ATTACHMENT F-2

Summary of Soil Resources Information for the Proposed IABR Facility Luna County, New Mexico

April 2009

Assessment Methods

Based upon the Natural Resources Conservation Service (NRCS) soil survey of Luna County, New Mexico, a site-specific investigation was conducted to document the nature of the soils at the proposed IABR site. Between March 5 and 7, 2009, soil observations were made and sampling was conducted at 10 locations. At the time of the soil investigation, the location of the IABR facility was not known and soils on all land controlled by Sapphire were investigated. This consisted of property that has been termed the "eastern" and "western" parcels in this report. Since that time, the "western" parcels have been selected for the new IABR facility.

Soil was excavated at five locations within the western parcel, and five locations within the eastern parcels (**Figure 1**). A test pit was excavated at each location to a depth of 12 inches. A hand-augured borehole was then advanced from 12 inches to 36 inches below surface within the excavation, except if refusal was encountered at less than 36 inches. At each location, soil observations were recorded, photographs were taken, and soil samples were collected. At least three soil samples were collected from each location, corresponding with depths of 0-12, 12-24, and 24-36 inches, unless specific horizon changes or shallow refusal indicated other sampling intervals were appropriate. Soil samples were submitted to A&L Plains Agricultural Laboratories, Inc. (A&L) for chemical analysis.

Findings

The western parcel of the Sapphire property (site of the proposed IABR) contains two NRCS soil map units (**Figure 1**). These map units are Stellar silty clay loam (SU), which comprises the vast majority of the western portion, and a smaller area of the relatively coarse-grained Nickel-Tres Hermanas complex (NT).

The eastern parcels contain six NRCS soil map units (**Figure 1**). Most of the eastern parcel is mapped by NRCS either as the Nickel-Tres Hermanas complex (NT), or as Mohave sandy clay loam (MU). The bottom of a narrow drainage that runs through the eastern parcel is mapped as Mimbres and Verhalen soils (MR), a unit that is described by NRCS as being primarily silty clay loam. Three other map units are depicted by NRCS as isolated areas within the eastern parcel. These map units are Akela very gravelly loam (AG), the Pintura-Berino (PB) complex which includes eroded fine sand to loamy sand, and Stellar silty clay loam (SU).

Soil observations made during this study are included in **Appendix A** and photographs at each location are presented in **Appendix B**. The A&L laboratory report is presented in **Appendix C**. NRCS reports regarding soils of the Sapphire property are included in **Appendix D**. United States Department of Agriculture (USDA) Highly Erodible Land (HEL) determinations for the property are included in **Appendix E**.

1.1 Field Observations - Western Parcel (Site of Proposed IABR)

Field investigation of the western parcel conducted during this study included sampling of four locations across the SU map unit (Sites B1, B2, B4, and B5, **Figure 1**) and one location in the smaller NT map unit (Site B6, **Figure 1**).

The SU map unit was found to be relatively coarse-grained when compared to the NRCS description. Sandy silt was the primary texture class observed in the SU locations, with significant gravel layers at locations B1 and B2 near the western end of the western parcel. Potential soil changes within the SU map unit were indicated by areas dominated by thistle vegetation, in contrast to the majority of the SU map unit that was covered with bentgrass, cheatgrass, and minor amounts of yucca (**Figure 1**). No significant topographic changes were observed within the SU map unit. The observed soil conditions in the smaller NT map unit were generally consistent with the NRCS description of that unit as a gravelly loam.

1.2 Field Observations - Eastern Parcels

Field investigation of the eastern parcels conducted during this study was designed to sample all six of the NRCS map units, except the Akela very gravelly loam (AG). AG is mapped only in a small area along the Mexican border, and is the most coarse-grained map unit on the property, therefore it was not anticipated that ponds associated with the proposed project would be constructed in the AG area.

On the eastern parcels, differences in soil materials were observed between each of the five sampled locations (B8, B9, B10, B12, and B13, **Figure 1**), as would be expected based on the NRCS soil survey showing each location in a separate soil map unit.

1.3 Laboratory Results

The soil samples were analyzed by A&L for Sodium Adsorption Ratio (SAR), Electrical Conductivity (EC), and pH. SAR is used to evaluate the potential for sodium-related dispersion of clays, which may result in decreased permeability of clay-containing soils. EC is used to evaluate salt accumulation, and pH is used to determine if soils are acidic or alkaline. Values obtained for these parameters were within acceptable limits for agricultural use of the property, and had the following characteristics.

The SAR was moderate to low at most locations, with the exception of relatively-high SAR in all samples from location B2, in the deepest sample from location B5, and in the surface soil sample from location B10. The highest SAR value was 13.44 at location B10, which is approaching levels where sodium-related clay dispersion would be prevalent.

EC values ranged from 0.1 to 2.7 millimhos per centimeter (mmhos/cm). These EC values indicate that the soils of the property are not saline. Values for pH ranged from 7.8 to 8.8, which indicates that moderately to strongly alkaline soils are present at all sampled locations, however none of the samples were extremely alkaline.

1.4 Summary of Soil Resources Findings

Site-specific investigation of the western parcel (location of proposed IABR) indicated that soils were generally more coarse-grained than the silty clay loam designation given to most of the western parcel by the NRCS soil survey for Luna County.

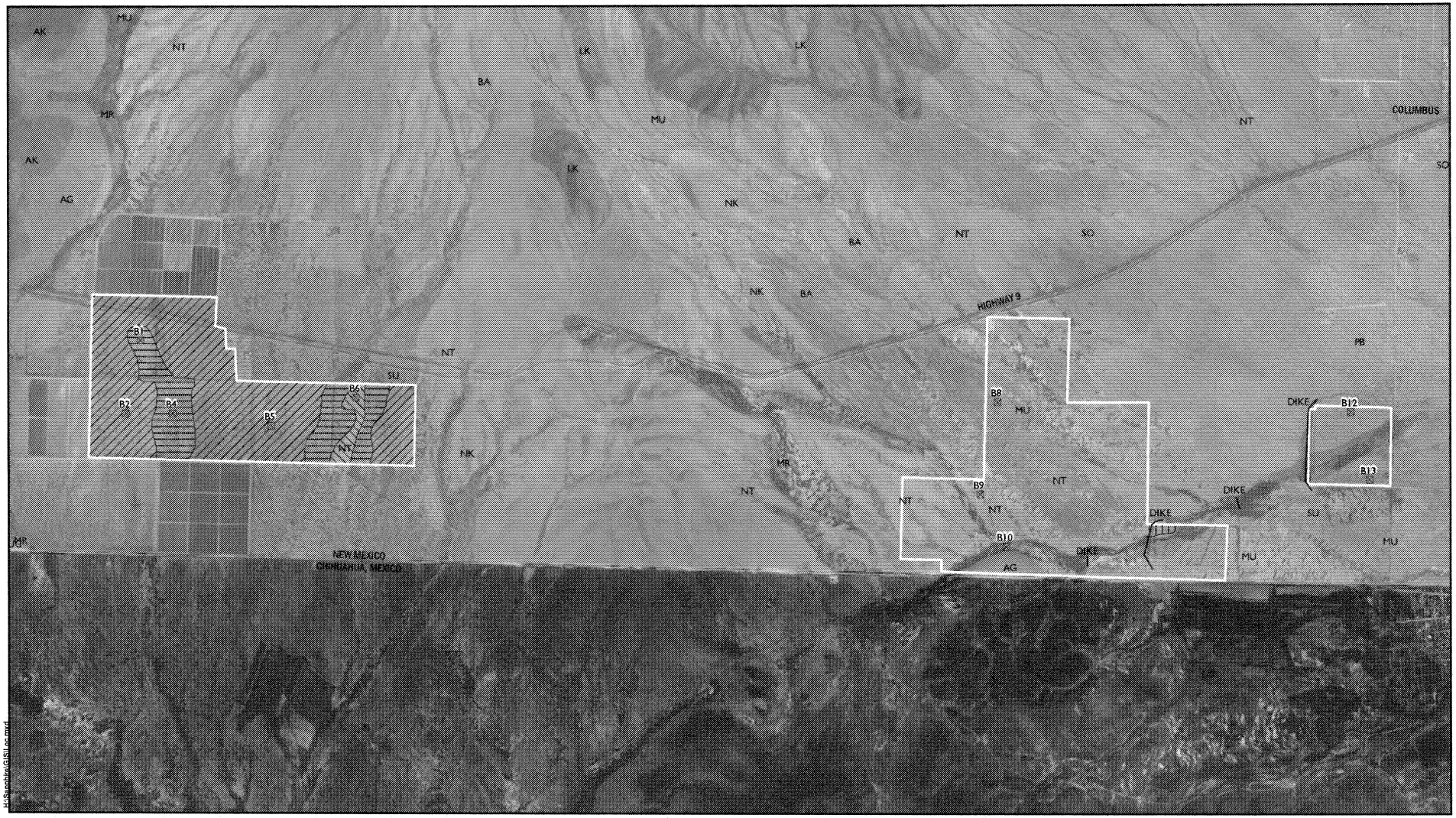
In the eastern parcels, greater diversity of soil conditions was observed, which is consistent with the greater number of map units present in the NRCS soil survey for the area. The following general characteristics were observed at the five locations excavated in the eastern parcels:

- Site B8 – gravelly materials, with increasing clay near the bottom of the excavation.
- Site B9 – silty material to the bottom of the excavation, with no gravel below 8 inches.
- Site B10 – silty, slightly moist in some subsurface layers. Gravel was only observed near the bottom of the excavation.
- Site B12 – very dense gravelly silt.
- Site B13 – very gravelly material.

The gravel encountered at each location in the eastern parcels was angular or subangular, except at locations B12 and B13, where subrounded gravel was encountered. Subsurface accumulation of carbonates was observed at many locations on the property, which is in accordance with the alkaline pH of all soil samples from the property. Dikes were observed within the eastern portion of the property, including one dike in the south-central area shown on **Figure 1**, dikes around the eastern-most quarter section of the property that includes locations B12 and B13, and dikes within the small area south of what is indicated on **Figure 1** as an elevated non-alluvium. These dikes generally were observed to cause the width of the mapped alluvial unit (MR) to be wider than shown on the NRCS soil survey. All observed locations had significant amounts of sand and/or gravel in upper 24 inches of soil, except location B10 excavated at the bottom of a drainage on the eastern portion of the property.

United States Department of Agriculture (USDA) Highly Erodible Land (HEL) determinations for the property indicates that soil at the proposed IABR site is highly erodible (**Appendix E**). According to USDA, the current soil conservation plan based on agricultural use will need to be revised to accommodate the algal ponds prior to construction of the IABR facility.

FIGURE 1



H:\Graphics\GIS\Locator.mxd

Source: New Mexico, RGIS

Feet
0 3,000

AMEC Geomatrix

NOTE:
Locations B3, B7, and B11 were not investigated, and are not shown on this figure

Soil Samples

Cover Type
- Bentgrass, Cheatgrass, and Minor Yucca
- Cheatgrass
- Thistle
- Elevated (Not Alluvium)

Soil Type
- AG - Akela very gravelly loam
- AK - Akela very gravelly loam
- BA - Berino and Mohave soils
- HT - Hondale-Mimbres complex
- LK - Lehmans extremely rocky loam
- MR - Mimbres and Verhalen soils
- MU - Mohave sandy clay loam
- NK - Nickel very gravelly sandy loam
- NT - Nickel-Tres Hermanos complex
- PB - Pintura-Berino complex
- SO - Sonoita gravelly sandy loam
- SU - Stellar silty clay loam
- UG - Upton gravelly sandy loam

Soil Map
Columbus, New Mexico
FIGURE 1

APPENDIX A

Soil Sampling Field Forms

Soil Survey		Soil Pedon Description Data Sheet [pg 1]	
Date:	3/5/09	**Site ID*:**	B1
Time:	17:20	**Boring / Pit / Other:**	Boring
Slope:	1%	**Northing**	
Aspect:	S	**Easting:**	
Parent Material/Origin:		**Photo (Y/N - Name]:** Y (circled)	9, 10, 11 (photos N S)
Drainage [depth to water table]:		**Observers/Party:**	W. Welzenbach
Topography / Landform:		**Site Sampled** [Y/N]: Y (circled)	**No. Samples:** 6

Taxonomic Description**

Epipedon:	Anthropic/Mollic
Control Texture:	
Classification [USDA]:	
Series :	Stellar

Biota (Plants & Animals):	Grasses and forbs < 1 ft tall, with islands of 5 ft bentgrass
Land Use:	Former farmland

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Dry surface with 25% coarse fragments ([illegible])
Plowlines and slight vehicle tracks present.
Soil dry to total borehole depth.

* Site ID comprised of unique alpha-numeric designator.

Soil Survey — Soil Pedon Description Data Sheet [pg 2]

HORIZON DESCRIPTIONS — SITEID: B1

	Horizon [x below number if sampled]	Depth [cm]	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl pH rxn	General Comment
1	Ap	0-8		5YR 6/3	(White gravel 2.5%)	Sandy silt 10% clay	N	Soft, loose	25% white limestone gravel (some small)	3	
2	B	8-17	Sharp (some broken)	Pres 5YR 6/3	(white gravel 25%)	Silt, gravel (Ca) 5% clay	N	V. douse	75% lime stone and other angular gravel in matrix	3	
3	B	17-20				gravelly silt 5% clay	N	dense	15% angular gravel 3cm in max. dim.	3	
4	B	20-30		10YR 6/4		silt (Ca) 5% clay	N	stiff	<5%	4	
5	BK	30-36		10YR 6/4	White (5% gravel)	silt (Ca) 5% clay	N	med. stiff	<5%	3	
6		-									
7		-									
8		-									
9		-									
10		-									

Samples
0-8 in (1)
8-12 in (2)
12-24 in (3)
24-36 in (4)

Soil Survey		Soil Pedon Description Data Sheet [pg 1]	
Date:	3/5/09	**Site ID*:**	B2
Time:	15:37	**Boring / Pit / Other:**	Boring
Slope:	1%	**Northing**	
Aspect:	South	**Easting:**	
Parent Material/Origin:		**Photo** [Y / N - Name]:	6, 7, 8 (photos N,S)
Drainage [depth to water table]:	NA	**Observers/Party:**	W. Wolzenmach
Topography / Landform:		**Site Sampled** [Y / N]:	**No. Samples:**

Taxonomic Description**

Epipedon:	Mollic Xanthozic
Control Texture:	
Classification [USDA]:	
Series :	Stellar
Biota (Plants & Animals):	Grasses and forbs (mostly non-native), anthills and gopher mounds in vicinity*
Land Use:	former farm field.

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Dry loose surface with ~40% coverage with angular gravel.
Plow lines present in nearby veg. patterns, some evidence of anthills in vicinity.
* vegetation all less than 1 ft. tall (no boulders)
Soil dry to total borehole depth.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B2

	Horizon [x below number if sampled]	Depth [cm] (1m)	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	~~pH~~ HCl rxn	General Comment
1	Ap	0 - 3		5YR6/5		sandy silt 15% clay	N	Loose soft	10% angular gravel up to 0.5 in. max. dim.	3	Very loose structure, grass roots present
2	B	3 - 20		5YR5/6		silty sand 5% clay	N	med dense	15% angular gravel up to 1.5 in max. dim.	3	Carbonate coatings on some rocks up to 2 in dia. roots to bottom
3	Bk	20 - 34		5YR8/1		silt (ML) 5% clay	N	v. stiff	15% angular gravel up to ½ in max dia.	4	Partially cemented
4	C	34 - 36		5YR8/1		silty gravel (GM) 5% clay	N	v. dense	55% angular limestone gravel up to 3 in dia.	4	Additional coarse fragments in Bk-lite matrix
5		-									
6		-									
7		-									
8		-									
9		-									
10		-									

Samples:
0-3 in (1) B
3-12 in D
12-24 (1)
24-28 (1), B
24-36 (1)

(1) = roots
1 - 5 %
2 - moderate
3 - common

Soil Survey		Soil Pedon Description Data Sheet [pg 1]	
Date:	3/6/09	**Site ID*:**	B4
Time:	9:30	**Boring / Pit / Other:**	boring
Slope:	2%	**Northing**	
Aspect:	S-SE	**Easting:**	
Parent Material/Origin:		**Photo** (Y / N - Name): ⓨ	
Drainage [depth to water table]:		**Observers/Party:**	W. Welzenbach
Topography / Landform:		**Site Sampled** (Y / N): ⓨ	**No. Samples:**

Taxonomic Description**

Epipedon:	Mollic / Anthropic
Control Texture:	
Classification [USDA]:	
Series [Ghanaian]:	Stellar ?
Biota (Plants & Animals):	bentgrass clusters (3-4 ft. tall)
Land Use:	Former farmland

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Drainage from blowout of ditch at N. end of quarter section runs down middle of bentgrass area (near power lines). Cracked dry crust at surface in bentgrass area. 5% gravel at surface (flat angular gravel up to 3/4 in max dimension). Soil dry to total depth.

* Site ID comprised of unique alpha-numeric designator.

** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** BH

	Horizon [x below number if sampled]	Depth [cm] (in.)	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl pH rxn	General Comment
1	O_i	0 - 0.25		5YR 5/6	—	silt (ML) 10% clay	N	loose, soft	5% flat angular gravel	3	Decomposing grass prevalent
2	A_p	0.25 - 3		5YR 5/4	—	sandy silt (ML) 15% clay	Y	mod. stiff	5% flat angular gravel ½ in. max. diam	3	prevalent roots and root channels
3	B	3 - 21		10YR 5/2	—	sandy silt (ML) 10% clay	N	mod. stiff	5% black angular gravel	3	
4	B_k	21 - 36		10YR 6/4	white, 10%	sandy silt 15% clay	N	v. stiff, partially cemented	15% white angular concretions	4	Deeper Bk thin strata of carbonate nodules
5		-						fine (¼ in.)	nodules		
6		-									
7		-									
8		-									
9		-									
10		-									

Sample Site
0 - 3 in
3 - 21 in
21 - 36
BC

Soil Survey — **Soil Pedon Description Data Sheet [pg 1]**

Date:	3/6/09	**Site ID*:**	B5
Time:	11:25	**Boring / Pit / Other:**	Boring
Slope:	1%	**Northing**	
Aspect:	S	**Easting:**	
Parent Material/Origin:		**Photo (Y/N - Name):**	Y (circled)
Drainage [depth to water table]:		**Observers/Party:**	W. Welzenbach
Topography / Landform:		**Site Sampled (Y/N):**	Y (circled) — **No. Samples:**

Taxonomic Description**

Epipedon:	Mollic / Anthropic
Control Texture:	
Classification [USDA]:	
Mapped **Series** [Ghanaian]:	Stellar

Biota (Plants & Animals):	thistle, small burrows present at surface (2in. channels to 6in. deep)
Land Use:	former farmland

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

large thistle area (almost [illegible] section width). Angular gravel up to 3/4 in. max dia at surface. Some chert ones within thistle (Sr. Biologist provided generic common names). Soil dry to total depth explored.

