21 Human-Modified Soils of Tulare County, California

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http://www.ca.nrcs.usda.gov/mlra/wtulare/wtularefrm.html

General Nature of the Area

This section provides information about the western part of Tulare County. It discusses history and development; physiography, relief and drainage; native vegetation; water supply; agriculture; altered soils; and climate.

History and Development

Tribes of the Yokut Indians and some 30 or more sub-tribes of the Yokuts lived in the valley before settlers, explorers, and miners arrived. Villages used by the Indians are still recognized by the dark surface of the midden areas, the scattering of shells, chips of obsidian, and an occasional arrowhead. These American Indians lived along the shores of Tulare Lake and generally in the extensive riparian areas along the major rivers, mainly the Kaweah.

Tulare County was formed in 1852 from the southern part of Mariposa County. At that time, Tulare County covered land from Mariposa County to Los Angeles County. At later dates, parts of Fresno, Kings, Inyo, and Kern Counties were made out of the original Tulare County (Michell, 1972). In 1853, Visalia, named after the Kentucky home of city founder Nathan Vise (Preston, 1981), became the county seat of Tulare County.

In 1805, Gabriel Moraga, one of the earliest known explorers, came to the area in search of sites for missions. He gave Spanish names to the rivers he crossed on his way through the valley, which include the Kings River. The Kaweah River was given its name by early settlers, after the Gawia, a tribe of Yokuts that inhabited the region along the Kaweah River (Preston, 1981). The Tule River was named by early settlers for the rushes that flourished along its banks.

Jedediah Smith and his party were the first known trappers to come to the San Joaquin Valley in 1827. John C. Fremont, with Kit Carson as his guide, camped near the Kaweah River in 1844.

Settlement accelerated at the time of the gold rush in 1855. About 1910 the first systematic and scientific survey of the soils of the area began (Blake, 1853). Mining continued in the county into the 1870's. After the gold rush many people turned to open range grazing of cattle and sheep. Before the railroads, residents of Tulare County were dependent on wagon and stage roads. After the railroads were extended and more of a market for agricultural commodities was established, more and more people turned to farming, mostly dryland wheat. Wheat farming prospered in the county through the 1880's, and California ranked first or second in wheat production in the nation throughout the period. In 1884 more than 90 percent of the cropland was planted to wheat. Grain profits plummeted, reaching a low in 1894. Farmers began to turn to more profitable crops. As soils were depleted and because of the low rainfall in the area, crudely built canals were constructed to obtain water from the Kaweah River; thus, irrigated farming developed.

According to the United States Bureau of Census, the population of Tulare County was 149,264 in 1950. By 1990, the population reached 311,921.

About 95 percent of the land in the area is in private ownership. The remaining acreage is in city and county parks. National forest and national parklands in the county are excluded from the area. However, the Pixley National Wildlife Refuge of about 5,992 acres is included.

Elementary and secondary schools serve all parts of the area. Two community colleges are in Tulare County. College of Sequoias is in the area, and Porterville Community College is in nearby Porterville.

Electricity and natural gas are supplied to nearly all parts of the area. Telephone service is supplied to most of the area, and television, shopping centers, and other modern conveniences are also available.

Recreation is limited as almost all the land is under irrigated cultivation, the great majority of which is land-leveled. When this survey was made, three preserves of the Nature Conservancy existed; the Kaweah Oaks Preserve along the Kaweah River, Creighton Ranch Preserve along the Tule River, and the

Pixley Vernal Pool Preserve. These three preserves are examples of some of the last remaining vestiges of native landforms and native soils.

Colonel Allensworth State Historic Park is in the southwest part of the area. Founded in 1908, it represented the first community in the United States completely owned and managed by African-Americans.

Throughout the area, state highways and secondary roads connect smaller communities. Trucklines, airlines, buslines, and two railroads provide shipping facilities and transportation.

Native vegetation

The valley soils are mostly cultivated and support a variety of crops under irrigation. Some native vegetation remains on alluvial fans and fan remnants and in small-unreclaimed areas of saline-sodic soils. Native vegetation consisted of perennial grasses, forbs, shrubs and the California white oak on the alluvial fans and floodplains near the rivers and streams. Originally, on the Kaweah River alluvial fan, a continuous and dense forest of oaks extended from the foothills to the Tulare Lake shore. Much of the native vegetation in the area has been replaced by introduced species or has been eliminated by cultivation and overgrazing.

The valley land originally supported large herds of elk, prong horn antelope, and wild horses that grazed mainly on native grasses. Even as early as 1844, filaree, a forb from the Mediterranean region, was noted in the stands (Jepson, 1951). Marshes in the valley supported large areas of bulrush or tule and cattail. Trees and shrubs grew along many of the streams and rivers, as they do today. These include cottonwood, willow, western sycamore, wild rose, California blackberry, and California white oak.

In native areas on the fan remnants the present vegetation consists mainly of red brome, soft chess, foxtail, and filaree. In places bur clover and wild oats grow on the finer-textured soils in years when the supply of moisture is favorable. Many forbs, including such wildflowers as California poppy, blue lupine, brodiea, and buttercups, are conspicuous in spring.

The natural cover of the native saline-sodic soils consists of poor stands of red brome, soft chess, foxtail, and plants that tolerate salt and sodium. Among the plants that tolerate salt and sodium are saltgrass, alkali-mallow, alkali barley, and alkali blite.

Weeds are a serious problem in cultivated areas. Bermudagrass provides good forage in irrigated pasture and makes a durable lawn in this climate, but it is a serious pest in fields of row crops and in vineyards. Other pests are starthistle, sandbur, Russian-thistle, Johnsongrass, mustard, and fiddleneck. Puncture vine is particularly troublesome in sandy soils along shoulders of roads. Some of these weeds can be controlled by clean cultivation and introduced insects; others can be more effectively controlled by weed killers.

