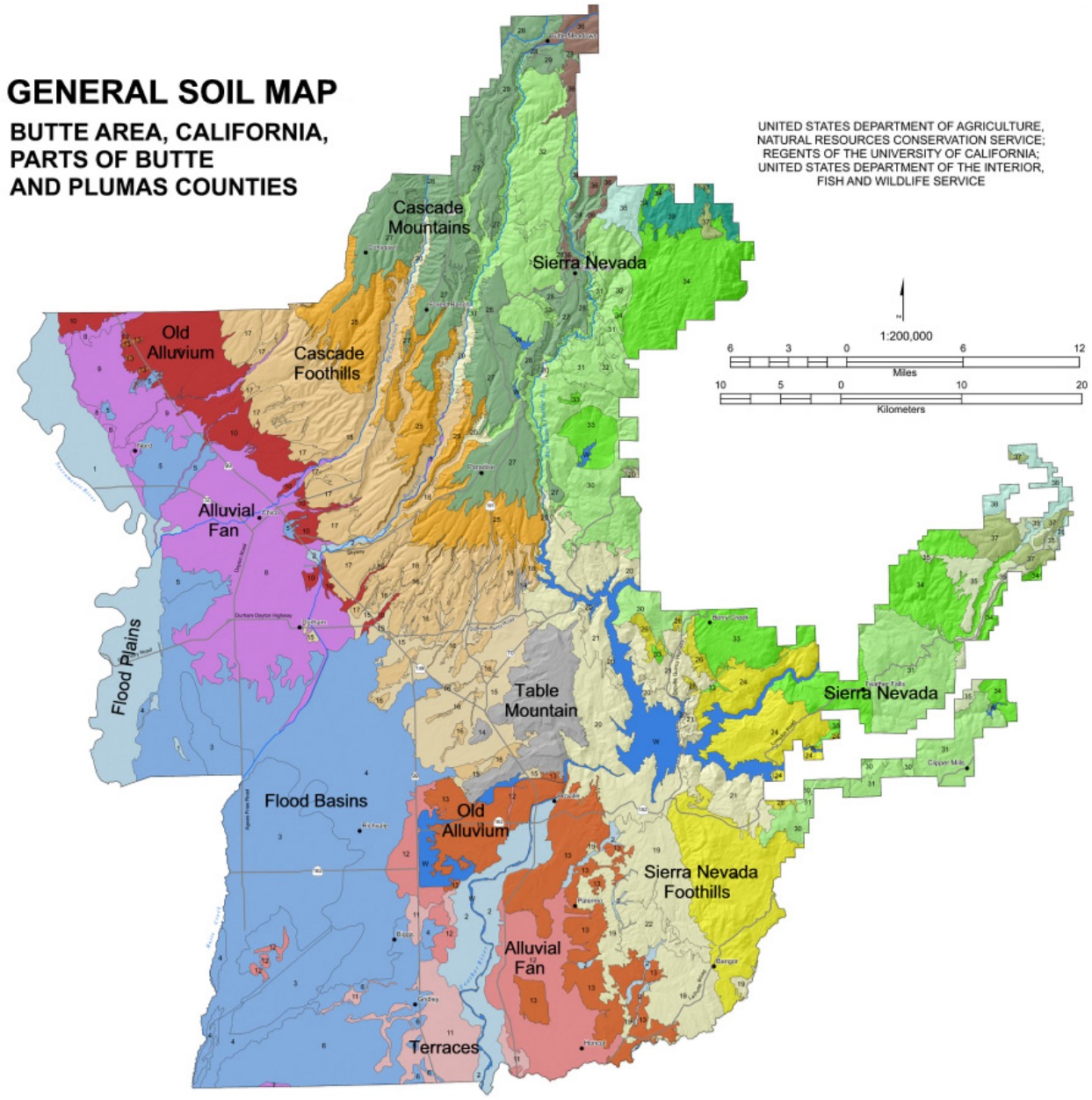

FIGURE 1. This general soil map covers the area surveyed by Burkett and Conlin (2006). The edges on the eastern (right) side of the map, are irregular because the survey area did not include parts of Butte County and extended into parts of Plumas County. This map illustrates north-to-south bands that are distinguished by colors (see text). This modified figure was presented by Andrew E. Conlin at the 2010 vernal pool conference in Chico. Figure 2 presents a modified cross section taken in the middle of this figure and that relates topographic features with this soil map.

in the following paragraphs.

Valley. On the far west of Figures 1 and 2, are deep, poorly-drained soils (colored blue) more recently impacted by the Sacramento River. These soils have developed a duripan and are heavily planted in rice, but they still do include some vernal pool landscapes such as those associated with the Sacramento Wildlife Refuge (Silveira, 2007).