* Site ID comprised of unique alpha-numeric designator.
** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B5

	Horizon [x below number if sampled]	Depth ~~(cm)~~ (in)	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl ~~pH~~	General Comment
1	O_i	0 - 0.75		5YR 5/4		S; H(mL) 10% clay	N	loose soft.	15% angular gravel up to ¾ in. max dim	Ø	Charcoal ash is mostly organic matter
2	A_p	0.75 - 5		5YR 5/4		Sandy silt (wk) 15% clay	Y	med. stiff	5% angular gravel up to [illegible]	Ø	prevalent roots (15% ranked on 1/4 samples)
3	B	5 - 14		5YR 5/6		Sandy silt 5% clay	N	V. stiff	20% angular gravel up to 3/4 in. max dim	X	[illegible] roots
4	B_w	14 - 20		5YR 5/6	white and black (15%)	sandy silt 5% clay	N	V. stiff	10% angular gravel up to ½ in.	Ø	
5	B	20 - 27		5YR 6/4		clayey silt 20% clay	N	V. stiff	none	Ø	
6	Bk	27 - 36		10YR 7/4	white (45%)	S; H(mL) 5% clay	N	M. stiff to soft	none	4	
7		-									
8		-									
9		-									
10		-									

Samples:
0-12 in
12-24/30 in
(15% ranked on 1/4 samples)
27-36 in*

* to max depth Bk only

Soil Survey — **Soil Pedon Description Data Sheet [pg 1]**

Date:	3/6/09	**Site ID*:**	B6
Time:	13:00	**Boring / Pit / Other:**	Boring
Slope:	0-1%	**Northing**	
Aspect:	S	**Easting:**	
Parent Material/Origin:		**Photo** (Y / N - Name):	Y (circled)
Drainage [depth to water table]:		**Observers/Party:**	W. Welzenbach
Topography / Landform:		**Site Sampled** (Y / N):	Y (circled) — **No. Samples:**

Taxonomic Description**

Epipedon:	Mollic / Anthropic
Control Texture:	
Classification [USDA]:	
Mapped **Series** [Ghanaian]:	Nickel / Tres Hermanos

Biota (Plants & Animals):	Cheatgrass and spurge (every 50m) yucca
Land Use:	former farmland

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Gopher mounds (2 ft tall) located 20m NE of site and 20m E-SE of site. Angular gravel up to 2.5 in. max. dim. present at surface. Soil dry to total depth.

* Site ID comprised of unique alpha-numeric designator.

** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B6

	Horizon [x below number if sampled]	Depth [cm] (in)	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl rxn pH	General Comment
1	Oi	0 - 0.5		10YR 5/2		fine silt (10% clay)	N	loose soft	very surface has 40% angular gravel	2	prevalent fine
2	Ap	0.5 - 3		5YR 5/6		sandy silt (my) (15% clay)	N	loose soft	<5%	3	prevalent roots
3	E	3 - 20		5YR 5/6		sandy silt (15% clay)	N	V. stiff	20% ~~drift~~ rounded gravel, ½ in. max dia	3	prevalent roots ~ 10 in.
4	Bt	20 - 26		5YR 5/6		sandy silt (25% clay)	Y	mod. stiff	<5% white angular gravel	3	weak cohesion to above and below horizons
5	BK	26 - 36		5YR 5/4 and lighter values	iron oxide (40%)	gravelly silt (10% clay)	N	V. stiff	35% white rounded gravel up to 2 in. max dia	4	
6		-									
7		-									
8		-									
9		-									
10		-									

Samples:
0-12 in. C
12-24 in. C
26-36 in. C
w/ 1x replicate only
B1c

Soil Survey — **Soil Pedon Description Data Sheet [pg 1]**

Date:	3/6/09	**Site ID*:**	B8
Time:	16:25	**Boring / Pit / Other:**	boring
Slope:	1%	**Northing**	
Aspect:	SW	**Easting:**	
Parent Material/Origin:		**Photo** (Y/N - Name]:	
Drainage [depth to water table]:		**Observers/Party:**	W Weltenbach
Topography / Landform:		**Site Sampled** [Y/N]:	**No. Samples:**

Taxonomic Description**

Epipedon:	
Control Texture:	
Classification [USDA]:	
mapped **Series** [Ghanaian]*:	MU

Biota (Plants & Animals):	Cheatgrass with interstitial mesquite
Land Use:	Former farmland (and pasture?)

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Edge of mesquite tree mixed mesquite-shortgrass is approx. 100m N of site. Surface is 70% subangular fine gravels from ½ to 4" max dimension.

* Site ID comprised of unique alpha-numeric designator.

** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** DB

	Horizon [x below number if sampled]	Depth [cm] (in)	Bound.	Color: Matrix	Color: Motties [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl rxn pH	General Comment
1	O	0-0.75		10YR 7/4		Sandy silt (SM) 5% clay	N	loose, soft	(surface only)	Ø	
2	A	0.75-6		5YR 4/4		Silt grave (GM) 10% clay	Y	weak, massive, v. dense	60% angular gravel up to 0.75 in. max. dia.	Ø	potentially collapsible?
3	A	6-15		5YR 4/4		Sandy silt 10% clay	Y	med. stiff	10% small gravel and coarse sand (fine, mor. dm.)	1	slightly moist
4	Bk	15-19		5YR 4/6	white, pearly concretions	Sandy silt 15% clay	N	v. stiff	50% white carbonate concretions	4	slightly moist
5		-									Refusal at 19 in. on large rock
6		-									
7		-									
8		-									
9		-									
10		-									

Samples
0-12 in. (3)
12-15 in (1)
15-19 in. (1), small vol. (4oz)

Soil Survey — **Soil Pedon Description Data Sheet [pg 1]**

Date:	3/7/09	**Site ID*:**	B9
Time:	9:30	**Boring / Pit / Other:**	boring
Slope:	1-3%	**Northing**	
Aspect:	S-SW	**Easting:**	
Parent Material/Origin:		**Photo** [Y / N - Name]:	
Drainage [depth to water table]:		**Observers/Party:**	W. Wolzenbach
Topography / Landform:	Shoulder	**Site Sampled** [Y N]:	**No. Samples:**

Taxonomic Description**

Epipedon:	Mollic
Control Texture:	
Classification [USDA]:	
Mapped **Series** [Ghanaian]:	Nickel – Tree Hermanas
Biota (Plants & Animals):	Sparse Cheatgrass w/ intermittent mesquite (see pic 58)
Land Use:	Former rangeland (?) or never developed

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Surface is 40% Subangular gravel up to 1 in max dia. Small (2in dia) animal burrow is located 15ft S. of Site, and 4m ghost Mesquite. Site at cheatgrass / sparse cheatgrass edge (see pic 58)

* Site ID comprised of unique alpha-numeric designator.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** ba

	Horizon [x below number if sampled]	Depth [cm]	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	pH (HCl vsn)	General Comment
1	A_1	0-2		10YR 7/4		Sandy s.lf 10% clay	N	100% soft	none [illegible] surface	4	eucalyptus [illegible] present
2	A	2-8		10YR 4/4		sandy silt 10% clay	N	v. sl. stiff	25% angular gravel throughout	4	prevalent roots dry
3	B_t	8-20		10YR 5/2		sandy silt 25% clay	Y	wea. stiff to v. stiff	none	4	[illegible] prevalent fine roots [illegible]
4	Bk	20-25		10YR 8/4		silt (ML) 15% clay	Y	stiff to soft	none Carbonate nodules up to 1 in. diam.	4	dry
5		-									
6		-									
7		-									
8		-									
9		-									
10		-									

Samples:
0-2in (5)
12-24in (1)
24-36in (1)

Soil Survey			Soil Pedon Description Data Sheet [pg 1]	
Date:	3/16/09	3/17/09	**Site ID*:**	B10
Time:	17:40	7:00	**Boring / Pit / Other:**	Borna
Slope:	< 1%		**Northing**	
Aspect:	E-SE		**Easting:**	
Parent Material/Origin:	Alluvium		**Photo** [Y/N - Name]:	
Drainage [depth to water table]:			**Observers/Party:**	W. Walzenbach
Topography / Landform:			**Site Sampled** [Y/N]:	**No. Samples:**

Taxonomic Description**

Epipedon:	
Control Texture:	
Classification [USDA]:	
Series [Ghanaian]:	

Biota (Plants & Animals):	Tall thistle with dead/dormant shrubs spaced 20m apart
Land Use:	Drainage way (unused). Near powerline right-of-way.

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Approx. 2% angular gravel up to 2 in^ar surface (i.e. much less surface gravel than upland sites).

* Site ID comprised of unique alpha-numeric designator.

** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B10

	Horizon [x below number if sampled]	Depth [cm] (in)	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl rxn pH	General Comment
1	A_i	0 - 2.5		5YR 7/2	—	sandy silt loam 10% clay	N	loose, soft	none below surface	2	
2	A	2.5 - 8		10YR 6/4		silt (mly) <5% clay	N	weak angular, friable	none	Ø	prevalent grass and fine roots throughout
3	B	8 - 16		10YR 4/4		sandy silt loam 10% clay	Y	weak angular, friable	none	Ø	slightly moist, fine roots present
4	Bk	16 - 36		10YR 4/4		sandy silt loam 15% clay	Y	weak, angular, friable	5% angular gravel up to ¼ in. max dim.	3	~5% carbonate nodules at 18 in.
5		-									increasing sand and carbonates with depth
6		-									
7		-									
8		-									
9		-									
10		-									

Samples: 0-12 in. (1) (2)

12 - 24 in.

Soil Survey	Soil Pedon Description Data Sheet [pg 1]
Date: 7/2/09	**Site ID*:** B12
Time: 11:10	**Boring / Pit / Other:** Boring
Slope: <1%	**Northing**
Aspect: SE	**Easting:**
Parent Material/Origin:	**Photo** [☑ N - Name]:
Drainage [depth to water table]:	**Observers/Party:** W. Walzenbach
Topography / Landform:	**Site Sampled** [Y / N]: Y **No. Samples:**

Taxonomic Description**

Epipedon:	
Control Texture:	
Classification [USDA]:	
Mapped **Series** [Ghanaian]:	PB
Biota (Plants & Animals):	weeds (thistle)
Land Use:	Former farmland, surrounded by ditches, previously irrigated

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Surface is approx. 50% vegetated. Volcanic gravel up to 1.5 in. max. dia. covers 40-60% of surface.

* Site ID comprised of unique alpha-numeric designator.

** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B2

	Horizon [x below number if sampled]	Depth [cm]	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl rxn pH	General Comment
1	Ap	0-2		5 YR 7/4		Silty Sand <5% clay	N	loose, soft	below surface: 5% angular gravel	Ø	dry
2	B_t	2-14		5YR 5/4		gravelly silt 15% clay	Y	v. dense	30% subrounded gravel up to 2in max dia	Ø	Fine roots present dry
3	B	14-24		10 YR 7/4		gravelly silt <5% clay	N	m. dense	10% subrounded white gravel up to 2in max dia	2	No roots dry
4	Bk	24-29		5 YR 5/4		gravelly silt 5% clay	N	m. dense	white nodules throughout matrix	4	dry
5		-									
6		-									
7		-									
8		-									
9		-									
10		-									

Soil Survey | **Soil Pedon Description Data Sheet [pg 1]**

Date: 3/7/09
Time: 12:40
Slope: < 1%
Aspect: E (on flat)
Parent Material/Origin:
Drainage [depth to water table]:
Topography / Landform:

Site ID*: B13
Boring / Pit / Other: Boring
Northing
Easting:
Photo (Y) / N - Name]:
Observers/Party: W. Welzenbach
Site Sampled [Y / N]: Y **No. Samples:**

Taxonomic Description**

Epipedon: Anthropic
Control Texture:
Classification [USDA]:
Mapped **Series** [Ghanaian]: SU (Stellar)

Biota (Plants & Animals): Thistles, bare surface, and dormant shrubs (see pic. 70)
Land Use: Former farmland

NOTES [specifically note recent weather, evidence of degradation, surface coarse fragments, etc.]

Area surrounded by dikes with known former irrigation
Subrounded volcanic gravel up to 2.5in. max. dim. present on 50% of soil surface.

* Site ID comprised of unique alpha-numeric designator.
** Profiles will be classified based on field observations. USDA classification to be completed following field effort.

Soil Survey — **Soil Pedon Description Data Sheet [pg 2]**

HORIZON DESCRIPTIONS — **SITEID:** B13

	Horizon [x below number if sampled]	Depth [cm]	Bound.	Color: Matrix	Color: Mottles [with % abund.]	Texture [& % Clay]	Clay Films [Y / N]	Structure [grade, size, class, strength]	C.F.% by Vol [note size, % ironstone or concretions]	HCl conc. pH	General Comment
1	O1	0 - 0.25		10YR 7/4		gravelly s.l. <5% clay	N	loose soft	50% subrounded gravel	0	thick fibers abundant
2	Ap	0.25-5		5YR 7/6		sandy silt 5% clay	N	loose soft	15% angular gravel up to 3/4 in.	0	brn
3	B	5 - 12		10YR 4/4		gravelly silt 15% clay	Y	v. stiff platy	25% subrounded gravel up to 1 in.	0	prevalent roots and root channels, brn
4	b	12 - 24		10YR 6/4		sandy silt 5% clay	N	v. stiff	10% subrounded gravel & caliche up to 3/4 in.	2	brn
5	C	24 - 31		5YR 6/4		sandy grade <5% clay	N	v. dense	70% angular gravel up to 6 in.	0	brn
6	C	31 - 36		10R 7/2		silty sand <5% clay	N	mod. dense	25% subangular gravel up to 3/4 in.	2	brn
7		-									
8		-									
9		-									
10		-									

samples:
0-12 in (3)
12-24 in (1)
24-31 in (1)
31-36 in (1)

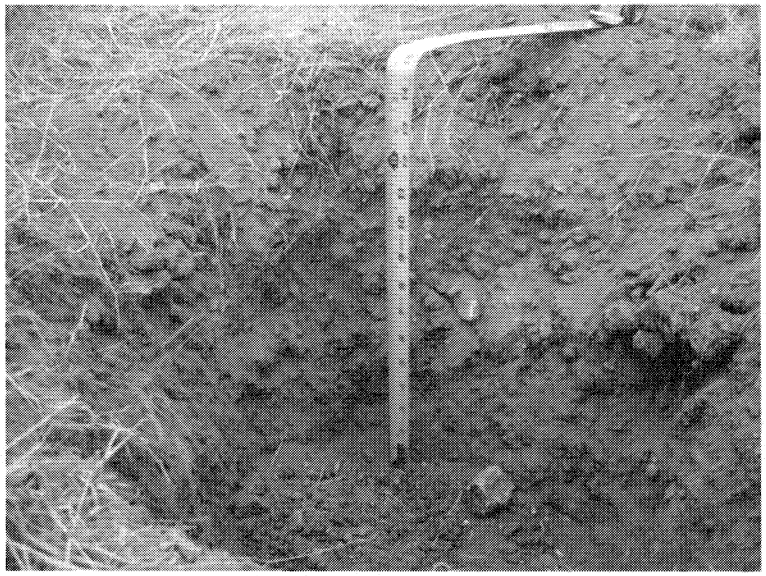
APPENDIX B

Soil Sampling Photographs

Soils Photo 1: B1 profile.

Soils Photo 2: B1 location facing north.

Soils Photo 3: B1 location facing south.



Soils Photo 4: B2 profile.

Soils Photo 5: B2 location facing northwest.

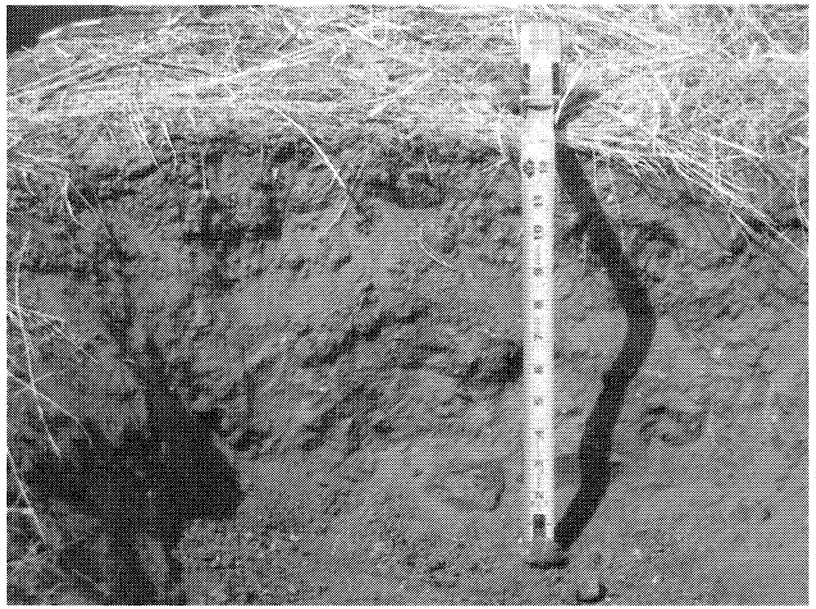
Soils Photo 6: B2 location facing south.

Soils Photo 7: B4 profile.

Soils Photo 8: B4 location facing northwest.

Soils Photo 9: B4 location facing south.