Water Supply

Water of generally good to excellent quality is available to the area from streams, rivers, reservoirs, springs, canals, and rainfall. The natural source is runoff or accumulation of rainfall and snowfall from the Sierra Nevada. Winter accumulation of snow in the higher mountains provides a seasonal reservoir of water. The water flows to the area mainly through the Kaweah, Kings, and Tule Rivers. Water from the major rivers is stored in surface reservoirs behind dams and in subsurface aquifers. These waters serve domestic, industrial, and agricultural users.

Water is diverted to the southern part of the San Joaquin Valley through the Friant-Kern Canal. This canal is along the eastern edge of the valley and is siphoned under the major rivers and larger streams. Water is diverted from the canal to irrigation districts. These irrigation districts distribute water to farmers in the central part of Tulare County.

The construction of Pine Flat, Success, and Terminus Dams, on the Kings, Tule, and Kaweah Rivers, has helped control flooding. The dams also help regulate the use of surface and ground water. This is necessary because much farming in the county is done by irrigating.

Pumping from the ground water reservoir supplies needed water during seasonal periods, when surface water is unavailable or during years of below normal precipitation. The ground water is replenished by infiltration of rainfall and tailwater from irrigated fields; by seepage from streams, unlined canals, ditches, and ponds; and by underground flow of streams through permeable material in canyons (Davis, 1963). Increased development of irrigated cropland, increased population, and new industry may make it necessary to utilize additional water supplies.

Agriculture

Highly specialized, intensive farming that uses a wide variety of crops has developed because of the combination of suitable soils, a plentiful supply of water for irrigation, and a long growing season.

Much of the income in Tulare County comes from the production of agricultural commodities. Tulare County often is the second or third county in the United States in total annual income from agricultural commodities. In 1990, agricultural income totaled over 2,169,000,000 dollars (Tulare County, 1990). The number one commodity in the county is milk. Tulare County is the largest dairy production county nationwide. Citrus production, primarily navel and Valencia oranges, is the number two commodity in the county.

Areas of citrus are mostly along the edges of the foothills. Agricultural income from grapes is usually third (figure 1), followed by beef cattle, almost all of which come from farmstead dairies. Cotton is the largest single crop grown, although cotton acreage varies widely from year to year, and usually ranks fifth in income. Plums are the most common fruit crop and are usually sixth in income. Other fruit crops of major importance include nectarines, peaches, olives, kiwi fruit and prunes. Nut crops are also common and include walnuts, almonds and pistachio nuts. Alfalfa hay commonly ranks seventh in income. Other agricultural commodities include poultry, mostly turkeys; wheat, hogs, beans, barley, apples, avocados, vegetable, and seed crops. These crops may be found on many of the soils countywide. The production of crops has been enhanced by soil reclamation.

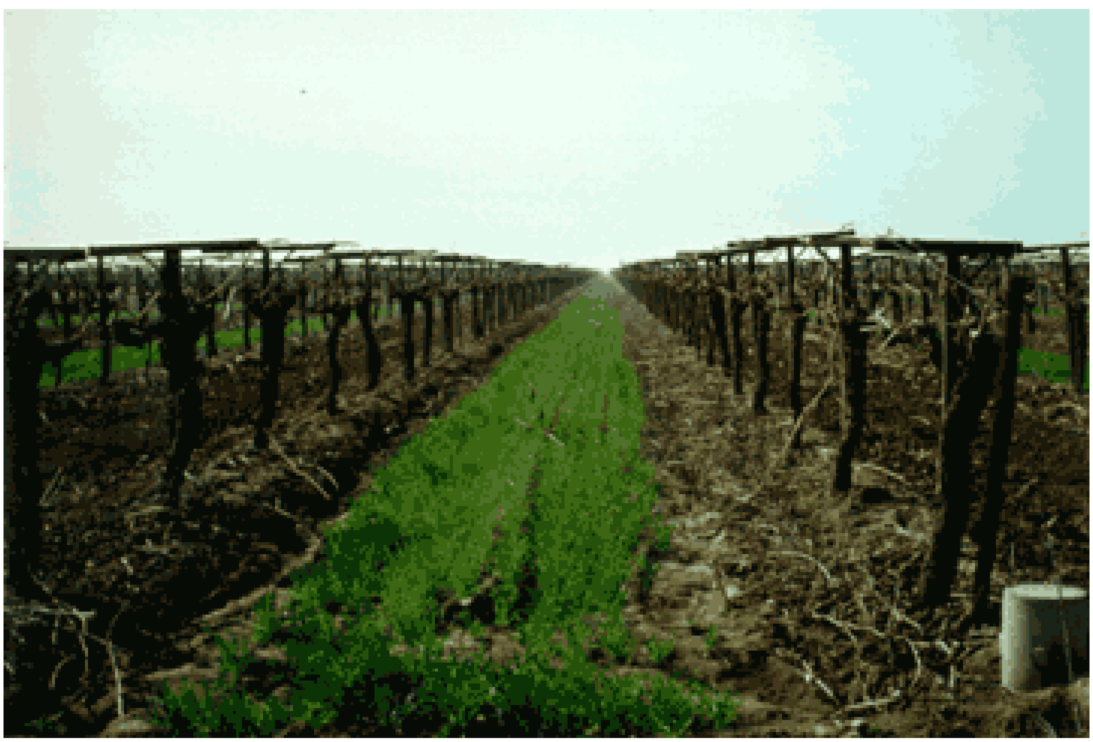

Figure 1. Grapes can be grown successfully on Exeter soils when the duripan has been mechanically ripped.