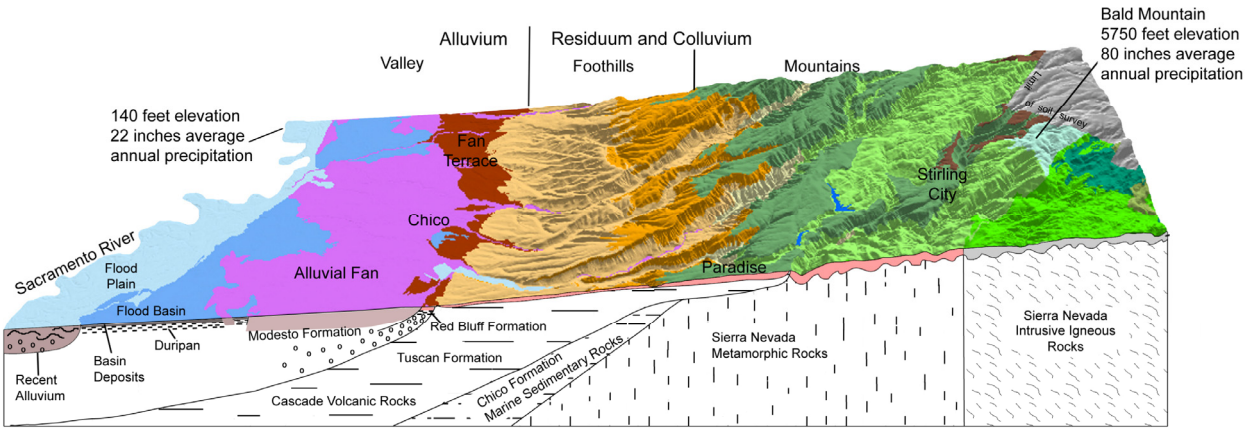

FIGURE 2. This modified figure was derived from Figure 29 (page 1244) in Burkett and Conlin (2006). This general block diagram illustrates the vertical progression encountered going from west (on the left) to east (on the right). The geologic formations are conceptual, for illustrative purposes only, and are not to scale. This modified figure was presented by Andrew E. Conlin at the 2010 vernal pool conference in Chico.

Old and new alluvial terraces. To the east, at the edge of the foothills, terraces of old valley alluvium (colored red-brown and brown) support a large number of vernal pool landscapes. Some of these landscapes have been replaced due to a variety of land use modifications by humans. The old alluvium occurs in isolated areas that are stable and without new sedimentation. These areas are cut by creek action into smaller units. The creeks that eroded the older alluvium established recent alluvium (colored lavender) that now support agricultural activity such as orchards.

The recent alluvial fans formed an irregular area between the Sacramento River and older terraces. Alluvial deposits (fans) are of different sizes depending on the magnitude of the contributing creek. For example, Chico Creek and Butte Creek have larger areas of alluvium, influenced by watersheds that include high mountains. In contrast, smaller creeks around Butte College have smaller areas of alluvium, influenced by watersheds that extend only to mountains in the Paradise area.

In the north, the older alluvial terraces (colored red-brown in Figures 1 and 2), were influenced by the Cascade Range. In the south, the older alluvial terraces (colored brown) were influenced by the Sierra Nevada.

Between these north (Cascade Range-influenced) and south (Sierra Nevadan-influenced) alluvial terraces, strath terraces are found with older alluvium over bedrock (see a description in the following section).

Foothills (woodland and chaparral). These soils (colored tan and yellow) transition from the old alluvial terraces up into the forests. These foothills occupy north-to-south bands that are divided by westward-flowing creeks. The middle of this region includes Feather River (with Lake Oroville) and Table Mountain (colored gray in Figure 1) which includes a few vernal pool landscapes on its relatively flat top (Jokerst, 1983; Sloop, 2011).

Mountains. This survey did not include forest soils (colored in shades of green).

SOIL MAP INFORMATION

Traditional soil surveys have been historically available as hard copy on 7½ minute quad-