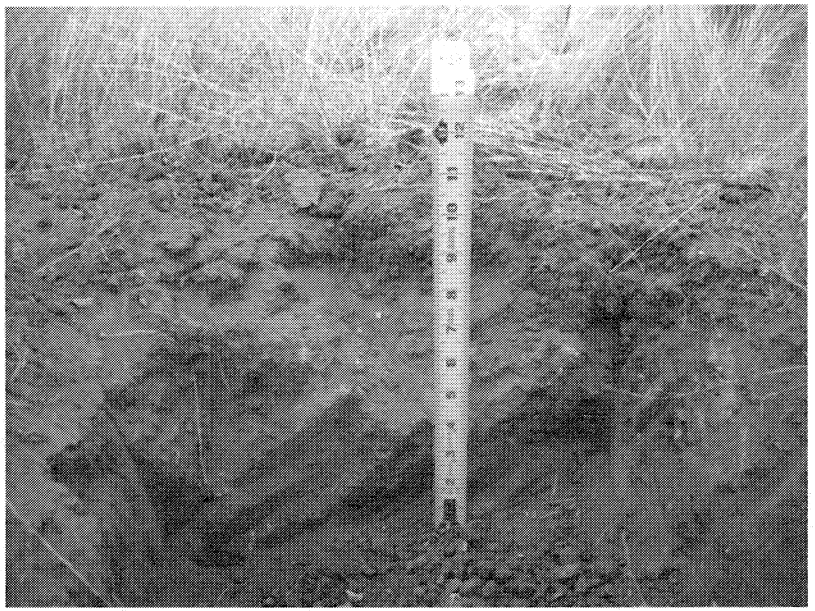
Soils Photo 10: B4 location facing east. Notice vegetation change from cheatgrass to darker thistle.



Soils Photo 11: B5 profile.

Soils Photo 12: B5 location facing north.

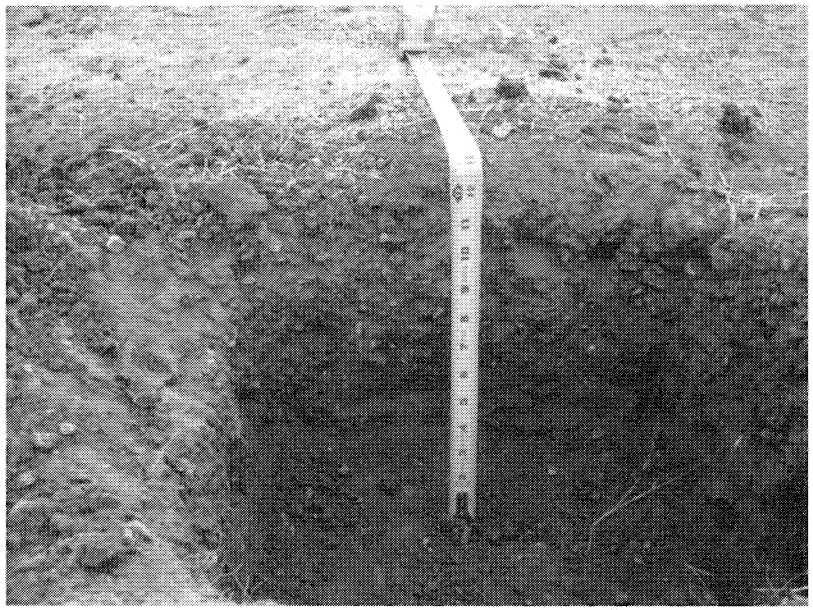
Soils Photo 13: B5 location facing south.



Soils Photo 14: B6 profile.

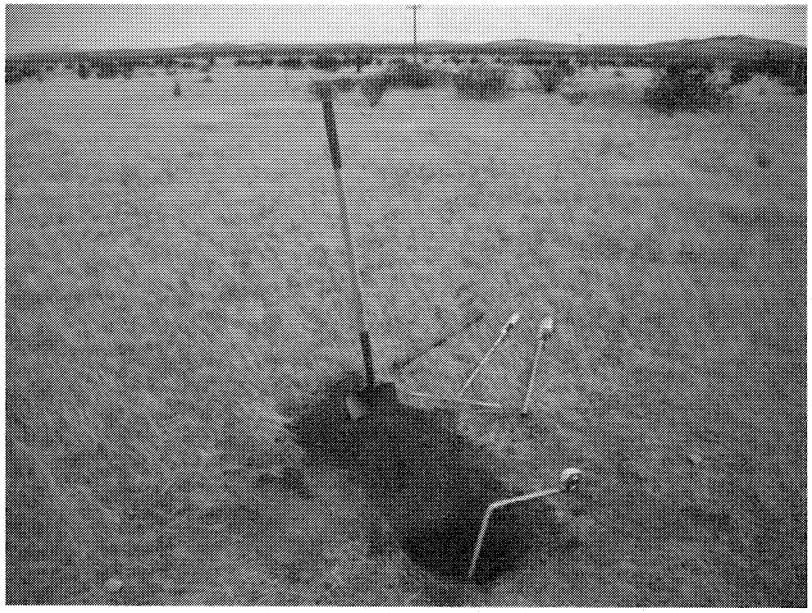
Soils Photo 15: B6 location facing north.

Soils Photo 16: B6 location facing south.

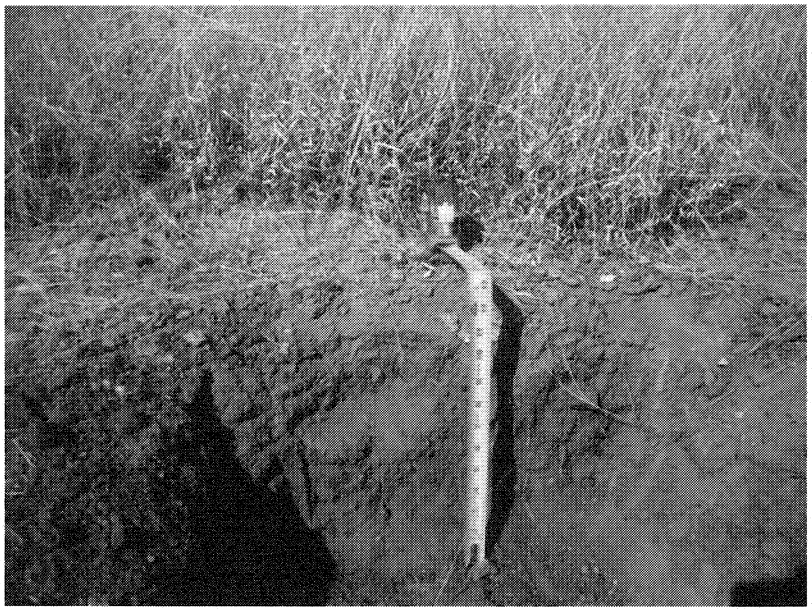


Soils Photo 17: B8 profile.

Soils Photo 18: B8 location facing north-northeast.

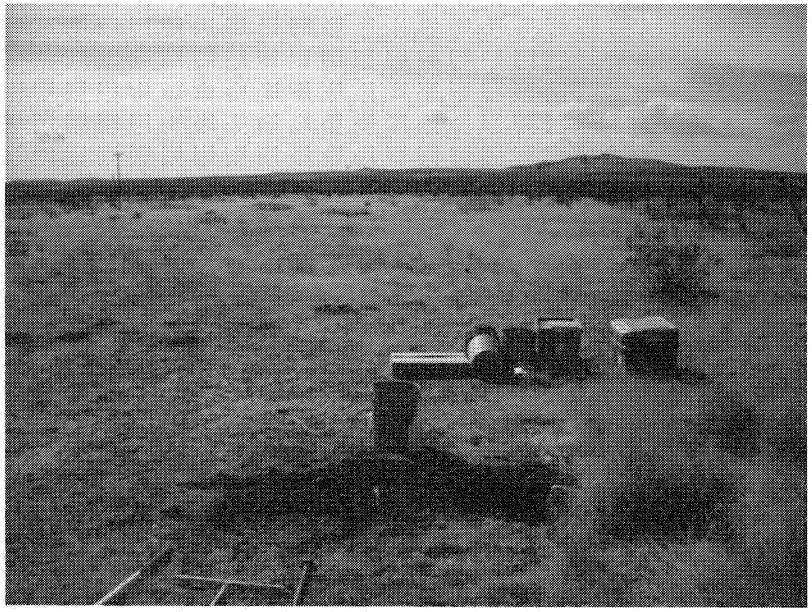


Soils Photo 19: B8 location facing south.

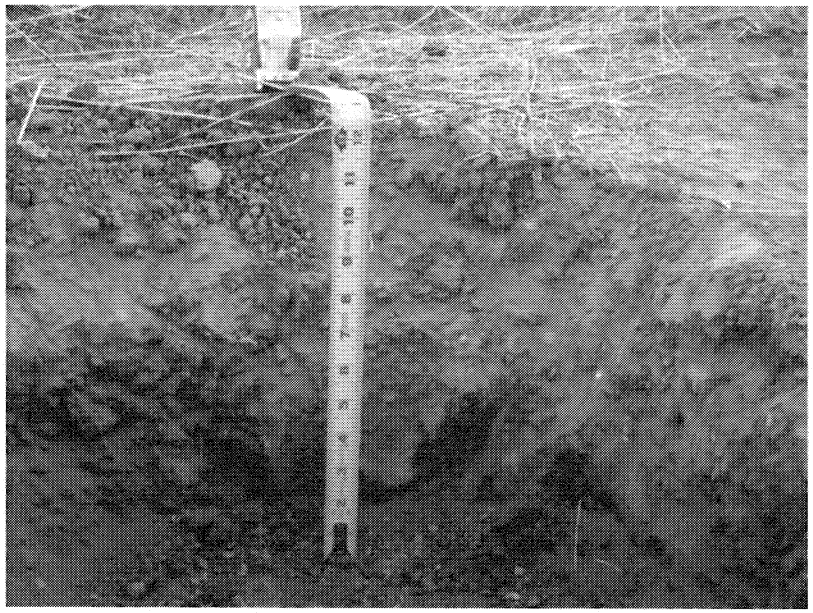


Soils Photo 20: B9 profile.

Soils Photo 21: B9 location facing north.



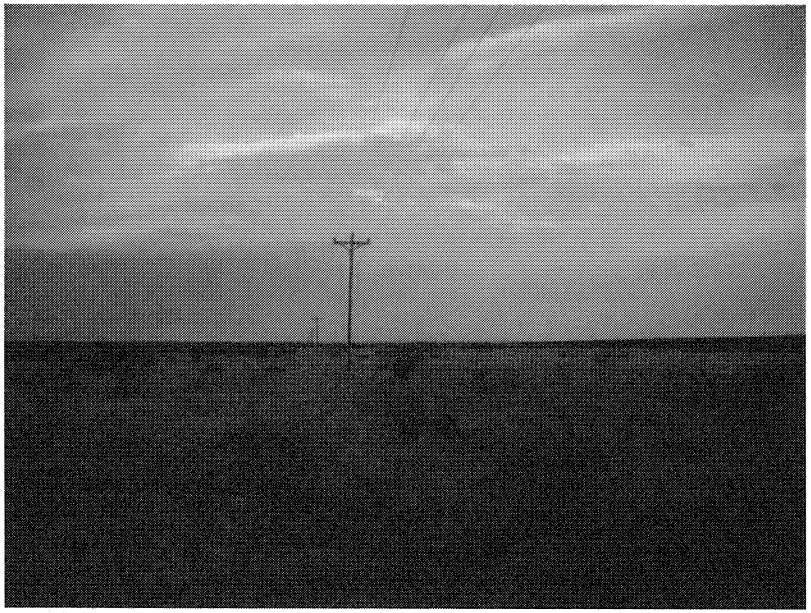
Soils Photo 22: B9 location facing south.



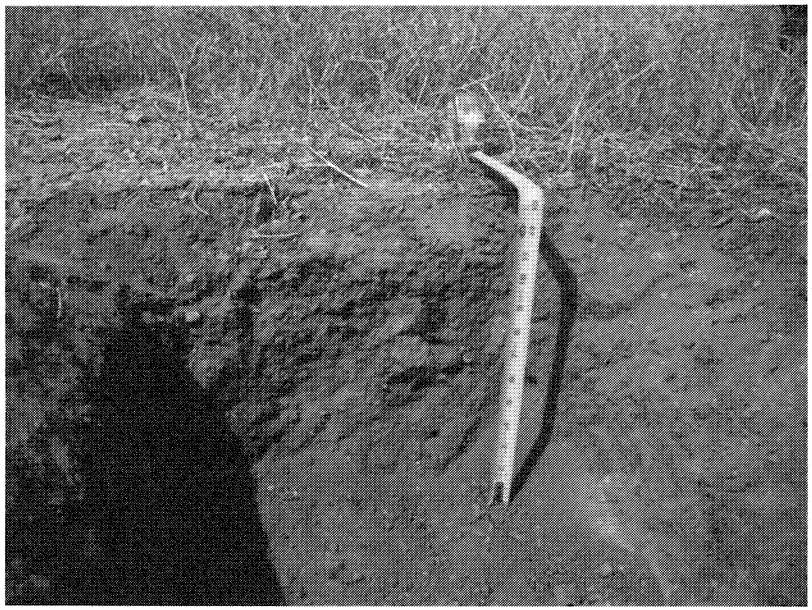
Soils Photo 23: B10 profile.

Soils Photo 24: B10 location facing north.

Soils Photo 25: B10 location facing south.

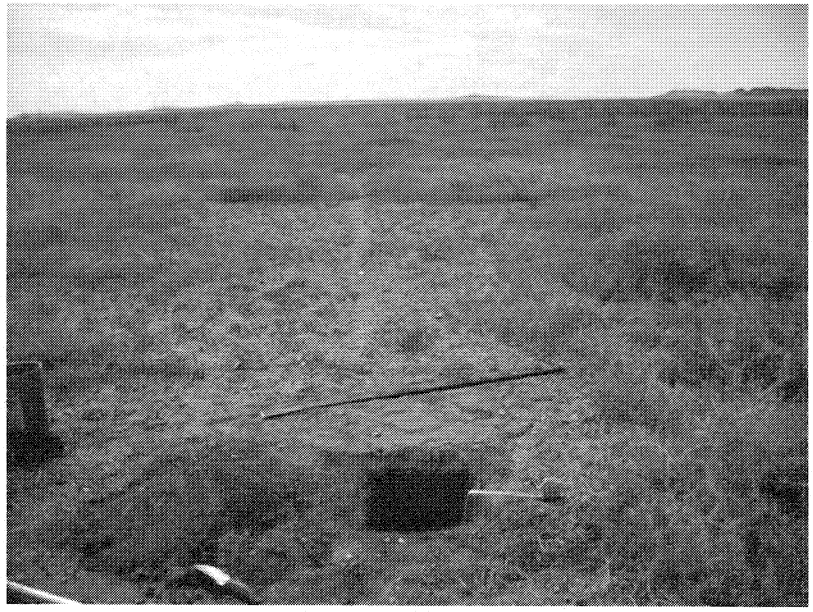


Soils Photo 26: B10 location facing east down drainageway.

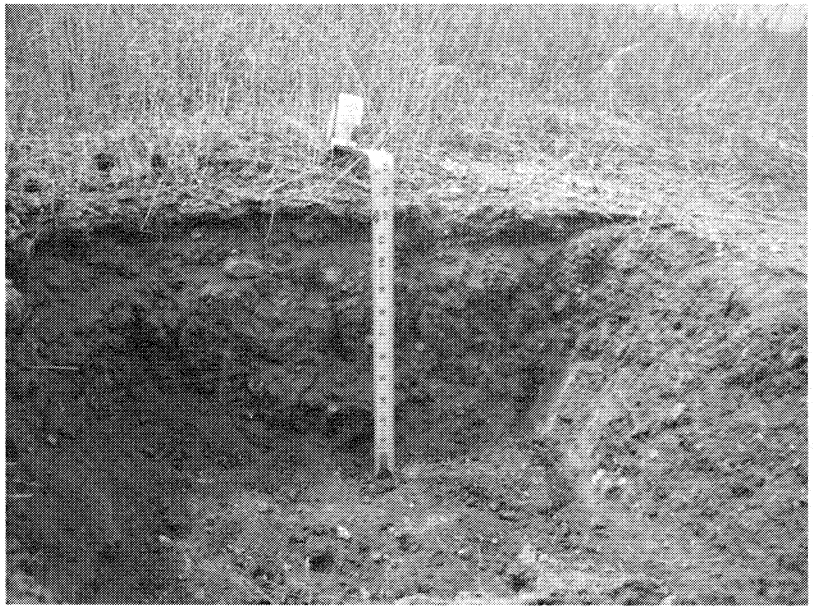


Soils Photo 27: B12 profile.

Soils Photo 28: B12 location facing north.



Soils Photo 29: B12 location facing south.



Soils Photo 30: B13 profile.

Soils Photo 31: B13 location facing north.

Soils Photo 32: B13 location facing south.

APPENDIX C

Laboratory Report

A & L PLAINS AGRICULTURAL LABORATORIES, INC.