Nurseries in the county produce a wide variety of ornamental trees and shrubs, deciduous fruit and nut trees, citrus and subtropical trees, and grapes and berry vines. A large amount of apiary products come from Tulare County including honey and beeswax.

Physiography, Relief, and Drainage

The western part of Tulare County is entirely in the San Joaquin Valley. The San Joaquin Valley forms the southern half of the Central Valley, which is enclosed on all sides by mountains, except where the Sacramento and San Joaquin Rivers enter the San Francisco Bay. The Sierra Nevada forms a barrier on the eastern side of the valley. The western slope of the Sierra Nevada has many deep cut river canyons. The soils in the western part of Tulare County were dominantly formed from the deposition of alluvial material along these rivers draining the Sierra Nevada.

The western part of Tulare County is almost entirely nearly level and may be divided into three basic geomorphic units. These include the more recent alluvial fans and floodplains associated with the major drainages, the older fan remnants that occur between the major drainages, and the basin rims and flood plains along the eastern edge of Tulare Lake. Two small hills occur in the northeastern part of the area and account for less than 1 percent of the area. All these areas slope toward the west.

The alluvial fans and floodplains of the Kings River, Kaweah River, Tule River, White River, Cross Creek, and Deer Creek formed in the dominantly granitic alluvial material deposited as a result of runoff from the Sierra Nevada. The soils associated with these landforms account for more than half the acreage in the county. Most of these soils are prime farmland.

The older fan remnants occur in areas where more recent alluvial deposition has not occurred. These areas occur far from the rivers and streams, either in between them, and thus out of the path of recent deposition; or adjacent to the basin rim and beyond the area of recent deposition.

The basin rims and floodplains along the eastern edge of Tulare Lake were at one time flooded in most wet years. Formed by the entrapped drainage of the Kings, Kaweah, Kern, White, and Tule Rivers, Tulare Lake once inundated large areas. In 1862, Tulare Lake covered 486,400 acres (Preston, 1981). Other minor streams and creeks supply runoff to Tulare Lake during very wet years, but most of these are dry in summer. The flow of water into Tulare Lake has been greatly restricted by dams and reservoirs in the Sierra Nevada, and by levees, canals, and diversions of water for irrigation.

The Kaweah River enters the valley through a canyon in the mountains east of Woodlake. Terminus Dam, constructed at the mouth of the canyon, impounds the waters of Lake Kaweah. The Tule River enters the valley through a canyon in the mountains east of Porterville. Success Dam impounds the waters of Lake Success.

A short distance below these dams, the Kaweah and Tule Rivers divide into a number of old stream channels. At McKays Point the Kaweah River divides and branches into the St. Johns River. Many of these old channels are now used during the early part of summer to convey irrigation water. Most of the surface waters of the Kaweah and Tule Rivers are diverted and used for irrigation, but a large quantity of water sinks into the sandy flood plains to replenish the underground reservoir and is later pumped to the surface for irrigation. At one time the water table in the delta of the Kaweah and Tule Rivers was very close to the surface. This favored the growth of water grasses, willows, and cottonwood trees, but extensive pumping for irrigation has lowered the water table to a considerable depth, except in local areas where ground water is recharged from nearby streams. Smaller streams are Cottonwood Creek, south of the town of Seville; Cross Creek and Elbow Creek, north of the town of Goshen; Packwood Creek and Cameron Creek, south and east of the town of Visalia; Porter Slough, north of the town of Woodville; Deep Creek, Bates Slough, and Elk Bayou, south and west of the town of Tulare; Lewis Creek, east of the town of Lindsay; Deer Creek, east of the town of Terra Bella; and Mill Creek, west of the town of Visalia. These streams extend into the valley, but soon dry up by seeping into the sandy creek beds.

A distinctive and important feature that was very common to the older fan remnants, and to a lesser degree on the basin rim, is the mound-intermound microrelief, commonly referred to as hogwallow land (Nikiforoff, 1941, 1942; Page, 1977) or as Mima mounds (Arkley, 1954).

Viewed from a distance, the relief in undisturbed areas appears fairly smooth, but closer observation brings out the hogwallow relief of low mounds and shallow depressions (figure 2). The mounds range from 5 feet to 30 feet in diameter and from 2 feet to 4 feet in height. Areas having mound-intermound microrelief are drained by channels, but water generally stands in the depressions for a considerable period following heavy rains. Outlets are lacking, and the duripan or claypan prevents water from moving through the soil. One of the largest remaining areas of hogwallow land is the Pixley Vernal Pool Preserve of the Nature Conservancy.

Figure 2. Native areas of saline-sodic Jerryslu soils are shown in the foreground. The highly productive Atesh soils are located under the almond orchard in the background.

Altered Soils

Human activities have had a significant influence on many soils in Tulare County. Soils used for cultivation and urban development have been modified. In many areas they have been highly altered. Drainage systems have been used to lower high water tables which have altered the natural wetness of many soils. Levees, which protect areas from flooding, prevent the deposition of new sediments on flood plains.

Extensive land leveling also has occurred in some areas of Tulare County. Almost all areas are sloping to the west. Across the entire county, land leveling has occurred. Soil material has been cut from the upslope, eastside of the fields, and has been filled on the downslope, west side. As a result the surface layers in some areas have been completely removed from the upslope, east side of fields. On the downslope, west side of the fields, the fill material has buried the surface layers.