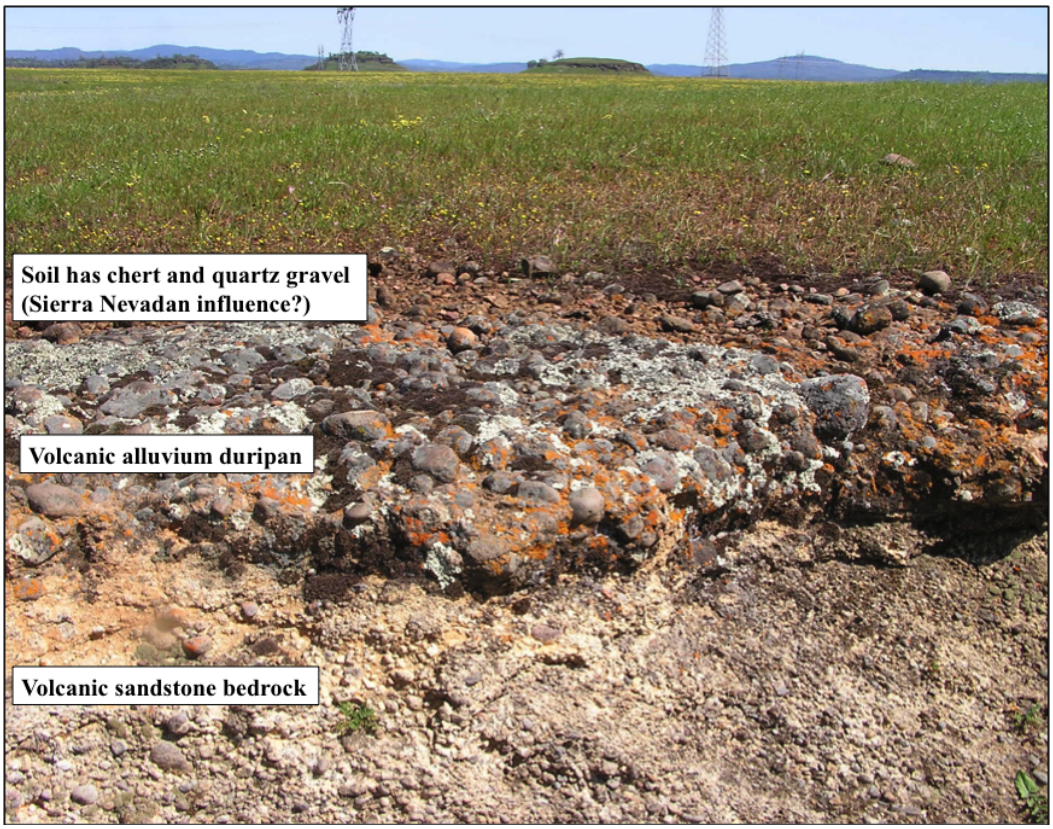

FIGURE 3. This picture illustrates a vertical cut through a strath terrace. The lowest layer is a volcanic sandstone bedrock that represents the former position of the flood plain. A volcanic alluvium was deposited on top of this bedrock. This deposit developed a duripan. The surface soil apparently has Sierra Nevadan influence as indicated by chert and quartz gravel. (This figure was presented by Andrew E. Conlin at the 2010 vernal pool conference in Chico.)

rangle maps. This same information can now be found in electronic files that are constantly updated, with both additional information and corrections. This information can also be viewed on electronic hand-held devices in the field.

Individual units on a soil map represent areas that contain the same landforms with similar soils (e.g., categories such as percent slope or depth to saturation). These areas are described by the percent composition of specific land forms. The resolution is influenced by the number of categories in the area described. This landform concept is unable to include small units when producing maps. As a result, detailed information about specific localities cannot be found on these maps developed to produce general information.

The Natural Resources Conservation Service (NRCS) offices and phone numbers are at http://offices.sc.egov.usda.gov/locator/app.

VERNAL POOL LANDSCAPES OVER STRATH TERRACES

The illustrated cross-section of a Butte County strath terrace (Figure 3) shows the volcanic sandstone bedrock that was leveled into a terrace by river action. An alluvial layer deposited over the bedrock has been in place so long that a duripan was formed. Vernal pools form in depressions over the duripan, which is

TABLE 1. Landscape components of Soil Survey of Butte Area Map Unit 677 (identified as "Tuscan-Fallager-Anita, gravelly duripan, complex, 0 to 3 percent slopes"). These old soils developed over volcanic sandstone bedrock that was leveled by stream activity (forming strath terraces). These surface layers developed volcanically-derived duripans. The current soil surface has chert, and quartz gravel, possibly of Sierra Nevadan origin. Vernal pool areas consist of only a small component (3% of the Map Unit).

Map unit composition	**Tuscan Gravelly Loam 40%**	**Fallager Loam 25%**	**Anita Gravelly Clay 15%**	**Minor Components 20%**
Percent slope	0-3	0-3	0-1	0-1
Geomorphic position	Mounds	Swales	Clayey swales	Vernal pools [3% of total]
Parent material (over cemented gravelly alluvium derived from volcanic rocks)	Loamy alluvium over clayey alluvium		Clayey alluvium	—
Depth to duripan	10-20 inches	4-10 inches	10-20 inches	—
Depth to bedrock	11-56 inches	5-46 inches	11-56 inches	—
Depth to zone of saturation (during rainy season)	2-20 inches	0-10 inches	0-20 inches	Pools potentially saturated at surface

water resistant (Table 1).

The strath terraces are higher than current, narrow stream terraces and extend from these to Tuscan Formation ridges. This area is a major component of soil Map Unit 677, identified as "Tuscan-Fallager-Anita, gravelly duripan, complex, 0 to 3 percent slopes."

The landscape components of Map Unit 677 are listed in Table 1. Vernal pool areas consist of only a small component (3% of the Map Unit). The area is dominated by Tuscan Gravelly Loam, found in mounds. Clay soils are found on the terrace along the edge of an adjacent Tuscan Formation ridge, and extend into the terrace in swales (larger drainage channels). Also, some smaller isolated swales contain clay soils. The clay soils are darker and support vegetation that remains green into the dry summer.

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