302 34th St. • P.O. Box 1590 • Lubbock, TX 79408 • (806) 763-4278
FAX (806) 763-2762 • www.al-labs-plains.com

09-086-01a

REPORT NUMBER

Date: March 26, 2009
Page 1

Amec GeoMatrix
7007 Wyoming Blvd. NE
Suite F-1
Albuquerque, NM 87109

Submitted by:
Tom Tangen
Jason Olivar

Project: Sapphire
Project No: 14821

S A R by Saturated Paste Extract

Lab No.	Sample ID	Sample Depth	Matrix	SAR	Sodium ppm	Calcium ppm	Magnesium ppm	E.C. mmhos/cm	pH
93292	B1	0-12	Soil	**3.64**	56	12	3	**0.3**	**8.3**
93293	B1	12-24	Soil	**8.89**	252	31	18	**1.1**	**8.3**
93294	B1	24-36	Soil	**6.76**	100	10	4	**0.5**	**8.1**
93295	B2	0-12	Soil	**10.40**	313	55	8	**1.4**	**8.0**
93296	B2	12-24	Soil	**9.25**	203	27	6	**0.9**	**8.1**
93297	B2	24-36	Soil	**10.13**	240	31	7	**1.0**	**8.1**
93298	B4	0-12	Soil	**3.84**	54	9	4	**0.3**	**8.5**
93299	B4	12-21	Soil	**5.77**	93	12	4	**0.4**	**8.5**
93300	B4	21-36	Soil	**7.08**	133	17	6	**0.6**	**8.2**
93301	B5	0-12	Soil	**2.87**	63	22	8	**0.4**	**8.3**
93302	B5	12-24	Soil	**3.67**	48	7	3	**0.2**	**8.8**
93303	B5	24-36	Soil	**10.48**	263	28	12	**1.1**	**8.5**
93304	B6	0-12	Soil	**1.85**	30	15	3	**0.2**	**8.2**
93305	B6	12-24	Soil	**2.91**	61	21	7	**0.3**	**8.5**
93306	B6	24-36	Soil	**4.24**	63	11	4	**0.7**	**8.4**
93307	B8	0-12	Soil	**5.44**	146	31	14	**0.2**	**8.1**
93308	B8	12-15	Soil	**0.95**	19	20	5	**0.2**	**8.0**
93309	B8	15-19	Soil	**0.93**	19	20	6	**0.3**	**8.0**

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09-086-01a

REPORT NUMBER

Date: March 26, 2009

Amec GeoMatrix
7007 Wyoming Blvd. NE
Suite F-1
Albuquerque, NM 87109

Submitted by:
Tom Tangen

Project: Sapphire
Project No: 14821

S A R by Saturated Paste Extract

Lab No.	Sample ID	Sample Depth	Matrix	SAR	Sodium ppm	Calcium ppm	Magnesium ppm	E.C. mmhos/cm	pH
93310	B9	0-12	Soil	**0.96**	28	44	13	**0.2**	**8.3**
93311	B9	12-24	Soil	**2.02**	31	12	3	**0.4**	**8.0**
93312	B9	24-36	Soil	**4.66**	66	10	3	**2.7**	**7.9**
93313	B10	0-12	Soil	**13.44**	622	105	34	**0.3**	**8.1**
93314	B10	12-24	Soil	**1.05**	25	33	5	**0.7**	**7.8**
93315	B10	24-36	Soil	**0.64**	28	109	20	**0.8**	**8.0**
93316	B12	0-12	Soil	**1.45**	58	88	19	**0.1**	**8.0**
93317	B12	12-24	Soil	**2.62**	31	7	2	**0.3**	**8.4**
93318	B12	24-36	Soil	**3.76**	49	7	3	**0.2**	**8.5**
93319	B13	0-12	Soil	**5.41**	104	15	8	**0.3**	**8.4**
93320	B13	12-24	Soil	**5.81**	107	15	7	**0.4**	**8.7**
93321	B13	24-31	Soil	**6.23**	102	12	5	**0.5**	**8.4**
93322	B13	31-36	Soil	**6.40**	108	12	5	**0.5**	**8.4**
						QC			
				%Accuracy	96.7	99.6	99.4		
				%Deviation	3.29	0.45	0.60		
				%Precision	93.6	97.1	99.4		

Respectfully submitted,

by
A&L Plains Ag Labs, Inc.

CHAIN-OF-CUSTODY RECORD

Wilhelm.welzenbach@amec.com

FRE 1523

PROJECT NAME: Sapphire

DATE: 3-19-09 PAGE OF

PROJECT NUMBER: 14821

RESULTS TO: tom.tangen@amec.com

TURNAROUND TIME: 3 to 5 Days

SAMPLE SHIPMENT METHOD: Fed-X

LABORATORY NAME: Amec GeoMatrix

LABORATORY ADDRESS: 7007 Wyoming Blvd, NE, Suite F-1 Albuquerque, NM 87109

LABORATORY CONTACT: Tom Tangen

LABORATORY PHONE NUMBER: 505-301-2091 (cell)

CLIENT INFORMATION

REPORTING REQUIREMENTS

GEOTRACKER REQUIRED: YES (NO)

SITE SPECIFIC GLOBAL ID NO:

SAMPLERS (SIGNATURE):

ANALYSES

DATE	TIME	SAMPLE NUMBER	Electrical Conductivity (Saturated Paste)	pH (Saturated Paste)	SAR (Saturated Paste)	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
3-5-09	17:20	B1,0-12in	X	X	X	1 Gallon Plastic Bags	S					1	
		B1,12-24in	X	X	X							1	
	↓	B1,24-36in	X	X	X							1	
	15:37	B2,0-2in	X	X	X							1	No sample
		B2,0-12in	X	X	X							1	No sample
		B2,12-24in	X	X	X							1	
		B2,24-28in	X	X	X							1	
↓	↓	B2,24-36in	X	X	X							1	
3-6-09	9:30	B4,0-12in	X	X	X							1	
		B4,12-21in	X	X	X							1	
	↓	B4,21-36in	X	X	X							1	
	11:25	B5,0-12in	X	X	X							1	
		B5,12-24in	X	X	X							1	
↓	↓	B5,24-36in	X	X	X							1	
			[redacted]		[redacted]							[redacted]	

TOTAL NUMBER OF CONTAINERS:

SAMPLING COMMENTS:

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE:	3/19/09		SIGNATURE:	3/20/09	3349
PRINTED NAME: Jason Oliver			PRINTED NAME: Scott Coleman		
COMPANY: Amec			COMPANY: K&C Trans.		
SIGNATURE			SIGNATURE		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE			SIGNATURE:		
PRINTED NAME:			PRINTED NAME		
COMPANY:			COMPANY:		

1281 East Alluvial Ave., Suite 101
Fresno, California 93720-2659
Tel 559.264.2535 Fax 559.264.7431

amec

FRE 1523

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Sapphire
PROJECT NUMBER: 14821
REPORTS TO: Tom.Jangen@amec.com
TURNAROUND TIME: 3 to 5 Days
SAMPLE SHIPMENT METHOD: Fed-X

LABORATORY NAME: Amec GeoMatrix
LABORATORY ADDRESS: 7007 Wyoming Blvd, NE, Suite F-1, Albuquerque, NM 87109
LABORATORY CONTACT: Tom Jangen
LABORATORY PHONE NUMBER: 505-301-2081 (cell)

CLIENT INFORMATION

DATE: 3-19-09 PAGE OF
REPORTING REQUIREMENTS
GEOTRACKER REQUIRED: YES
SITE SPECIFIC GLOBAL ID#:

SAMPLERS (SIGNATURE):

ANALYSES

DATE	TIME	SAMPLE NUMBER	Electrical Conductivity (Saturated Paste)	pH (Saturated Paste)	SAR (Saturated Paste)	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	# of Containers
3-6-09	13:00	B6, 0-12 in	X	X	X	S			
		B6, 12-24 in	X	X	X				
		B6, 26-36 in	X	X	X				
	16:25	B8, 0-12 in	X	X	X				
		B8, 12-15 in	X	X	X				
		B8, 15-19 in	X	X	X				
3-7-09	9:30	B9, 0-12 in	X	X	X				
		B9, 12-24 in	X	X	X				
		B9, 24-36 in	X	X	X				
3-6-09	17:40	B10, 0-12 in	X	X	X				
3-7-09	7:00	B10, 12-24 in	X	X	X				
		B10, 24-36 in	X	X	X				
	11:10	B12, 0-12 in	X	X	X				
		B12, 12-24 in	X	X	X				
		B12, 24-36 in	X	X	X				

CONTAINER TYPE AND SIZE: 1 Gallon Plastic Bags

ADDITIONAL COMMENTS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE	3/19/09		SIGNATURE	3/19/09	13:30
PRINTED NAME: Jason Oliver			PRINTED NAME: Scott Colborn		
COMPANY: Amec			COMPANY: H2C Petro		
SIGNATURE			SIGNATURE		
PRINTED NAME			PRINTED NAME		
COMPANY			COMPANY		
SIGNATURE			SIGNATURE		
PRINTED NAME			PRINTED NAME		
COMPANY			COMPANY		

TOTAL NUMBER OF CONTAINERS

SAMPLING COMMENTS

1281 East Alluvial Ave., Suite 101
Fresno, California 93720-2659
Tel 559.264.2535 Fax 559 264.7431

amec

FRE 1523

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Sapphire
PROJECT NUMBER: 14821
RESULTS TO: tom.tangen@amec.com
TURNAROUND TIME: 3 to 5 Days
SAMPLE SHIPMENT METHOD: Fed-X

LABORATORY NAME: Ames Geomatrix
LABORATORY ADDRESS: 7007 Wyoming Blvd, NE Suite F-1, Albuquerque, NM 87109
LABORATORY CONTACT: Tom Tangen
LABORATORY PHONE NUMBER: 505-301-2091 (cell)

CLIENT INFORMATION

DATE: 3-19-09
PAGE: OF
REPORTING REQUIREMENTS
GEOTRACKER REQUIRED: YES
SITE SPECIFIC GLOBAL ID NO.:

SAMPLERS (SIGNATURE):

DATE	TIME	SAMPLE NUMBER	Electrical Conductivity (Saturated Paste)	pH (Saturated Paste)	SAR (Saturated Paste)	CONTAINER TYPE AND SIZE	Soil (S), Water (W) Vapor (V) or Other (O)	Filtered	Preservative Type	ICE?	RUSH?	ADDITIONAL COMMENTS
3-7-09	12:40	B13, 0-12 in	X	X	X	1 Gallon Plastic Bags	S					
		B13, 12-24 in	X	X	X							
		B13, 24-31 in	X	X	X							
		B13, 31-36 in	X	X	X							

ANALYSES

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE:	3/19/09		SIGNATURE:	3-19-09	
PRINTED NAME: Jason Oliver			PRINTED NAME: Scott Clawson		
COMPANY: Amec			COMPANY: H&L PLATING		
SIGNATURE			SIGNATURE		
PRINTED NAME			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE			SIGNATURE		
PRINTED NAME:			PRINTED NAME		
COMPANY			COMPANY:		

TOTAL NUMBER OF CONTAINERS

SAMPLING COMMENTS

1281 East Alluvial Ave , Suite 101
Fresno, California 93720-2659
Tel 559.264.2535 Fax 559 264.7431

amec

APPENDIX D

NRCS Custom Soil Resource Reports

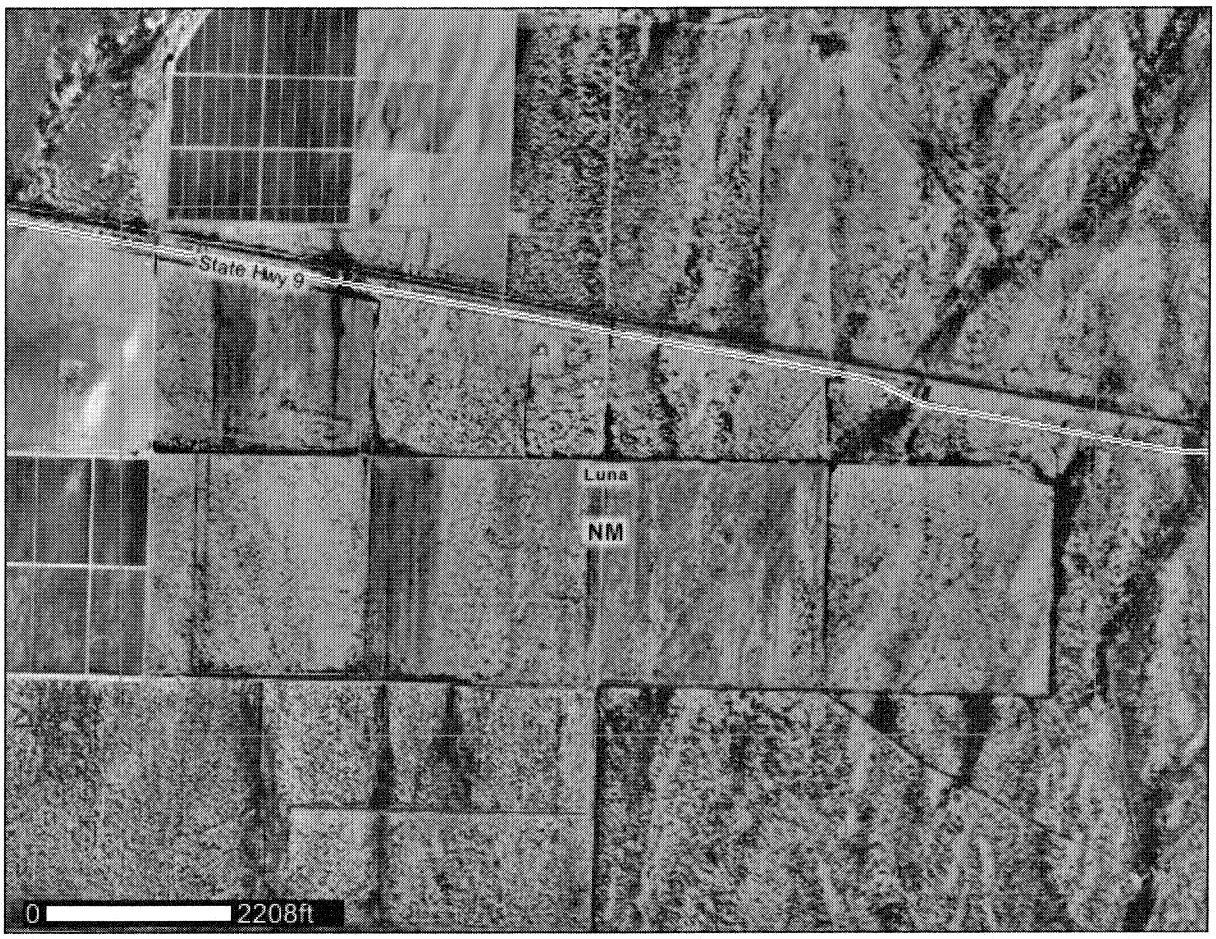
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Luna County, New Mexico



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

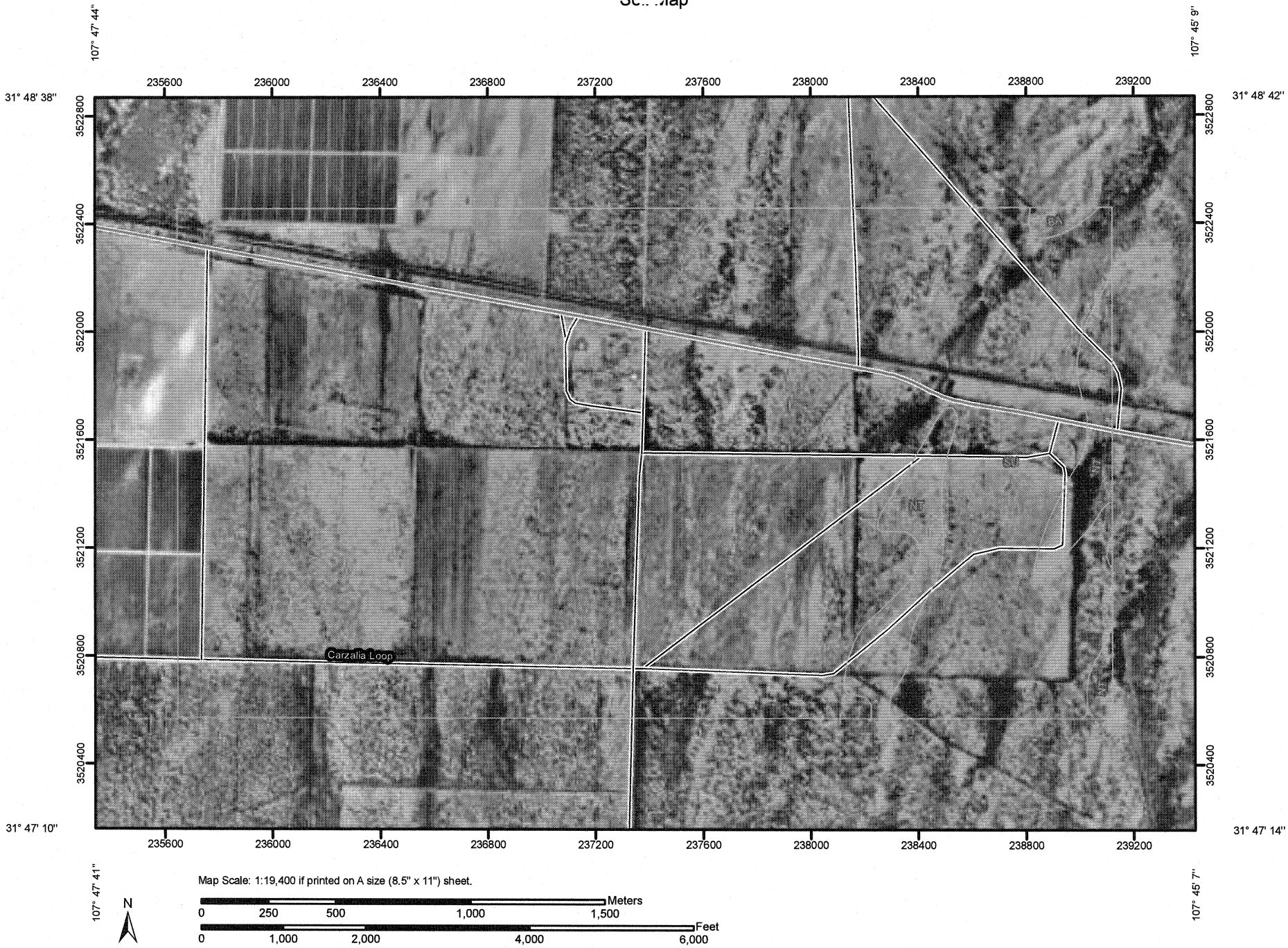
While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


107° 47' 44"
107° 45' 9"
31° 48' 38"
31° 48' 42"
235600
236000
236400
236800
237200
237600
238000
238400
238800
239200
3522800
3522400
3522000
3521600
3521200
3520800
3520400
Carzalia Loop
31° 47' 10"
31° 47' 14"
107° 47' 41"
107° 45' 7"
N
Map Scale: 1:19,400 if printed on A size (8.5" x 11") sheet.
Meters
0
250
500
1,000
1,500
Feet
0
1,000
2,000
4,000
6,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:19,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Luna County, New Mexico (NM029)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BA	Berino and Mohave soils	5.0	0.3%
NT	Nickel-Tres Hermanos complex	78.2	4.8%
SU	Stellar silty clay loam	1,535.1	94.9%
Totals for Area of Interest		**1,618.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Luna County, New Mexico

BA—Berino and Mohave soils

Map Unit Setting

Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition

Berino and similar soils: 65 percent
Mohave and similar soils: 30 percent

Description of Berino

Setting

Landform: Valley floors, fan piedmonts
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7e
Ecological site: Sandy (R042XB012NM)