On fan remnants, the soils are commonly underlain by a duripan. In an area of approximately 71,000 acres (about 10 percent of the area) these duripans have been mechanically ripped to a depth of greater than 40 inches. These soils are modified in such a permanent manner that in the soil classification system they are called Arents. Also, 23,850 acres originally were soils that had a natric horizon and did not have a duripan. These soils have had this natric horizon chemically and mechanically modified, so much so that the natric horizon is no longer a limiting factor, thus forming an Arent. These permanently modified areas have greatly improved characteristics for farming (Figure 3, below).

Figure 3. Almond orchard in bloom on the Atesh soil. Atesh is a modified Jerryslu soil. Modifications of this site include land leveling, ripping of the duripan, irrigation, and fertilization (including additions of gypsum, manure, and elemental sulfur).

Drainage systems have altered the natural wetness of soils on more than 100,000 acres in the county. A soil that is saturated for prolonged periods has morphological features, such as redoximorphic concentrations or depletions of iron and manganese in the zone of saturation. Where artificially drained, the soil retains these features even though the water table may be lower or may be high for a shorter period. In the Tulare Lake basin and along the major rivers, water tables have been lowered and are managed by a system of field ditches, collector drainage ditches, and pumps that return drainage water to an adjacent channel.

Guidelines for Reclamation

Field and laboratory determinations indicate that amounts of soluble salts and sodium can vary considerably within short distances. Soil conditions vary so much, that a general statement cannot be made about the specific salts each soil contains or about the practices needed to improve any particular soil.

Some general guidelines can be given, however, that should be helpful in dealing with the problem. The key items to consider in planning a reclamation program are the following:

Water supply—ample supplies of water of good quality are a primary requirement. More water than is needed should be applied to grow crops. The additional water is for leaching the salts downward into the lower part of the subsoil or below. If extensive reclamation is planned in the area and the content of salt is not known, a laboratory determination should be made.

Drainage—adequate drainage is needed to remove excess salts from the soil. Whatever the other conditions may be, improvement is likely only to that depth in the soil for which adequate drainage can be provided. The better the drainage, the more readily excess salts can be removed. If drainage is not adequate, and no measures are taken to improve it, little change is likely.

Rate of internal drainage—many factors affect downward movement of water through the soil: Texture, bulk density, porosity, structure, and the shrinking or swelling of the soil upon wetting and drying. The more rapid the rate of internal drainage, the more quickly excess salts can be removed and the sooner improvement can be obtained.

The Lewis silty clay loam in the area is an example of a soil with dense, very slowly permeable subsoil and a cemented duripan. Unless this soil is deeply plowed and mixed or is ripped and the duripan is broken, reclamation generally is not successful.

Amount of excess salts and sodium—if internal drainage is adequate or is artificially improved, even severely affected saline soils can be readily improved by soaking the soil deeply. The use of sufficient water to flush the salts downward is all that is needed.

Removing excess sodium is somewhat more difficult and expensive than removing excess salts. A chemical change must take place in the soil. This is generally brought about by applying gypsum, or calcium sulfate. A soil test shows how much gypsum to use. Gypsum supplies the calcium to replace the excess sodium on the surface of the clay particles. Needed calcium can also be obtained by applying sulfuric acid in bulk quantities. The acid reacts with the calcium carbonate prevalent in the soil. Both the calcium and hydrogen ions work to displace the adsorbed sodium. The acid method often achieves quick results, but it is more expensive and extra care is needed in handling the acid. Elemental sulfur also can be used instead of gypsum, but sulfur takes longer to react. Before it can act, sulfur must be changed to sulfate. This is done by microbes living in the soil. About the same result is obtained using any of these materials, but time and cost differences should be considered.

Reclamation practices

On the basis of these guidelines, saline-sodic soils with duripans, such as the Kai, Lewis, or Jerryslu soils, require more intensive management to reclaim. The key practices needed to improve these soils include: leveling; deep ripping that shatters the duripan or substratum to improve internal drainage; establishing drainage ditches or subsurface drains; applying large amounts of gypsum or sulfur to correct the sodic conditions; applying water to leach excess salts downward; and establishing plants that tolerate salts and sodium.

Assistance in interpreting laboratory tests of soil and water and detailed reclamation schedules for various soil conditions can be obtained from your local office of the Natural Resources Conservation Service or the Tulare County Farm Advisor's Office.

Atesh Laboratory Tables

S92CA-107-002 (TULARE COUNTY, CALIFORNIA)
MAP SYMBOL: 103
SOIL NAME: ATESH-JERRYSLU ASSOCIATION, 0 TO 2 PERCENT SLOPES
CLASSIFICATION: COARSE-LOAMY, MIXED, SUPERACTIVE, CALCAREOUS, THERMIC SODIC TORRIARENT