Typical profile

0 to 5 inches: Loamy sand
5 to 40 inches: Sandy clay loam
40 to 60 inches: Loamy sand

Description of Mohave

Setting

Landform: Fan piedmonts, valley floors
Landform position (two-dimensional): Backslope, shoulder, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c
Ecological site: Sandy (R042XB012NM)

Typical profile

0 to 8 inches: Sandy loam
8 to 60 inches: Clay loam

NT—Nickel-Tres Hermanos complex

Map Unit Setting

Elevation: 4,000 to 5,500 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 170 to 210 days

Map Unit Composition

Nickel and similar soils: 65 percent
Tres hermanos and similar soils: 20 percent

Description of Nickel

Setting

Landform: Fan piedmonts, fan remnants
Landform position (two-dimensional): Footslope, backslope, shoulder
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Gravelly (R042XB010NM)

Typical profile

0 to 4 inches: Very gravelly sandy loam
4 to 18 inches: Very gravelly loam
18 to 60 inches: Very gravelly loam

Description of Tres Hermanos

Setting

Landform: Alluvial fans, hillslopes
Landform position (two-dimensional): Shoulder, footslope, backslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 7s
Ecological site: Gravelly (R042XB010NM)

Typical profile

0 to 3 inches: Gravelly sandy loam
3 to 36 inches: Gravelly clay loam
36 to 60 inches: Very gravelly sandy clay loam

SU—Stellar silty clay loam

Map Unit Setting

Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition

Stellar and similar soils: 100 percent

Description of Stellar

Setting

Landform: Hillslopes, basin floors
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7s
Ecological site: Clayey (R042XB023NM)

Typical profile

0 to 3 inches: Silty clay loam
3 to 37 inches: Clay
37 to 60 inches: Clay loam

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Saturated Hydraulic Conductivity (Ksat), Standard Classes (Western Cooper Ranch)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits. The classes are:

Very low: 0.00 to 0.01

Low: 0.01 to 0.1

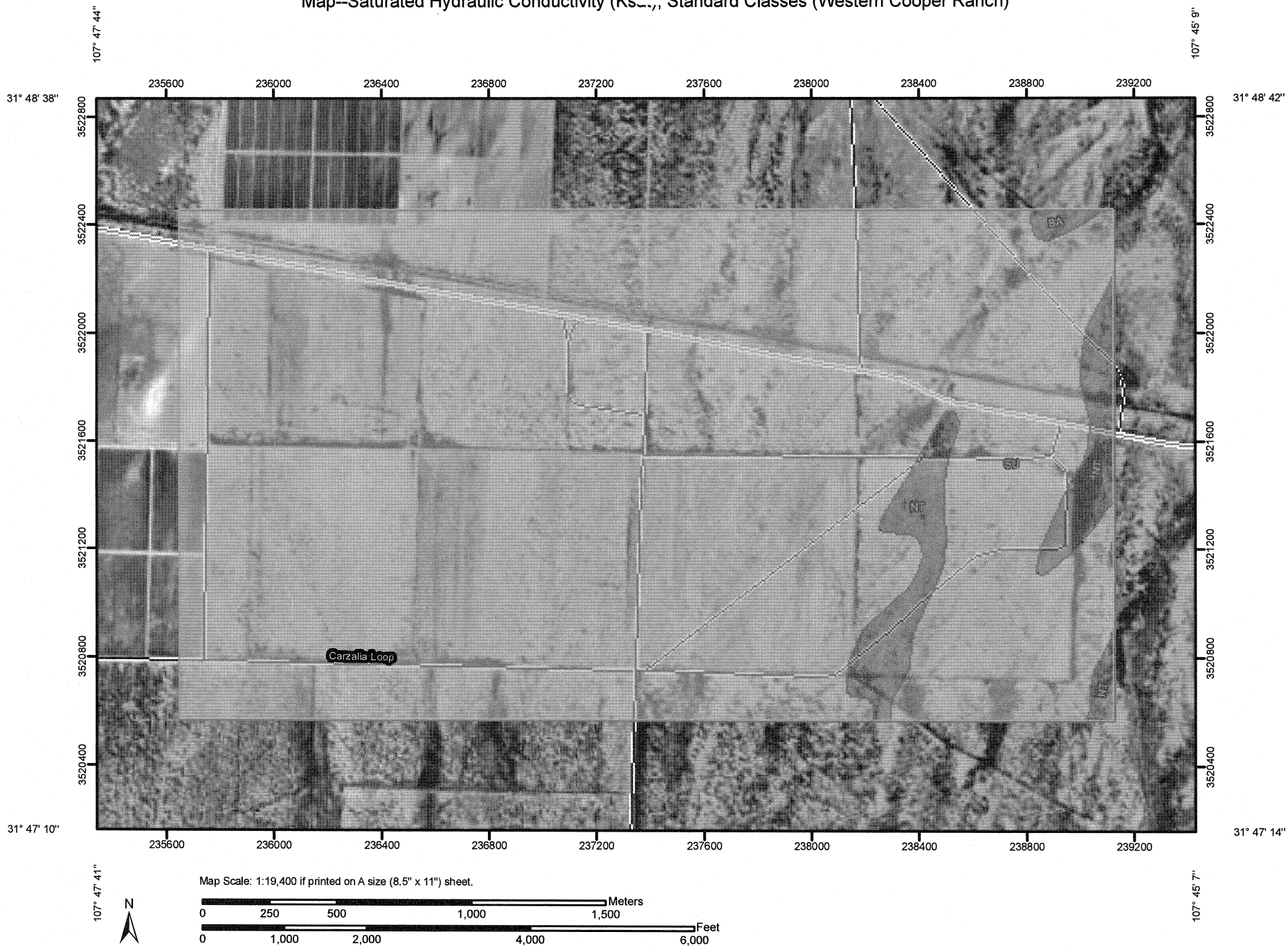
Moderately low: 0.1 to 1.0

Moderately high: 1 to 10

High: 10 to 100

Very high: 100 to 705

Custom Soil Resource Report
Map--Saturated Hydraulic Conductivity (Ksat), Standard Classes (Western Cooper Ranch)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Very Low (0.0 - 0.01)
- Low (0.01 - 0.1)
- Moderately Low (0.1 - 1)
- Moderately High (1 - 10)
- High (10 - 100)
- Very High (100 - 705)
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:19,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Western Cooper Ranch)

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — Luna County, New Mexico				
Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
BA	Berino and Mohave soils	28.2300	5.0	0.3%
NT	Nickel-Tres Hermanos complex	28.2300	78.2	4.8%
SU	Stellar silty clay loam	2.8200	1,535.1	94.9%
Totals for Area of Interest			**1,618.4**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Western Cooper Ranch)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: Surface Layer

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Unified Soil Classification (Surface) (Western Cooper Ranch)

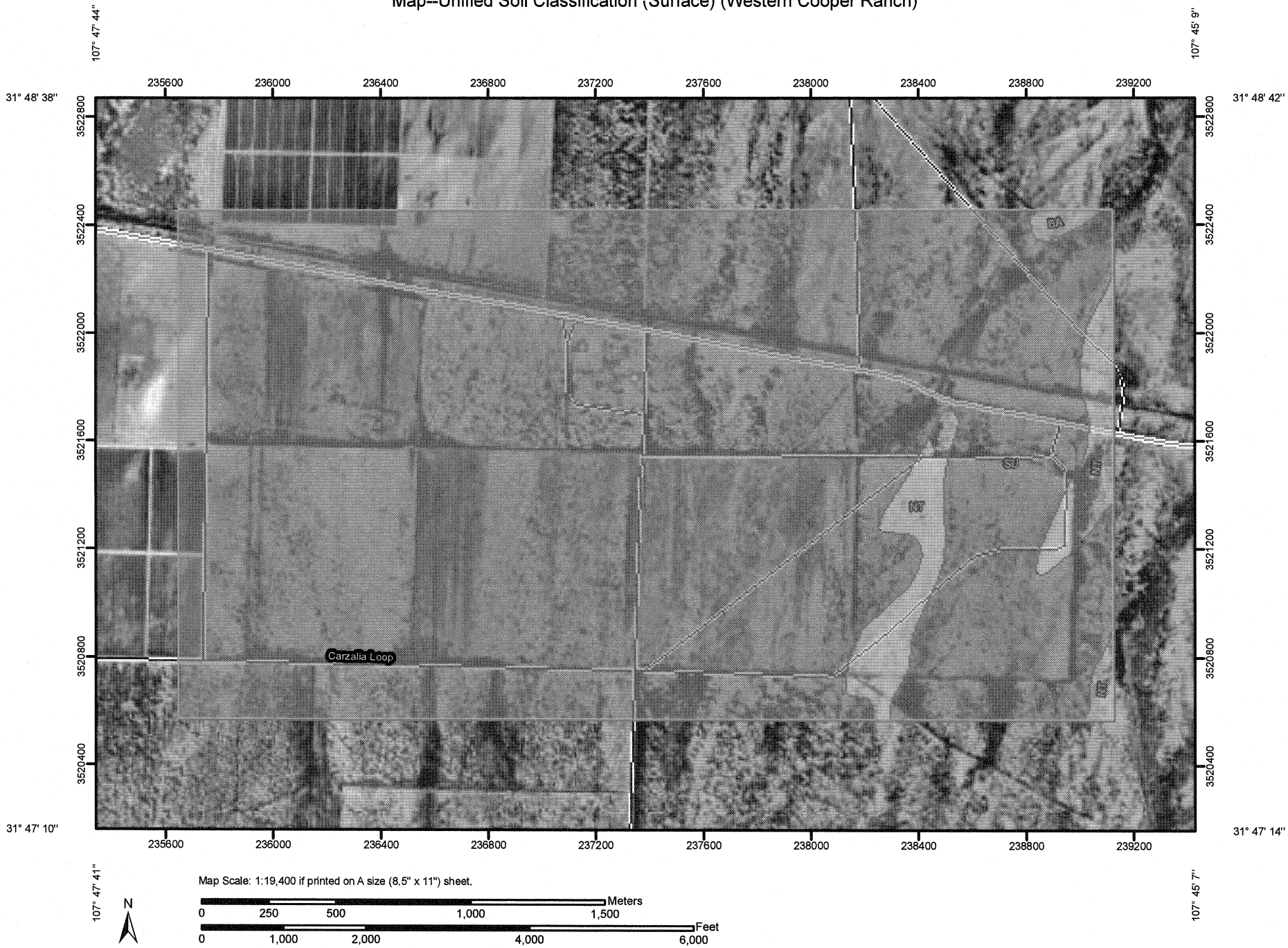
The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM

D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Custom So source Report
Map--Unified Soil Classification (Surface) (Western Cooper Ranch)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- CH
- CL
- CL-A (proposed)
- CL-K (proposed)
- CL-ML
- CL-O (proposed)
- CL-T (proposed)
- GC
- GC-GM
- GM
- GP
- GP-GC
- GP-GM
- GW
- GW-GC
- GW-GM
- MH
- MH-A (proposed)
- MH-K (proposed)
- MH-O (proposed)
- MH-T (proposed)
- ML
- ML-A (proposed)
- ML-K (proposed)
- ML-O (proposed)
- ML-T (proposed)
- OH
- OH-T (proposed)
- OL
- PT
- SC
- SC-SM
- SM
- SP
- SP-SC
- SP-SM
- SW
- SW-SC
- SW-SM
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:19,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Unified Soil Classification (Surface) (Western Cooper Ranch)

Unified Soil Classification (Surface)— Summary by Map Unit — Luna County, New Mexico				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BA	Berino and Mohave soils	SM	5.0	0.3%
NT	Nickel-Tres Hermanos complex	GC-GM	78.2	4.8%
SU	Stellar silty clay loam	CL	1,535.1	94.9%
Totals for Area of Interest			**1,618.4**	**100.0%**

Rating Options—Unified Soil Classification (Surface) (Western Cooper Ranch)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Land Classifications

This folder contains a collection of tabular reports that present a variety of soil groupings. The reports (tables) include all selected map units and components for each map unit. Land classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Taxonomic Classification of the Soils (Western Cooper Ranch)

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2003). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. This table shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisols.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalfs (*Ud*, meaning humid, plus *alfs*, from Alfisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalfs*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great

group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, active, mesic Typic Hapludalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

References:
Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. (The soils in a given survey area may have been classified according to earlier editions of this publication.)

Report—Taxonomic Classification of the Soils (Western Cooper Ranch)

[An asterisk by the soil name indicates a taxadjunct to the series]

Taxonomic Classification of the Soils– Luna County, New Mexico	
Soil name	**Family or higher taxonomic classification**
Berino	Fine-loamy, mixed, thermic Typic Haplargids
Mohave	Fine-loamy, mixed, thermic Typic Haplargids
Nickel	Loamy-skeletal, mixed, thermic Typic Calciorthids
Stellar	Fine, mixed, thermic Ustollic Haplargids
Tres Hermanos	Fine-loamy, mixed, thermic Typic Haplargids

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties (Western Cooper Ranch)

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
BA—Berino and Mohave soils												
Berino	0-5	Loamy sand	SM, SW-SM	A-2-4	0	0	95-100	95-100	50-95	10-35	0-0	NP
	5-40	Sandy clay loam, sandy loam, loam	SC, SC-SM, CL	A-4, A-6	0	0	95-100	95-100	65-80	35-60	20-35	5-15
	40-60	Loamy sand	SM, SC-SM	A-2-4	0	0	95-100	95-100	55-75	15-25	10-20	1-6
Mohave	0-8	Sandy loam	SC, SC-SM, SM	A-2-4, A-4	0	0	75-100	70-100	55-75	25-45	20-30	NP-10
	8-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7-6	0	0	100	95-100	85-95	70-80	25-45	5-25

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
NT—Nickel-Tres Hermanos complex												
Nickel	0-4	Very gravelly sandy loam	GC, GC-GM, GM	A-2-4, A-1-b	0	10-15	45-60	40-55	30-45	20-35	20-30	NP-10
	4-18	Gravelly loam, very gravelly loam, gravelly fine sandy loam	GC-GM, SC-SM, GC, SC	A-1-b, A-2-4, A-4	0	10-15	45-75	40-70	30-50	20-40	25-30	5-10
	18-60	Very gravelly loam, very gravelly sandy loam, extremely gravelly loam	GC-GM, GW-GC, GC	A-1-a, A-2-4	0	10-15	20-60	15-55	10-40	5-30	25-30	5-10
Tres hermanos	0-3	Gravelly sandy loam	SM, SC-SM, SW-SM	A-1-b, A-2, A-4	0	0-5	60-80	55-75	35-60	10-40	20-25	NP-5
	3-36	Gravelly loam, gravelly clay loam	SC, CL, GC	A-6	0	0-10	60-80	55-75	45-70	35-55	25-35	10-15
	36-60	Very gravelly loam, very gravelly sandy clay loam, very gravelly sandy loam	GW-GC, GC-GM, GC	A-1-a, A-2-4	0	0-15	35-55	30-50	25-45	10-30	25-30	5-10
SU—Stellar silty clay loam												
Stellar	0-3	Silty clay loam	CL	A-6	0	0	100	100	90-100	70-95	30-40	10-20
	3-37	Clay, sandy clay, clay loam	SC, CH, CL	A-7-6, A-6	0	0	100	100	80-95	45-90	40-60	15-30
	37-60	Clay loam, sandy clay loam, gravelly clay loam	GM, ML, SC, CL	A-4, A-6, A-7-6	0	0-5	65-100	60-100	55-100	45-70	30-50	5-25

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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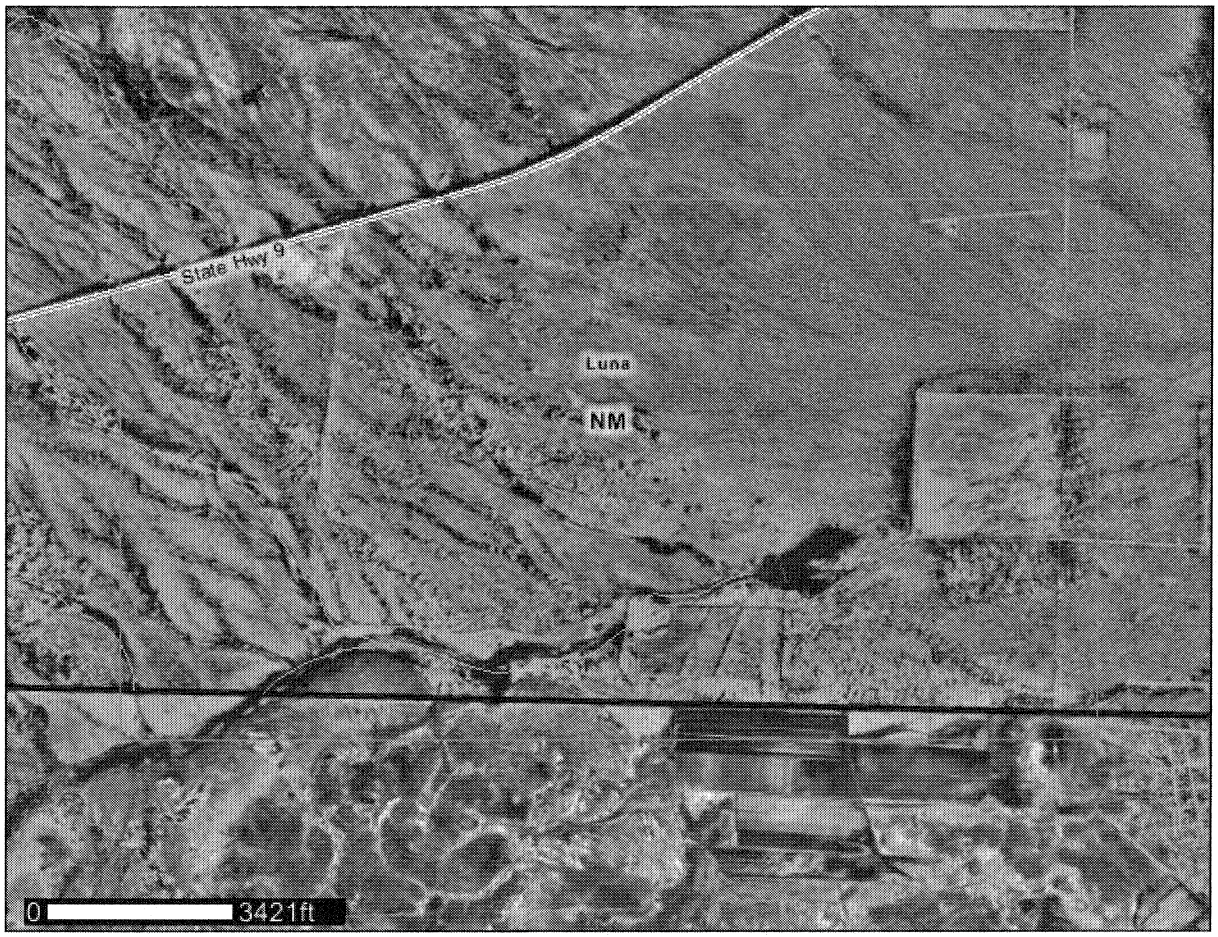
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Luna County, New Mexico