SSL - PROJECT 93P 39, (CP93CA052) CA-TULARE WEST
- PEDON 93P 246, SAMPLES 93P 1968- 1982

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
NATIONAL SOIL SURVEY CENTER
SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	(- -CLAY- -) FINE LT .0002	CO3 LT .002	(- -SILT- -) FINE .002 -.02	COARSE .02 -.05	(- - - - - -SAND- - - - - - -) VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) - - - - WEIGHT - - - - 2 -5	5 -20	20 -75	.1- 75	(>2MM) WT % OF WHOLE SOIL
			<- - - - - - - - - - - - -	PCT OF <2MM	(3A1)	- - - - - -	- - - - -	- - -						->	<- PCT OF	<75MM(3B1)->			SOIL
93P1968S	0- 2	AP1	14.2	29.9	55.9	3.8	2.2	13.1	16.8	14.9	24.4	11.1	4.2	1.3	1	TR	--	42	1
93P1969S	2- 6	AP2	12.9	28.4	58.7	3.5	1.2	12.5	15.9	13.6	25.8	13.5	4.4	1.4	1	--	--	46	1
93P1970S	6- 14	AP3	6.8	25.4	67.8	1.6	1.5	14.8	10.6	13.4	26.8	17.6	7.0	3.0	2	TR	--	55	2
93P1971S	14- 23	AP4	5.0	26.7	68.3	0.9	1.8	15.3	11.4	13.6	27.7	17.4	6.4	3.2	1	TR	--	55	1
93P1972S	23- 28	AP5	5.4	37.1	57.5	0.8	2.8	24.4	12.7	14.2	21.4	12.2	6.7	3.0	1	--	--	44	1
93P1973S	28- 36	AP6	4.2	30.7	65.1	0.7	0.9	18.7	12.0	9.1	17.4	16.8	13.1	8.7	2	TR	--	57	2
93P1974S	36- 43	AP7	4.4	28.4	67.2	--	0.6	14.6	13.8	10.3	15.6	15.9	15.7	9.7	4	1	--	59	5
93P1975S	43- 49	2BTKQYMB	7.4	21.1	71.5	1.6	0.3	11.0	10.1	8.5	14.8	17.0	18.8	12.4	4	TR	--	64	4
93P1976S	49- 58	2BTKQYB	11.2	38.5	50.3	2.1		24.9	13.6	8.4	12.1	13.0	11.6	5.2	3	TR	--	44	3
93P1977S	58- 71	2BTKQB1	7.4	29.6	63.0	1.5	0.9	15.8	13.8	9.9	16.9	17.0	12.2	7.0	8	1	--	57	9
93P1978S	71- 83	2BTKQB2	3.9	25.4	70.7	0.8	0.9	12.7	12.7	12.8	15.2	18.2	15.5	9.0	3	1	--	60	4
93P1979S	83- 92	2BTKB	4.3	23.9	71.8	0.9	0.6	13.2	10.7	6.5	10.7	17.8	20.6	16.2	8	TR	--	68	8
93P1980S	92-100	3C	1.7	3.3	95.0	0.8	0.6	2.1	1.2	1.6	14.2	26.8	28.5	23.9	15	1	--	94	16

DEPTH (IN)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3b <- PERCENT	(- - DITH-CIT - -) EXTRACTABLE FE 6C2b	AL 6G7a OF	MN 6D2a <2MM -->	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1 PCT	PI 4F <0.4MM	(- BULK DENSITY -) FIELD MOIST 4A5 <- -	1/3 BAR 4A1d G/CC	OVEN DRY 4A1h - - ->	COLE WHOLE SOIL 4D1 CM/CM	(- - -WATER CONTENT - -) FIELD MOIST 4B4 <- -	1/10 BAR 4B1c -PCT OF	1/3 BAR 4B1c <2MM	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 2	0.83	0.107	16	--	0.3	TR	TR	1.06	0.52				1.48	1.53	0.011			15.4	7.4	0.12
2- 6	0.50	0.046	15					1.12	0.50				1.44	1.54	0.023			16.4	6.4	0.14
6- 14	0.13	0.035	--	--	0.3	TR	--	1.94	0.96				1.50	1.52	0.004			15.8	6.5	0.14
14- 23	0.10	0.005	--					2.80	1.32				1.38	1.40	0.005			17.9	6.6	0.15
23- 28	0.13	0.035	1	--	0.3	TR	TR	3.20	1.22				1.39	1.39	--			20.1	6.6	0.19
28- 36	0.06		--					3.24	1.05				1.67	1.67	--			13.2	4.4	0.15
36- 43	0.06		--		0.2	TR	TR	2.32	0.95				1.76	1.83	0.013			11.1	4.2	0.12
43- 49	0.08		TR					2.01	0.95				1.60	1.60	--			15.5	7.0	0.13
49- 58	0.03		9		0.4	0.1	TR	2.38	0.83				1.67	1.77	0.019			15.3	9.3	0.10
58- 71	0.04							2.01	0.80				1.75	1.90	0.026			13.2	5.9	0.12
71- 83	0.04				0.2	TR	TR	2.97	1.36				1.57	1.58	0.002			15.3	5.3	0.15
83- 92	0.03							2.07	1.00				1.56	1.80	0.046			13.3	4.3	0.13
92-100	0.02				0.1	0.3	--	1.53	0.82										1.4	

AVERAGES, DEPTH 25- 91: PCT CLAY 3 PCT .1-75MM 54
ANALYSES: S= ALL ON SIEVED <2mm BASIS G= <2mm ON GROUND <75mm BASIS P= FABRIC ON <75mm FRACTION