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

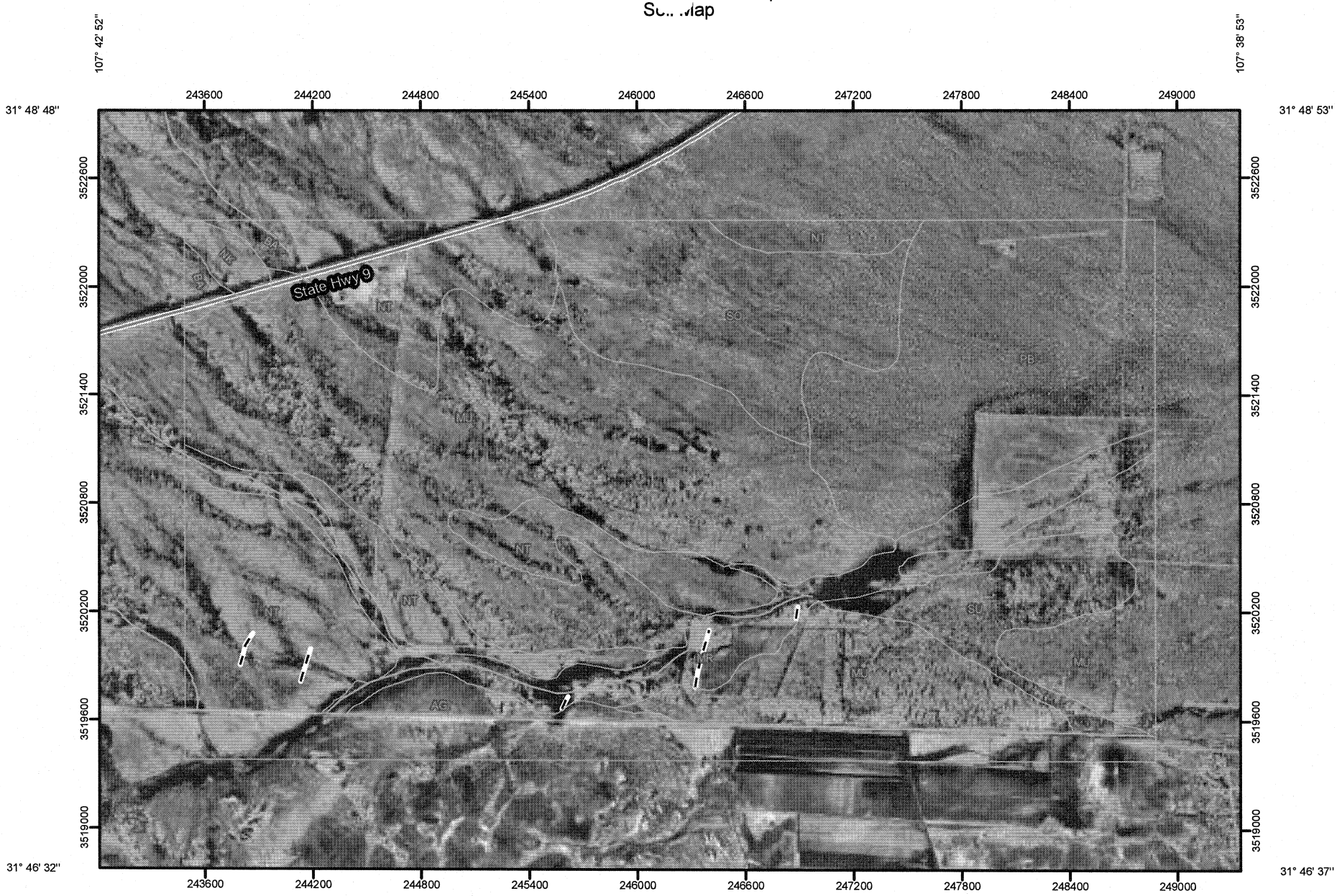
While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.


107° 42' 52"
107° 38' 53"
31° 48' 48"
31° 48' 53"
243600
244200
244800
245400
246000
246600
247200
247800
248400
249000
3522600
3522000
3521400
3520800
3520200
3519600
3519000
State Hwy 9
31° 46' 32"
31° 46' 37"
107° 42' 48"
107° 38' 49"
Map Scale: 1:30,100 if printed on A size (8.5" x 11") sheet.
N
Meters
0 400 800 1,600 2,400
Feet
0 1,500 3,000 6,000 9,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:30,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Luna County, New Mexico (NM029)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AG	Akela very gravelly loam, 0 to 10 percent slopes	53.2	1.3%
BA	Berino and Mohave soils	38.4	1.0%
MR	Mimbres and Verhalen soils	278.7	7.0%
MU	Mohave sandy clay loam, 0 to 3 percent slopes	1,427.1	35.9%
NK	Nickel very gravelly sandy loam, 3 to 9 percent slopes	30.1	0.8%
NT	Nickel-Tres Hermanos complex	734.7	18.5%
PB	Pintura-Berino complex, eroded	606.5	15.3%
SO	Sonoita gravelly sandy loam	366.2	9.2%
SU	Stellar silty clay loam	163.4	4.1%
Subtotals for Soil Survey Area		**3,698.3**	**93.1%**
Totals for Area of Interest		**3,974.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the

contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Luna County, New Mexico

AG—Akela very gravelly loam, 0 to 10 percent slopes

Map Unit Setting

Elevation: 4,500 to 5,500 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 170 to 210 days

Map Unit Composition

Akela and similar soils: 95 percent

Description of Akela

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous, metamorphic and sedimentary rock

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: 4 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Very low (about 1.4 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Malpais (R042XB037NM)

Typical profile

0 to 3 inches: Very gravelly loam
3 to 18 inches: Very gravelly loam
18 to 60 inches: Bedrock

BA—Berino and Mohave soils

Map Unit Setting

Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 8 to 11 inches

Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition
Berino and similar soils: 65 percent
Mohave and similar soils: 30 percent

Description of Berino

Setting
Landform: Valley floors, fan piedmonts
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7e
Ecological site: Sandy (R042XB012NM)

Typical profile
0 to 5 inches: Loamy sand
5 to 40 inches: Sandy clay loam
40 to 60 inches: Loamy sand

Description of Mohave

Setting
Landform: Fan piedmonts, valley floors
Landform position (two-dimensional): Backslope, shoulder, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c
Ecological site: Sandy (R042XB012NM)

Typical profile

0 to 8 inches: Sandy loam
8 to 60 inches: Clay loam

MR—Mimbres and Verhalen soils

Map Unit Setting

Elevation: 3,800 to 6,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 55 to 62 degrees F
Frost-free period: 170 to 210 days

Map Unit Composition

Mimbres and similar soils: 50 percent
Verhalen and similar soils: 45 percent

Description of Mimbres

Setting

Landform: Alluvial fans, stream terraces, valley floor remnants
Landform position (three-dimensional): Tread, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0

Available water capacity: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7c
Ecological site: Bottomland (R042XB018NM)

Typical profile

0 to 3 inches: Silty clay loam
3 to 42 inches: Silty clay loam
42 to 60 inches: Sandy clay loam

Description of Verhalen

Setting

Landform: Alluvial fans, stream terraces, valley floor remnants
Landform position (three-dimensional): Tread, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability (nonirrigated): 6s
Ecological site: Bottomland (R042XB018NM)

Typical profile

0 to 5 inches: Silty clay loam
5 to 60 inches: Clay

MU—Mohave sandy clay loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 3,800 to 6,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition
Mohave and similar soils: 100 percent

Description of Mohave

Setting
Landform: Alluvial fans, hillslopes
Landform position (two-dimensional): Backslope, shoulder, footslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: High (about 12.0 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c
Ecological site: Loamy (R042XB014NM)

Typical profile
0 to 8 inches: Sandy clay loam
8 to 60 inches: Clay loam

NK—Nickel very gravelly sandy loam, 3 to 9 percent slopes

Map Unit Setting
Elevation: 4,000 to 6,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 170 to 210 days

Map Unit Composition
Nickel and similar soils: 100 percent

Description of Nickel

Setting
Landform: Fan piedmonts, fan remnants
Landform position (two-dimensional): Shoulder, footslope, backslope

Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Gravelly (R042XB010NM)

Typical profile

0 to 4 inches: Very gravelly sandy loam
4 to 18 inches: Very gravelly loam
18 to 60 inches: Very gravelly loam

NT—Nickel-Tres Hermanos complex

Map Unit Setting

Elevation: 4,000 to 5,500 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 170 to 210 days

Map Unit Composition

Nickel and similar soils: 65 percent
Tres hermanos and similar soils: 20 percent

Description of Nickel

Setting

Landform: Fan piedmonts, fan remnants
Landform position (two-dimensional): Footslope, backslope, shoulder
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water capacity: Low (about 5.5 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Gravelly (R042XB010NM)

Typical profile

0 to 4 inches: Very gravelly sandy loam
4 to 18 inches: Very gravelly loam
18 to 60 inches: Very gravelly loam

Description of Tres Hermanos

Setting

Landform: Alluvial fans, hillslopes
Landform position (two-dimensional): Shoulder, footslope, backslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability (nonirrigated): 7s
Ecological site: Gravelly (R042XB010NM)

Typical profile

0 to 3 inches: Gravelly sandy loam
3 to 36 inches: Gravelly clay loam
36 to 60 inches: Very gravelly sandy clay loam

PB—Pintura-Berino complex, eroded

Map Unit Setting

Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 58 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition

Pintura and similar soils: 50 percent
Berino and similar soils: 40 percent

Description of Pintura

Setting

Landform: Fan piedmonts, valley floors
Landform position (two-dimensional): Backslope, footslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Hummocks of alluvium derived from calcareous sandstone

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Sandy (R042XB012NM)

Typical profile

0 to 2 inches: Fine sand
2 to 60 inches: Fine sand

Description of Berino

Setting

Landform: Fan piedmonts, valley floors
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7e
Ecological site: Sandy (R042XB012NM)

Typical profile
0 to 5 inches: Loamy sand
5 to 40 inches: Sandy clay loam
40 to 60 inches: Loamy sand

SO—Sonoita gravelly sandy loam

Map Unit Setting
Elevation: 4,200 to 5,700 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition
Sonoita and similar soils: 100 percent

Description of Sonoita

Setting
Landform: Hillslopes, terraces
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Properties and qualities
Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7s
Ecological site: Gravelly Loam (R042XB035NM)

Typical profile

0 to 3 inches: Gravelly sandy loam
3 to 60 inches: Sandy loam

SU—Stellar silty clay loam

Map Unit Setting

Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 62 degrees F
Frost-free period: 180 to 210 days

Map Unit Composition

Stellar and similar soils: 100 percent

Description of Stellar

Setting

Landform: Hillslopes, basin floors
Landform position (two-dimensional): Footslope, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability (nonirrigated): 7s
Ecological site: Clayey (R042XB023NM)

Typical profile

0 to 3 inches: Silty clay loam
3 to 37 inches: Clay
37 to 60 inches: Clay loam

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Saturated Hydraulic Conductivity (Ksat), Standard Classes (Eastern Cooper Ranch)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits. The classes are:

Very low: 0.00 to 0.01

Low: 0.01 to 0.1

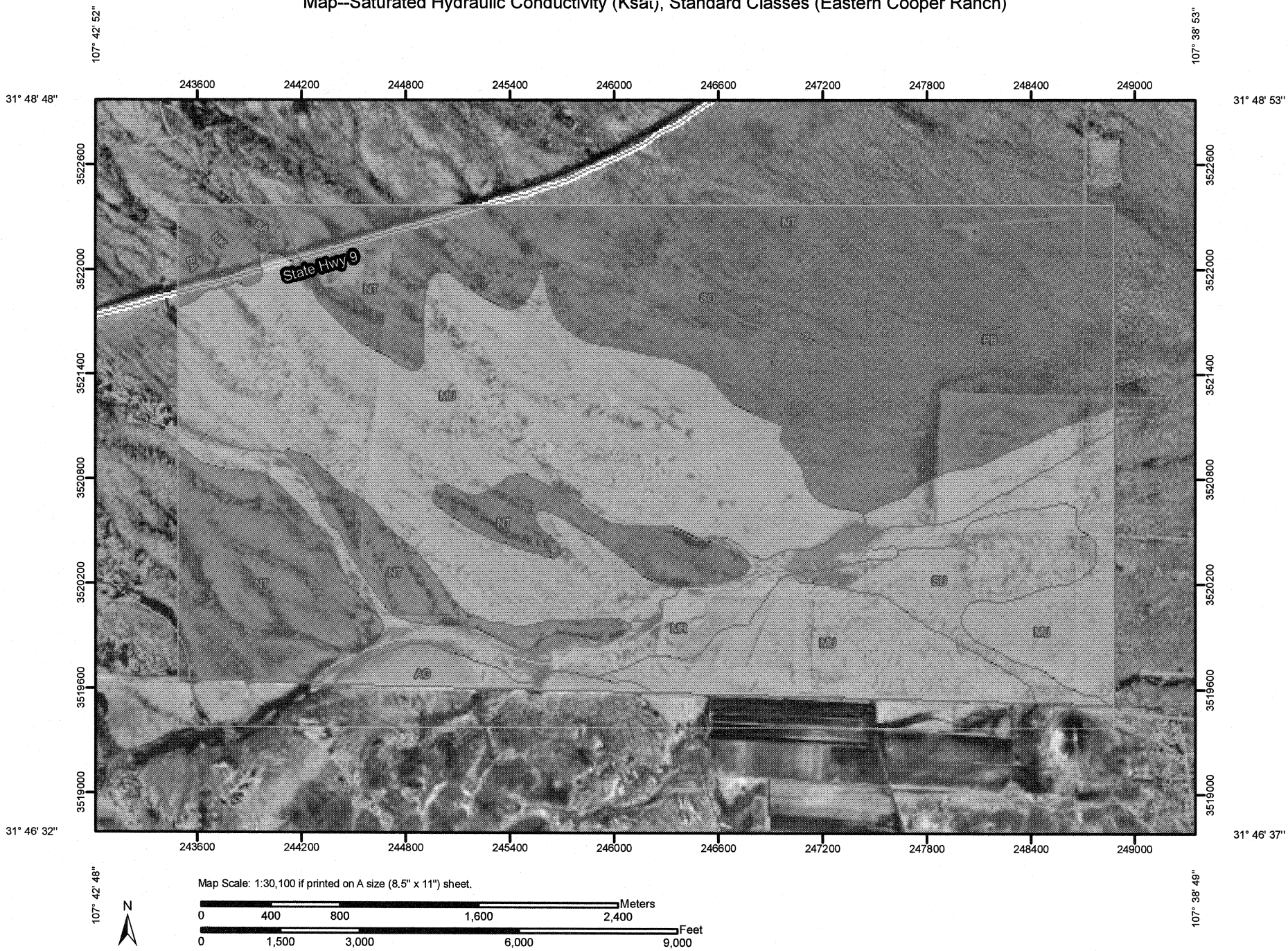
Moderately low: 0.1 to 1.0

Moderately high: 1 to 10

High: 10 to 100

Very high: 100 to 705

Custom Soil ource Report
Map--Saturated Hydraulic Conductivity (Ksat), Standard Classes (Eastern Cooper Ranch)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Very Low (0.0 - 0.01)
- Low (0.01 - 0.1)
- Moderately Low (0.1 - 1)
- Moderately High (1 - 10)
- High (10 - 100)
- Very High (100 - 705)
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:30,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Eastern Cooper Ranch)

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — Luna County, New Mexico				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
AG	Akela very gravelly loam, 0 to 10 percent slopes	9.1700	53.2	1.3%
BA	Berino and Mohave soils	28.2300	38.4	1.0%
MR	Mimbres and Verhalen soils	2.8200	278.7	7.0%
MU	Mohave sandy clay loam, 0 to 3 percent slopes	2.8200	1,427.1	35.9%
NK	Nickel very gravelly sandy loam, 3 to 9 percent slopes	28.2300	30.1	0.8%
NT	Nickel-Tres Hermanos complex	28.2300	734.7	18.5%
PB	Pintura-Berino complex, eroded	91.7400	606.5	15.3%
SO	Sonoita gravelly sandy loam	28.2300	366.2	9.2%
SU	Stellar silty clay loam	2.8200	163.4	4.1%
Subtotals for Soil Survey Area			**3,698.3**	**93.1%**
Totals for Area of Interest			**3,974.2**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Eastern Cooper Ranch)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: Surface Layer

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

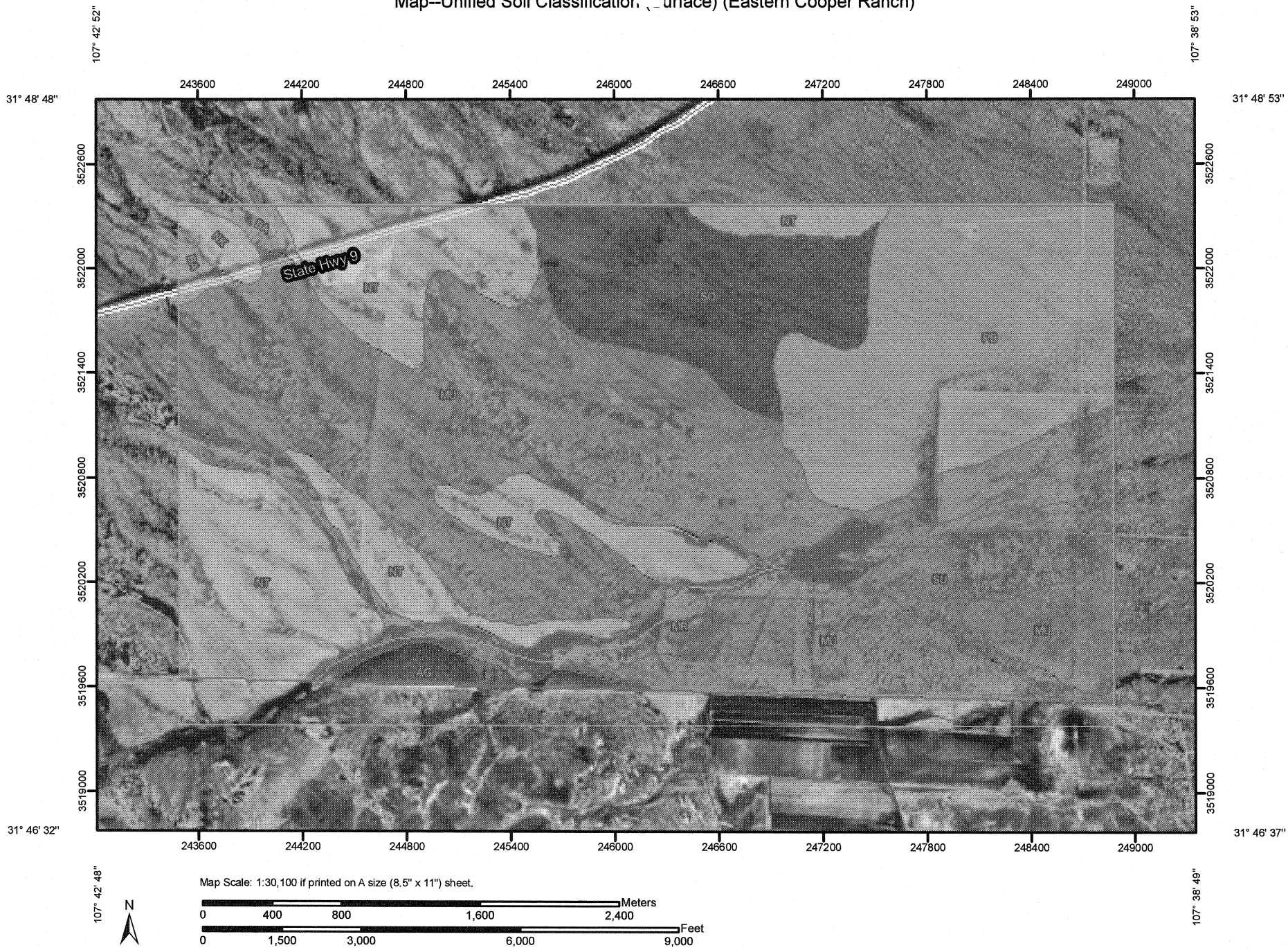
Unified Soil Classification (Surface) (Eastern Cooper Ranch)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Custom Soil ource Report
Map--Unified Soil Classificatio. urface) (Eastern Cooper Ranch)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- CH
- CL
- CL-A (proposed)
- CL-K (proposed)
- CL-ML
- CL-O (proposed)
- CL-T (proposed)
- GC
- GC-GM
- GM
- GP
- GP-GC
- GP-GM
- GW
- GW-GC
- GW-GM
- MH
- MH-A (proposed)
- MH-K (proposed)
- MH-O (proposed)
- MH-T (proposed)
- ML
- ML-A (proposed)
- ML-K (proposed)
- ML-O (proposed)
- ML-T (proposed)
- OH
- OH-T (proposed)
- OL
- PT
- SC
- SC-SM
- SM
- SP
- SP-SC
- SP-SM
- SW
- SW-SC
- SW-SM
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:30,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Luna County, New Mexico
Survey Area Data: Version 7, Dec 9, 2008

Date(s) aerial images were photographed: 1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Unified Soil Classification (Surface) (Eastern Cooper Ranch)

Unified Soil Classification (Surface)— Summary by Map Unit — Luna County, New Mexico				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AG	Akela very gravelly loam, 0 to 10 percent slopes	GM	53.2	1.3%
BA	Berino and Mohave soils	SM	38.4	1.0%
MR	Mimbres and Verhalen soils	CL	278.7	7.0%
MU	Mohave sandy clay loam, 0 to 3 percent slopes	CL	1,427.1	35.9%
NK	Nickel very gravelly sandy loam, 3 to 9 percent slopes	GC-GM	30.1	0.8%
NT	Nickel-Tres Hermanos complex	GC-GM	734.7	18.5%
PB	Pintura-Berino complex, eroded	SM	606.5	15.3%
SO	Sonoita gravelly sandy loam	SC-SM	366.2	9.2%
SU	Stellar silty clay loam	CL	163.4	4.1%
Subtotals for Soil Survey Area			**3,698.3**	**93.1%**
Totals for Area of Interest			**3,974.2**	**100.0%**

Rating Options—Unified Soil Classification (Surface) (Eastern Cooper Ranch)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Land Classifications

This folder contains a collection of tabular reports that present a variety of soil groupings. The reports (tables) include all selected map units and components for each map unit. Land classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Taxonomic Classification of the Soils (Eastern Cooper Ranch)

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2003). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. This table shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Alfisols.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalfs (*Ud*, meaning humid, plus *alfs*, from Alfisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalfs*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great

group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, active, mesic Typic Hapludalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

References:
Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. (The soils in a given survey area may have been classified according to earlier editions of this publication.)

Report—Taxonomic Classification of the Soils (Eastern Cooper Ranch)

[An asterisk by the soil name indicates a taxadjunct to the series]

Taxonomic Classification of the Soils– Luna County, New Mexico	
Soil name	**Family or higher taxonomic classification**
Akela	Loamy-skeletal, mixed (calcareous), thermic Lithic Torriorthents
Berino	Fine-loamy, mixed, thermic Typic Haplargids
Mimbres	Fine-silty, mixed, thermic Typic Camborthids
Mohave	Fine-loamy, mixed, thermic Typic Haplargids
Nickel	Loamy-skeletal, mixed, thermic Typic Calciorthids
Pintura	Mixed, thermic Typic Torripsamments
Sonoita	Coarse-loamy, mixed, thermic Typic Haplargids
Stellar	Fine, mixed, thermic Ustollic Haplargids
Tres Hermanos	Fine-loamy, mixed, thermic Typic Haplargids
Verhalen	Fine, montmorillonitic, thermic Mollic Torrerts

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties (Eastern Cooper Ranch)

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
AG—Akela very gravelly loam, 0 to 10 percent slopes												
Akela	0-3	Very gravelly loam	GM, GC-GM	A-1-b, A-2-4	0	5-20	40-55	35-50	30-45	20-35	20-25	NP-5
	3-18	Very gravelly sandy loam, very gravelly loam, extremely gravelly loam	GM, GW-GM, GC-GM	A-1-b, A-1-a, A-2-4	0	10-15	15-60	10-55	10-40	5-30	20-25	NP-5
	18-60	Bedrock	—	—	—	—	—	—	—	—	—	—
BA—Berino and Mohave soils												
Berino	0-5	Loamy sand	SM, SW-SM	A-2-4	0	0	95-100	95-100	50-95	10-35	0-0	NP
	5-40	Sandy clay loam, sandy loam, loam	SC, SC-SM, CL	A-4, A-6	0	0	95-100	95-100	65-80	35-60	20-35	5-15
	40-60	Loamy sand	SM, SC-SM	A-2-4	0	0	95-100	95-100	55-75	15-25	10-20	1-6
Mohave	0-8	Sandy loam	SC, SC-SM, SM	A-2-4, A-4	0	0	75-100	70-100	55-75	25-45	20-30	NP-10
	8-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7-6	0	0	100	95-100	85-95	70-80	25-45	5-25

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
MR—Mimbres and Verhalen soils												
Mimbres	0-3	Silty clay loam	CL	A-6	0	0	100	100	95-100	75-95	35-40	15-20
	3-42	Silty clay loam, silt loam, clay loam	CL	A-6	0	0	100	100	95-100	75-95	25-40	10-20
	42-60	Sandy clay loam, silt loam, clay loam	CL, SC	A-6	0	0	90-100	90-100	90-100	40-95	25-40	10-20
Verhalen	0-5	Silty clay loam	CH, CL	A-7-6, A-6	0	0	95-100	95-100	90-100	70-85	40-55	20-33
	5-60	Clay, silty clay, clay loam	CH, CL	A-7-6	0	0	95-100	95-100	90-100	70-95	45-65	25-40
MU—Mohave sandy clay loam, 0 to 3 percent slopes												
Mohave	0-8	Sandy clay loam	CL	A-6, A-7-6	0	0	100	95-100	85-95	70-80	35-45	15-25
	8-60	Clay loam, loam	CL, CL-ML	A-7-6, A-4, A-6	0	0	100	95-100	85-95	70-80	25-45	5-25
NK—Nickel very gravelly sandy loam, 3 to 9 percent slopes												
Nickel	0-4	Very gravelly sandy loam	GC, GC-GM, GM	A-2-4, A-1-b	0	10-15	45-60	40-55	30-45	20-35	20-30	NP-10
	4-18	Gravelly loam, very gravelly loam, gravelly fine sandy loam	SC, GC-GM, SC-SM, GC	A-2-4, A-4, A-1-b	0	10-15	45-75	40-70	30-50	20-40	25-30	5-10
	18-60	Very gravelly loam, very gravelly sandy loam, extremely gravelly loam	GC-GM, GW-GC, GC	A-1-a, A-2-4	0	10-15	20-60	15-55	10-40	5-30	25-30	5-10

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
NT—Nickel-Tres Hermanos complex												
Nickel	0-4	Very gravelly sandy loam	GC, GC-GM, GM	A-2-4, A-1-b	0	10-15	45-60	40-55	30-45	20-35	20-30	NP-10
	4-18	Gravelly loam, very gravelly loam, gravelly fine sandy loam	GC-GM, SC-SM, GC, SC	A-1-b, A-2-4, A-4	0	10-15	45-75	40-70	30-50	20-40	25-30	5-10
	18-60	Very gravelly loam, very gravelly sandy loam, extremely gravelly loam	GC-GM, GW-GC, GC	A-1-a, A-2-4	0	10-15	20-60	15-55	10-40	5-30	25-30	5-10
Tres hermanos	0-3	Gravelly sandy loam	SM, SC-SM, SW-SM	A-1-b, A-2, A-4	0	0-5	60-80	55-75	35-60	10-40	20-25	NP-5
	3-36	Gravelly loam, gravelly clay loam	SC, CL, GC	A-6	0	0-10	60-80	55-75	45-70	35-55	25-35	10-15
	36-60	Very gravelly loam, very gravelly sandy clay loam, very gravelly sandy loam	GW-GC, GC-GM, GC	A-1-a, A-2-4	0	0-15	35-55	30-50	25-45	10-30	25-30	5-10

Engineering Properties– Luna County, New Mexico												
Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				*Pct*	*Pct*					*Pct*	
PB—Pintura-Berino complex, eroded												
Pintura	0-2	Fine sand	SM	A-2-4, A-3	0	0	100	100	70-95	5-15	0-0	NP
	2-60	Loamy fine sand, fine sand	SC-SM, SM, SW-SM	A-2-4	0	0	100	100	70-95	5-25	12-20	2-6
Berino	0-5	Loamy sand	SW-SM, SM	A-2-4	0	0	95-100	95-100	50-95	10-35	0-0	NP
	5-40	Sandy clay loam, sandy loam, loam	SC-SM, CL, CL-ML, SC	A-4, A-6	0	0	95-100	95-100	65-80	35-60	20-35	5-15
	40-60	Loamy sand	SM, SC-SM	A-2-4	0	0	95-100	95-100	55-75	15-25	10-20	1-6
SO—Sonoita gravelly sandy loam												
Sonoita	0-3	Gravelly sandy loam	SM, SC-SM	A-1-b, A-2-4	0	0-5	70-75	65-75	40-60	20-30	15-21	3-6
	3-60	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SC-SM	A-1-b, A-2-4	0	0-5	70-95	65-95	40-65	20-35	15-25	NP-5
SU—Stellar silty clay loam												
Stellar	0-3	Silty clay loam	CL	A-6	0	0	100	100	90-100	70-95	30-40	10-20
	3-37	Clay, sandy clay, clay loam	SC, CH, CL	A-7-6, A-6	0	0	100	100	80-95	45-90	40-60	15-30
	37-60	Clay loam, sandy clay loam, gravelly clay loam	GM, ML, SC, CL	A-4, A-6, A-7-6	0	0-5	65-100	60-100	55-100	45-70	30-50	5-25

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

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Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://soils.usda.gov/

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/

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United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.glti.nrcs.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://soils.usda.gov/

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

APPENDIX E

USDA Highly Erodible Land Determinations

U.S.D.A.
Soil Conservation Service

SCS CPA 026
(1-88)

HIGHLY ERODIBLE LAND AND WETLAND CONSERVATION DETERMINATION

1. Name and Addr of Person
SAM TEAGUE
902 VENTURE OUT
MESA, AZ 85205

2. Date of Request
6-22-87

3. County
LUNA

4. Name of USDA Agency or Person Requesting Determination
ASCS

5. Farm No. and Tract No.
260 - TRACTS 140 & 243

SECTION I – HIGHLY ERODIBLE LAND

	Yes	No	Field No.(s)	Total Acres
6. Is soil survey now available for making a highly erodible land determination?	X			
7. Are there highly erodible soil map units on this farm?	X			
8. List highly erodible fields that, according to ASCS records, were used to produce an agricultural commodity in any crop year during 1981-1985.			TR. 140 - 2, 3 & 7 TR. 243 - 1, 2 & 3	455.1
9. List highly erodible fields that have been or will be converted for the production of agricultural commodities and, according to ASCS records, were not used for this purpose in any crop year during 1981-1985; and were not enrolled in a USDA set-aside or diversion program.			NA	

10. This Highly Erodible Land determination was completed in the: Office [X] Field [ ]

NOTE: If you have highly erodible cropland fields, you may need to have a conservation plan developed for these fields. For further information, contact the local office of the Soil Conservation Service.

SECTION II – WETLAND

	Yes	No	Field No.(s)	Total Wetland Acres
11. Are there hydric soils on this farm?		X		
List field numbers and acres, where appropriate, for the following EXEMPTED WETLANDS:				
12. Wetlands (W), including abandoned wetlands, or Farmed Wetlands (FW). Wetlands may be farmed under natural conditions. Farmed Wetlands may be farmed and maintained in the same manner as they were prior to December 23, 1985, as long as they are not abandoned.			N.A.	
13. Prior Converted Wetlands (PC) - The use, management, drainage, and alteration of prior converted wetlands (PC) are not subject to FSA unless the area reverts to wetland as a result of abandonment. You should inform SCS of any area to be used to produce an agricultural commodity that has not been cropped, managed, or maintained for 5 years or more.			N.A.	
14. Artificial Wetlands (AW) - Artificial Wetlands includes irrigation induced wetlands. These Wetlands are not subject to FSA.			N.A.	
15. Minimal Effect Wetlands (MW) - These wetlands are to be farmed according to the minimal effect agreement signed at the time the minimal effect determination was made.			N.A.	
NON-EXEMPTED WETLANDS:				
16. Converted Wetlands (CW) - In any year that an agricultural commodity is planted on these Converted Wetlands, you will be ineligible for USDA benefits. If you believe that the conversion was commenced before December 23, 1985, or that the conversion was caused by a third party, contact the ASCS office to request a commenced or third party determination.			N.A.	

17. The planned alteration measures on wetlands in fields N.A. are considered maintenance and are in compliance with FSA.

18. The planned alteration measures on wetlands in fields N.A. are not considered to be maintenance and if installed will cause the area to become a Converted Wetland (CW). See item 16 for information on CW.

19. This wetland determination was completed in the: Office [X] Field [ ]

20. This determination was: Delivered [X] Mailed [ ] To the Person on Date: 10/18/89

NOTE: If you do not agree with this determination, you may request a reconsideration from the person that signed this form in Block 22 below. The reconsideration is a prerequisite for any further appeal. The request for the reconsideration must be in writing and must state your reasons for the request. The request must be mailed or delivered within 15 days after this determination is mailed to or otherwise made available to you. Please see reverse side of the producer's copy of this form for more information on appeals procedure.

NOTE: If you intend to convert additional land to cropland, or alter any wetlands you must initiate another Form AD-1026 at the local office of ASCS. Abandonment is where land has not been cropped, managed, or maintained for 5 years or more. You should inform SCS if you plan to produce an agricultural commodity on abandoned wetlands.

21. Remarks THERE ARE OTHER NON-CROPLAND FIELDS ON THIS FARM THAT ARE HIGHLY ERODIBLE. IF ANY OF THESE FIELDS ARE CONVERTED TO CROPLAND AND PLANTED TO A COMMODITY CROP, THEY WILL NEED TO BE INCLUDED IN THIS CONSERVATION PLAN.

22. Signature of SCS District Conservationist
Bobby K. Hanna

23. Date
3-2-88

AD-1026
(07 86)

UNITED STATES DEPARTMENT OF AGRICULTURE

HIGHLY ER[illegible]E LAND AND WETLAND CONSERVAT[illegible]RTIFICATION

The following statements are made in accordance with the Privacy Act of 1974 (5 USC 552a). The authority for requesting the information to be supplied on this form is the Food Security Act of 1985, P.L. 99-198, and regulations promugulated under the Act (7CFR Part 12). The information will be used to determine eligibility for program benefits and other financial assistance administered by USDA agencies. The information may be furnished to other USDA agencies, IRS, Department of Justice, or other State and Federal law enforcement agencies, and in response to orders of a court magistrate or administrative tribunal. Furnishing the Social Security Number is voluntary. Furnishing the other requested information is voluntary; however, failure to furnish the correct, complete information will result in a determination of ineligibility for certain program benefits and other financial assistance administered by USDA agencies. The provisions of criminal and civil fraud statutes, including 18 USC 286, 287, 371, 641, 1001; 15 USC 714m; and 31 USC 3729, may be applicable to information provided by the producer on this form.