Atesh Laboratory Data--Continued

DEPTH (IN)	NH4OAC EXTRACTABLE BASES: CA 5B5a 6N2e	MG 5B5a 6O2d	NA 5B5a 6P2b	K 5B5a 6Q2b	SUM BASES	ACIDITY 6H5a	CEC: SUM CATS 5A3a	CEC: NH4-OAC 5A8b	EXCH NA 5D2	SAR 5E	BASE SATURATION: SUM 5C3	BASE SATURATION: NH4OAC 5C1	CARBONATE AS CACO3: <2MM 6E1g	CARBONATE AS CACO3: <20MM 6E4	CASO4 AS GYPSUM: <2MM 6F1a	CASO4 AS GYPSUM: <20MM 6F4	PH: SAT PASTE 8C1b	PH: CACL2 .01M 8C1f 1:2	PH: H2O 8C1f 1:1
	<- - - - - - - - - - -MEQ / 100 G							- - - - - - - - - - ->	PCT		<- -PCT- >		<- -PCT ->		<- -PCT ->				
0- 2		1.7	4.0	0.4				15.0	25	2	100	100	1		--		7.9	7.5	8.0
2- 6		1.3	3.5	0.2				14.4	24	2	100	100	1		--		8.0	7.6	8.2
6- 14		2.0	2.3	TR				13.2	18		100	100	4		--			7.8	8.6
14- 23		2.5	2.5	0.2				14.0	17	5	100	100	4		--		8.6	8.0	8.8
23- 28		2.9	3.4	TR				17.3	19	6	100	100	9		--		8.8	8.1	9.0
28- 36		2.3	2.4	TR				13.6	16	5	100	100	2		--		8.7	8.0	8.8
36- 43		1.8	2.1	TR				10.2	19	5	100	100	2		--		8.7	7.9	8.8
43- 49		2.4	4.5	TR				14.9	29	5	100	100	8		--		8.6	7.9	8.9
49- 58	21.3	1.6	3.8	0.1	26.8	--	26.8	26.7	14	5	100	100	--		--		8.4	7.8	8.7
58- 71		2.0	1.9	TR				14.9	12	5	100	100	2		--		8.4	7.9	8.7
71- 83		2.1	1.2	TR				11.6	9	5	100	100	2		--		8.4	7.9	8.7
83- 92		1.6	0.9	TR				8.9	8	5	100	100	1		--		8.3	7.8	8.6
92-100		0.9	0.4	TR				2.6	15		100	100	1		--			7.9	9.0

DEPTH (IN)	WATER EXTRACTED FROM SATURATED PASTE: CA 6N1b	MG 6O1b	NA 6P1b	K 6Q1b	CO3 6I1b	HCO3 6J1b	F 6U1a	CL 6K1c	SO4 6L1c	NO2 6W1a	NO3 6M1c	H2O 8A	TOTAL SALTS EST. 8D5	ELEC. COND. 8A3a MMHOS /cm	PRED. ELEC. COND. 8I MMHOS /cm
	< - - - - - - - - - - - - - - - -					-MEQ / LITER - - - - - - - - - - - - - - ->						<- -PCT- ->			
0- 2	9.4	1.4	4.8	0.1	--	12.0	0.1	0.9	1.8	TR	0.2	38.1	TR	1.28	0.45
2- 6	4.3	0.6	2.7	0.1	--	4.8	0.1	0.4	0.7	TR	0.5	36.2	TR	0.69	0.30
6- 14															0.23
14- 23	1.4	0.4	4.4	--	--	2.9	0.2	0.8	1.3	0.1	0.2	38.6	TR	0.58	0.27
23- 28	1.1	0.3	5.3	0.1	--	3.2	0.4	0.7	1.5	TR	0.1	41.2	TR	0.62	0.34
28- 36	1.0	0.3	4.4		--	2.4	0.4	0.8	1.7	--	TR	30.5	TR	0.58	0.26
36- 43	1.0	0.3	4.1		--	2.3	0.5	0.7	1.4	--	0.1	31.4	TR	0.53	0.25
43- 49	1.0	0.3	4.1		--	2.5	0.4	0.6	1.3	--	TR	37.6	TR	0.53	0.27
49- 58	0.9	0.3	4.2	0.1	--	2.1	0.3	0.9	1.6	--	TR	36.9	TR	0.55	0.26
58- 71	1.2	0.3	4.6		--	2.0	0.3	1.3	2.3	--	TR	32.8	TR	0.65	0.27
71- 83	1.8	0.4	5.0	TR		1.7	0.1	1.9	2.7	--	0.1	32.7	TR	0.79	0.28
83- 92	2.2	0.5	5.5	0.1		1.6	0.1	2.0	4.0	--	0.1	29.4	TR	0.87	0.28

MMHOS/CM OF 1:2 WATER EXTRACT (8I) & EXCH NA AS EXTRACTABLE NA FOR LAYERS 3,
ANALYSES: S= ALL ON SIEVED <2mm BASIS

Jerryslu Laboratory Data.

S92CA-107-001 (TULARE COUNTY, CALIFORNIA)
MAP SYMBOL: 103
SOIL NAME: ATESH-JERRYSLU ASSOCIATION, 0 TO 2 PERCENT SLOPES
CLASSIFICATION: FINE-LOAMY, MIXED, SUPERACTIVE, THERMIC TYPIC NATRIDURID

SSL - PROJECT 93P 39, (CP93CA052) CA-TULARE WEST
- PEDON 93P 245, SAMPLES 93P 1954- 1967

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
NATIONAL SOIL SURVEY CENTER
SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (IN)	HORIZON	TOTAL CLAY LT .002	TOTAL SILT .002 -.05	TOTAL SAND .05 -2	CLAY FINE LT .0002	CLAY CO3 LT .002	SILT FINE .002 -.02	SILT COARSE .02 -.05	SAND VF .05 -.10	SAND F .10 -.25	SAND M .25 -.50	SAND C .5 -1	SAND VC 1 -2	COARSE FRACTIONS WEIGHT 2 -5	WEIGHT 5 -20	WEIGHT 20 -75	WEIGHT .1- 75	(>2MM) WT % OF WHOLE SOIL
			<- PCT OF <2MM (3A1)											->	<- PCT OF <75MM(3B1)			->	
93P1954S	0- 1	A	8.8	44.7	46.5	2.2	1.6	19.9	24.8	16.1	18.4	8.9	2.6	0.5	TR	--	--	30	--
93P1955S	1- 3	E1	5.7	39.7	54.6	1.5	1.5	14.1	25.6	18.2	23.0	10.2	2.8	0.4	--	--	--	36	--
93P1956S	3- 4	E2	13.9	35.8	50.3	4.9	3.4	12.4	23.4	16.3	21.1	10.1	2.6	0.2	--	--	--	34	--
93P1957S	4- 9	BTKN1	25.1	26.9	48.0	13.0	1.2	11.7	15.2	12.3	21.2	11.6	2.5	0.4	TR	--	--	36	--
93P1958S	9- 12	BTKN2	16.2	30.2	53.6	6.6	1.5	16.1	14.1	13.4	21.0	15.2	3.6	0.4	TR	--	--	40	--
93P1959S	12- 17	BTKN3	16.7	48.4	34.9	5.7	0.6	25.3	23.1	13.5	12.3	6.9	1.8	0.4	TR	--	--	21	--
93P1960S	17- 29	BTKN4	17.3	49.1	33.6	5.4	1.2	27.0	22.1	16.6	11.1	3.7	1.6	0.6	TR	--	--	17	TR
93P1961S	29- 35	BTKN5	18.0	37.8	44.2	4.9	1.2	23.6	14.2	9.1	15.6	11.4	6.1	2.0	TR	TR	--	35	TR
93P1962S	35- 41	BTKQM1	11.1	28.5	60.4	2.9	0.6	14.2	14.3	13.5	18.8	13.7	10.4	4.0	9	24	2	65	35
93P1963S	41- 50	BTKQM2	14.0	28.5	57.5	4.8	1.5	13.2	15.3	12.1	18.5	12.4	9.0	5.5	2	1	--	47	3
93P1964S	50- 55	BTKQM3	12.7	20.7	66.6	3.7	2.1	9.9	10.8	8.8	16.9	13.9	15.4	11.6	14	27	8	78	49
93P1965S	55- 64	BTK	15.9	22.7	61.4	4.7	2.1	10.7	12.0	10.6	20.7	13.6	10.3	6.2	6	1	--	54	7
93P1966S	64- 72	2BKQ	10.9	19.7	69.4	3.2	2.1	9.6	10.1	11.2	20.5	15.9	12.1	9.7	8	1	--	62	9
93P1967S	72- 79	2BQ	6.3	20.1	73.6	2.4	1.8	9.9	10.2	9.5	21.6	17.9	14.7	9.9	11	1	--	68	12

DEPTH (IN)	ORGN C 6A1c PCT	TOTAL N 6B3a <2MM	EXTR P 6S3 PPM	TOTAL S 6R3b <- PERCENT	DITH-CIT EXTRACTABLE FE 6C2b	AL 6G7a OF	MN 6D2a <2MM -->	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1 PCT <0.4MM	PI 4F	(BULK DENSITY) FIELD MOIST 4A5 <- - G/CC	1/3 BAR 4A1d	OVEN DRY 4A1h - - ->	COLE WHOLE SOIL 4D1 CM/CM	(WATER CONTENT) FIELD MOIST 4B4 <- - -PCT OF <2MM	1/10 BAR 4B1c	1/3 BAR 4B1c	15 BAR 4B2a - ->	WRD WHOLE SOIL 4C1 CM/CM
0- 1	1.99	0.202	3	0.02	0.3	TR	--	1.44	0.59				1.89	1.97	0.014			17.3	5.2	0.23
1- 3	0.43	0.038	9					1.16	0.35				1.63	1.67	0.008			12.1	2.0	0.16
3- 4	0.27	0.043	--	0.03	0.3	TR		0.66	0.35				1.72	1.80	0.015			11.0	4.8	0.11
4- 9	0.13	0.010	--					0.65	0.39				1.66	1.76	0.018			13.8	9.9	0.06
9- 12	0.04	0.005	29		0.6	TR	--	0.84	0.40				1.45	1.51	0.014			17.7	6.5	0.16
12- 17	0.04		18					1.04	0.44				1.28	1.30	0.005			20.8	7.4	0.17
17- 29	0.05		24		0.9	0.1	TR	1.06	0.49				1.31	1.33	0.005			26.7	8.5	0.24
29- 35	0.06				0.6	0.1	TR	0.94	0.41				1.52	1.54	0.004			16.3	7.3	0.14
35- 41	0.05				0.2	TR	--	0.85	0.48				1.56	1.57	0.002			12.8	5.3	0.09
41- 50	0.01							0.71	0.41				1.73	1.78	0.009			10.8	5.7	0.09
50- 55	0.04				0.3	TR	--	0.83	0.36				1.99	2.00	0.001			7.8	4.6	0.04
55- 64	0.01							0.77	0.43				1.81	1.86	0.009			13.0	6.9	0.11
64- 72	0.01				0.3	TR	--	0.93	0.46				1.81	1.84	0.005			7.6	5.0	0.04
72- 79	--							1.06	0.65				1.77	1.78	0.002			8.7	4.1	0.07

AVERAGES, DEPTH 10- 60: PCT CLAY 18 PCT .1-75MM 27

Jerryslu Laboratory Data--Continued

DEPTH (IN)	CA 5B5a 6N2e	MG 5B5a 6O2d	NA 5B5a 6P2b	K 5B5a 6Q2b	SUM BASES	ACIDITY 6H5a	CEC SUM CATS 5A3a	CEC NH4-OAC 5A8b	EXCH NA 5D2 PCT	SAR 5E	BASE SATURATION SUM 5C3 (PCT)	BASE SATURATION NH4OAC 5C1 (PCT)	CARBONATE AS CACO3 <2MM 6E1g (PCT)	CARBONATE AS CACO3 <20MM 6E4 (PCT)	CASO4 AS GYPSUM <2MM 6F1a (PCT)	CASO4 AS GYPSUM <20MM 6F4 (PCT)	PH SAT PASTE 8C1b	PH CACL2 .01M 8C1f 1:2	PH H2O 8C1f 1:1
	<- - - - - - - - - - -MEQ / 100 G							- - - - - - - - - - ->											
0- 1		1.4	6.0	1.4				12.7	41	7	100	100	1		--		6.9	7.3	7.8
1- 3		1.1	5.9	0.4				6.6	76	17	100	100	2		--		7.8	7.9	8.5
3- 4		1.7	17.9	0.6				9.2	140	170	100	100	4		--		9.2	9.1	9.5
4- 9		1.6	31.6	1.0				16.4	142	307	100	100	2		--		10.1	9.7	10.0
9- 12		0.5	23.7	0.4				13.6	140	152	100	100	1		--		10.2	9.7	10.1
12- 17		0.7	25.9	0.4				17.3	112	203	100	100	1		--		10.3	9.7	10.1
17- 29		2.0	30.1	0.4				18.4	115	256	100	100	1		TR		10.3	9.8	10.2
29- 35		1.8	27.4	0.6				16.9	124	202	100	100	2		--		10.2	9.9	10.2
35- 41		2.6	16.5	0.2				9.4	147	94	100	100	5	7	--		8.9	8.7	9.3
41- 50		1.7	12.3	0.1				10.0	98	36	100	100	2		--		8.1	8.1	8.6
50- 55		2.4	9.5	0.2				10.5	74	20	100	100	3	3	--		8.1	8.0	8.3
55- 64		2.8	7.8	0.4				12.2	55	11	100	100	2		--		8.0	7.9	8.1
64- 72		2.4	3.0	0.3				10.1	22	5	100	100	1		--		8.0	7.8	8.2
72- 79	12.1	1.3	0.8	TR	14.2		14.2	6.7	11	3	100	100	TR		--		8.1	7.7	8.3

(- - - - - - - - - - - -WATER EXTRACTED FROM SATURATED PASTE- - - - - - - - - - - - - -)

DEPTH (IN)	CA 6N1b	MG 6O1b	NA 6P1b	K 6Q1b	CO3 6I1b	HCO3 6J1b	F 6U1a	CL 6K1c	SO4 6L1c	NO2 6W1a	NO3 6M1c	H2O 8A	TOTAL SALTS EST. 8D5	ELEC. COND. 8A3a MMHOS /cm	PRED. ELEC. COND. 8I MMHOS /cm
	< - - - - - - - - - - - - - - -MEQ / LITER										- - - - - - - - - - - - ->	<- -PCT- ->			
0- 1	11.1	2.1	17.5	2.0	--	16.9	2.6	7.2	2.8	--	--	48.8	0.1	2.70	0.83
1- 3	5.3	0.9	29.8	1.0	--	9.0	0.5	19.9	5.9	--	--	28.1	0.1	3.30	0.74
3- 4	2.2	0.3	190.6	1.6	--	10.4	--	113.3	54.9	--	--	26.6	0.4	16.00	4.06
4- 9	0.8	0.2	216.8	1.1	24.5	11.3	--	127.2	49.2	--	--	38.1	0.6	17.80	4.83
9- 12	1.0	0.3	122.8	0.4	13.6	9.1	--	68.1	28.6	--	TR	38.6	0.3	10.90	3.16
12- 17	0.6	0.2	128.6	0.2	13.0	9.1	--	72.7	29.7	--	TR	51.3	0.5	11.40	3.86
17- 29	0.6	0.2	162.0	0.2	16.8	11.3	--	87.4	40.5	--	--	54.9	0.6	14.00	4.66
29- 35	0.9	0.3	156.6	0.3	11.6	11.1	--	80.6	37.2	--	--	40.6	0.5	13.80	3.72
35- 41	1.3	0.4	87.0	0.2	--	3.7	--	63.1	20.5	--	--	30.6	0.2	7.68	1.88
41- 50	9.7	2.4	89.0	0.1	--	1.1	--	76.6	21.5	--	--	28.7	0.2	8.57	1.96
50- 55	9.6	2.4	48.0	0.1	--	1.0	--	51.8	7.7	--	--	37.1	0.2	5.60	1.47
55- 64	9.5	2.2	26.6	0.1	--	1.1	--	35.7	2.6	--	--	40.0	0.1	3.75	1.13
64- 72	7.1	1.6	10.9	0.1	--	1.0	--	16.7	1.2	--	TR	66.8	0.1	2.10	0.58
72- 79	4.3	1.0	4.5	0.1	--	0.9	0.1	9.2	0.3	--	TR	27.9	TR	1.09	0.30

ANALYSES: S= ALL ON SIEVED <2mm BASIS

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Appendix I – A personal note by Alan Wasner

"*Here on the Santa Monica Mtns. (#692 in NASIS) we have not had any Arents but we have had a lot of Orthents. The main thing I have done differently here (which has been difficult for me to get approved) was map units – as opposed to the previous way we did things - the changes are as follows: Old Way = Urban Land-Balcom Complex, 30-75% slope; new way = Xerorthents, Landscaped-Urban Land-Balcom complex, 0 to 75% slopes.*

You can see that the "new way" we have used on this survey would raise a lot of eyebrows because of the 0 to 75% slopes.

The old way totally ignored the "modified" soils on the landscape, ie: the Xerorthents. In this case, the Xerorthents would be people's yards, parks, etc. and have a slope like 0 to 5%.

Now, using the new way, we capture the interps on the "yards" and other landscaped areas, which are actually the dominant component in the data map unit.

Also, the Urban Land does have some data in NASIS and does have some interps, such as runoff. And its' slopes are 0-2%; therefore, the map unit shows the entire slope range of 0-75%.

The Balcom soils are 30-75% on sideslopes of hills intermingled very closely with the houses so at order 2 and on our mapping scale we couldn't cut it out. We are talking in areas like Beverley Hills and Bel Air, etc."