PART A - PRODUCER'S INTENTIONS FOR USE OF LAND

1. NAME AND ADDRESS OF PRODUCER	2. SOCIAL SECURITY NUMBER (or tax ID number)	3. CROP YEAR
Sam Teague		1987

4. FARM NUMBER(S)	5. COUNTY(IES) WHERE LOCATED
260	Luna, New Mexico
	Deaf Smith, Texas Hereford
	Gaines County, Texas Seminole

	Yes	No
6. During either the crop year entered in item 3 above, or the term of a requested USDA loan, will an agricultural commodity be produced on fields of the farm(s) that were not used for the production of any agricultural commodity (see instructions) or not enrolled in an USDA set-aside or diversion program during any crop year 1981 through 1985? If "yes," list the farm and field numbers.		✓
7. Will an agricultural commodity be produced on any land on the farm(s) listed above that was a wet area but was improved, drained, or modified, or converted after December 23, 1985? If "yes," list the farm and field numbers.		✓
8. Do you plan to convert any land including wet areas for the production of an agricultural commodity this year or during the term of a requested USDA loan or other program benefit? If "yes," list the farm and field numbers.		✓

I certify that the above information is true and correct to the best of my knowledge and belief.

9. SIGNATURE OF PRODUCER: Sam Teague — DATE: June 22, 1987

PART B - REFERRAL TO SCS

10. Based on county office information, a SCS determination is:	CHECK
a. Needed prior to the producer's certification in Part C.	
b. Needed before January 1, 1990.	

NOTE: If the producer answers "No" to Part A, items 6, 7, and 8, and the agency so agrees, the producer may complete the certification in Part C without a SCS determination. However, beginning January 1, 1990, or 2 years after a soil survey is completed, the producer must be actively applying an approved conservation plan on all highly erodible fields. Therefore, a SCS determination regarding the existence of any highly erodible fields on the farm(s) listed above is necessary before January 1, 1990.

11. DATE REFERRED TO SCS FOR DETERMINATION	12. SIGNATURE OF AGENCY REPRESENTATIVE	DATE
	John Burris	6-22-87

PART C - USE CERTIFICATION (Completed by producer)

13. As a condition of eligibility for any USDA loans or other program benefits, I hereby certify that:

a. I will not produce an agricultural commodity on highly erodible fields (except fields that, in any crop year between 1981 and 1985, were used to produce any agricultural commodity or were enrolled in a USDA set-aside or diversion program); and I will not use the proceeds of any FmHA loan, insured or guaranteed, received after December 23, 1985, for a purpose that will contribute to production of an agricultural commodity on these highly erodible fields, as determined by SCS, unless an approved conservation system has been fully applied.

b. I will not produce an agricultural commodity on converted wetlands or use proceeds from any FmHA farm loan, insured or guaranteed, received after December 23, 1985, for a purpose that will contribute to the conversion of a wetland to produce an agricultural commodity, as determined by SCS.

c. I will not convert wetlands or bring new lands into production for the purpose of producing an agricultural commodity without first consulting all USDA agencies with which (1) I have a current contract or loan agreement, insured or guaranteed, or (2) I have a crop insurance contract issued by or reinsured by the Federal Crop Insurance Corporation.

d. USDA representatives may enter upon my land for the purpose of confirming any of the above statements.

[illegible]ATURE OF PRODUCER: Sam Teague — DATE: June 22, 1987

14. REMARKS

SCS COPY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-CPA-027
(11-87)

CERTIFICATION OF HIGHLY ERODIBLE LAND CONSERVATION PLAN(S) AND SYSTEM(S)

1. NAME AND ADDRESS OF PERSON
SAM TEAGUE
902 VENTURE OUT
MESA, AZ 85205

2. FARM NO.
260

3. COUNTY
LUNA

CONSERVATION PLAN APPROVED

4. TRACT NUMBER(S)	5. FIELD NUMBER(S)	6. ACRES	7. PLAN APPROVED (Date)	8. CONSERVATION SYSTEM APPLIED (Date)	9. REMARKS
140	2,3 & 7	240.8			
243	1, 2 & 3	214.3			

10. REMARKS

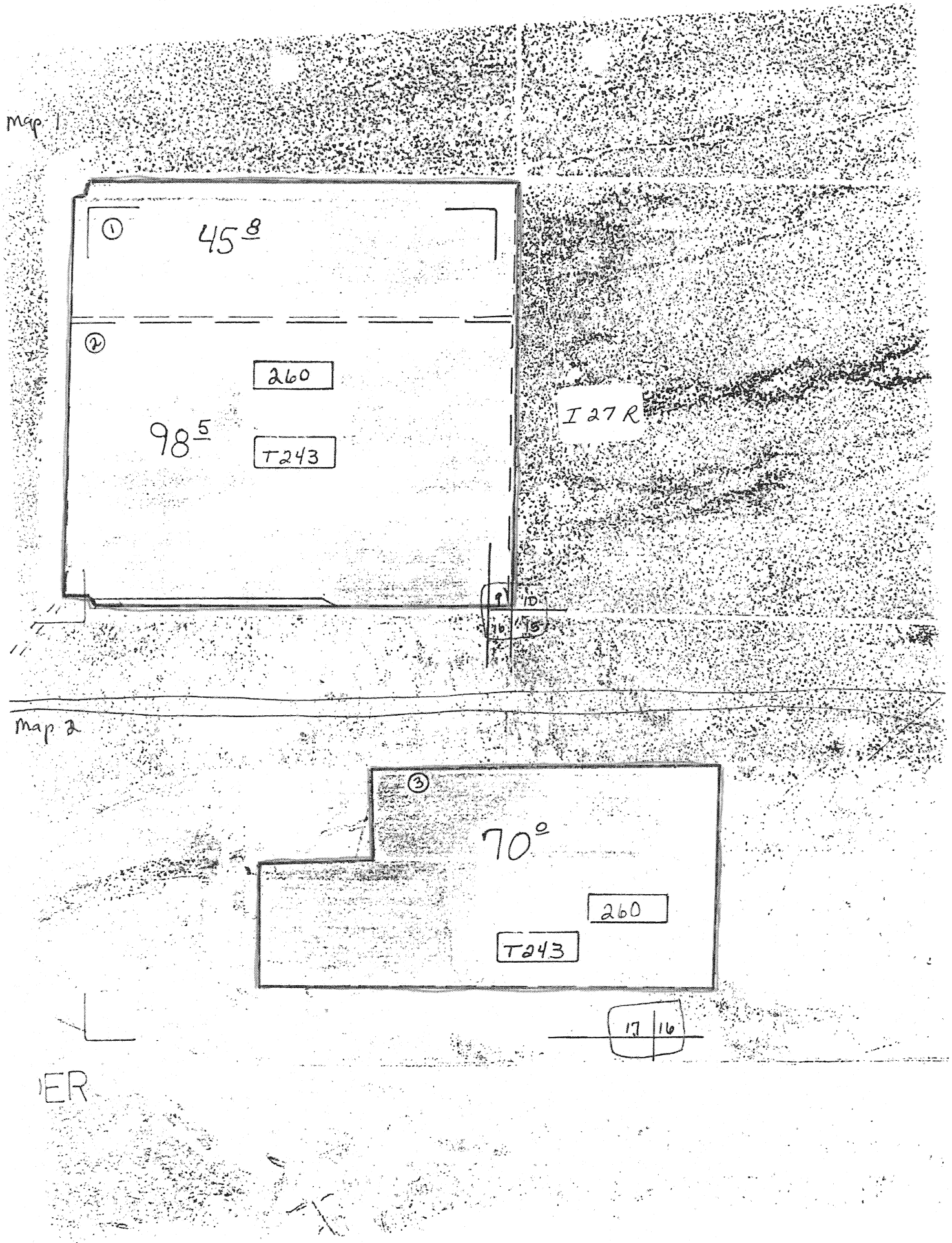
11. SIGNATURE OF SCS DISTRICT CONSERVATIONIST
Bobby K. Hanna

12. DATE
3-2-88

CROPPING SYSTEM HISTORY SAM TEAGUE

YEAR

FIELD NUMBER	ACRES	88	89	90	91	92
TR 140 2	65.7	IDLE	IDLE			
3	13.1	IDLE	IDLE			
7	162.0	IDLE	IDLE			
TR 243 1	45.8	IDLE	IDLE			
2	98.5	IDLE	IDLE			
3	70.0	IDLE	IDLE			


Map 1
①
45 8
②
260
98 5
T243
I 27 R
9
10
16
15
Map 2
③
70°
260
T243
17
16
ER

CONSERVATION PLAN MAP

Owner SAM TEAGUE Operator SAME

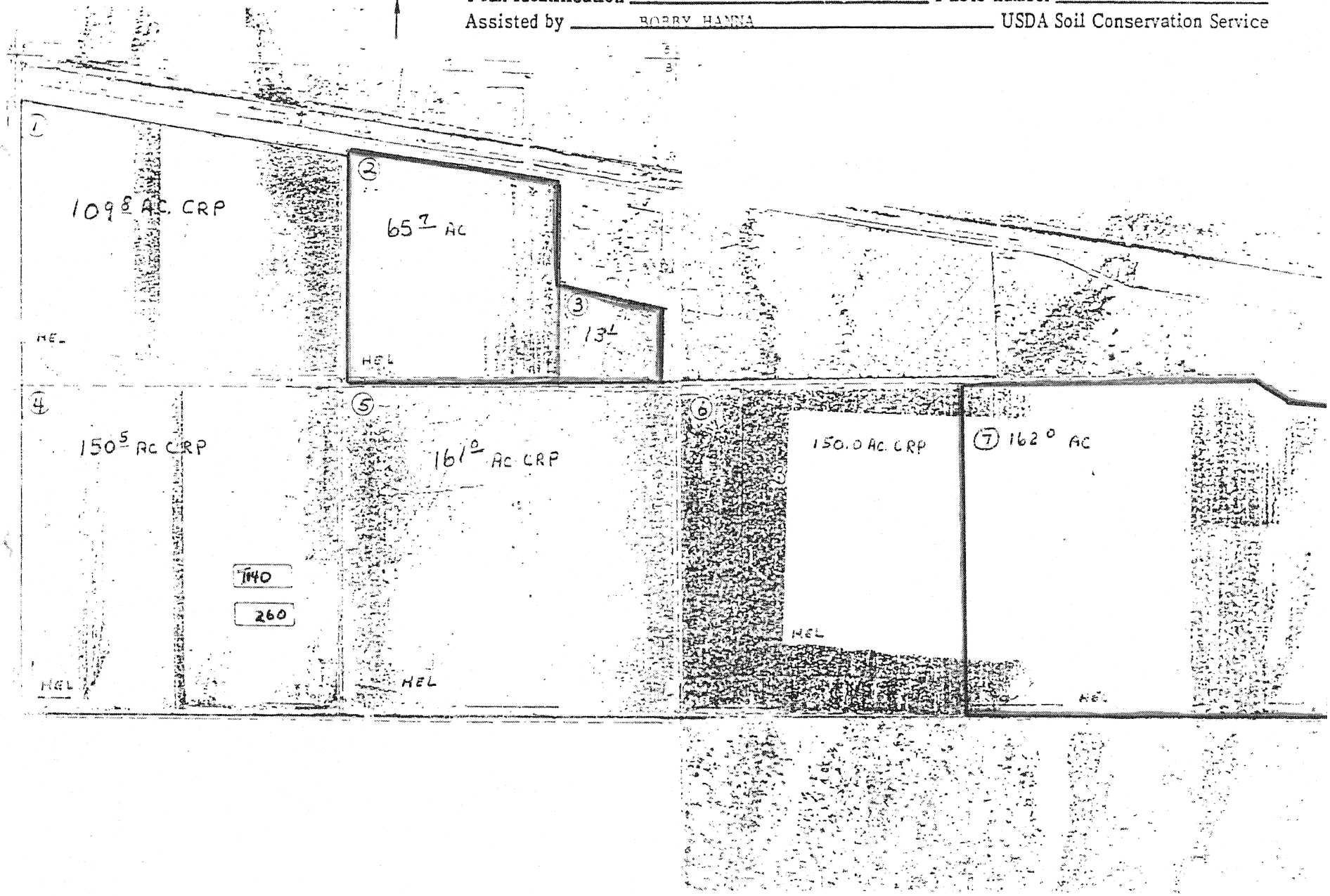
County LUNA State NEW MEXICO Date 2-17-88

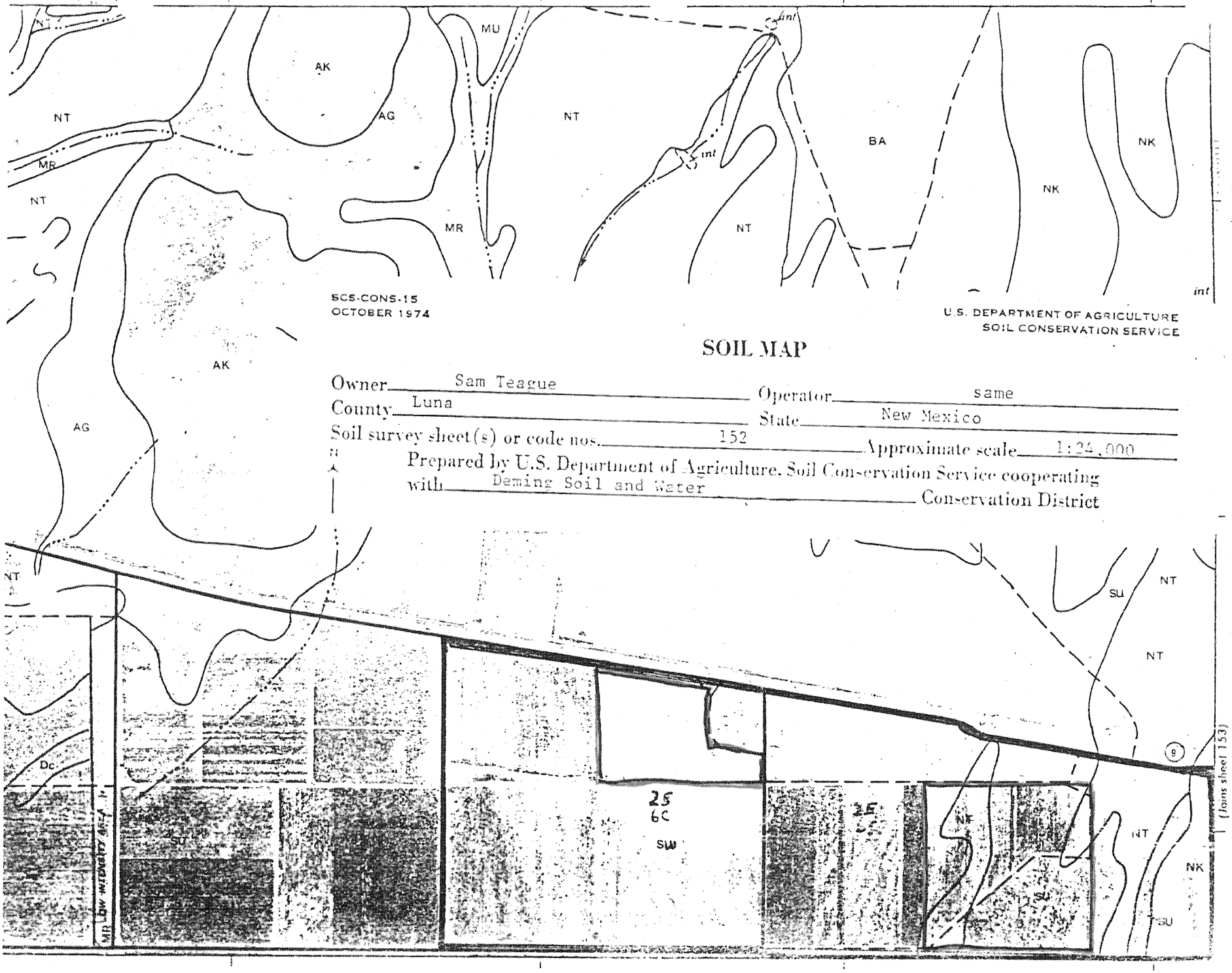
Approximate acres 708.7 Approximate scale

Cooperating with DEMING SOIL AND WATER Conservation District

Plan identification Photo number

Assisted by BOBBY HANNA USDA Soil Conservation Service





SCS-CONS-15
OCTOBER 1974

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

Owner Sam Teague Operator same

County Luna State New Mexico

Soil survey sheet(s) or code nos. 152 Approximate scale 1:24,000

Prepared by U.S. Department of Agriculture, Soil Conservation Service cooperating with Deming Soil and Water Conservation District

U.S.D.A.
Soil Conservation Service

SCS-CPA-026
(1 68)

HIGHLY ERODIBLE LAND AND WETLAND CONSERVATION DETERMINATION

1. Name and Ac : of Person
SAM TEAGUE
902 VENTURE OUT
MESA, AZ 85205

2. Date of Request
6-22-87

3. County
LUNA

Name of USDA Agency or Person Requesting Determination
SAM TEAGUE

5. Farm No. and Tract No.
260 TRACT 140

SECTION I – HIGHLY ERODIBLE LAND

	Yes	No	Field No.(s)	Total Acres
6. Is soil survey now available for making a highly erodible land determination?	X			
7. Are there highly erodible soil map units on this farm?	X			
8. List highly erodible fields that, according to ASCS records, were used to produce an agricultural commodity in any crop year during 1981-1985.			1, 2, 4, 5 & wl. 150 AC. 6	571.3
9. List highly erodible fields that have been or will be converted for the production of agricultural commodities and, according to ASCS records, were not used for this purpose in any crop year during 1981-1985; and were not enrolled in a USDA set-aside or diversion program.			NONE	

10. This Highly Erodible Land determination was completed in the: Office [X] Field [ ]

NOTE: If you have highly erodible cropland fields, you may need to have a conservation plan developed for these fields. For further information, contact the local office of the Soil Conservation Service.

SECTION II – WETLAND

	Yes	No	Field No.(s)	Total Wetland Acres
11. Are there hydric soils on this farm?		X		
List field numbers and acres, where appropriate, for the following EXEMPTED WETLANDS:				
12. Wetlands (W), including abandoned wetlands, or Farmed Wetlands (FW). Wetlands may be farmed under natural conditions. Farmed Wetlands may be farmed and maintained in the same manner as they were prior to December 23, 1985, as long as they are not abandoned.				
13. Prior Converted Wetlands (PC) - The use, management, drainage, and alteration of prior converted wetlands (PC) are not subject to FSA unless the area reverts to wetland as a result of abandonment. You should inform SCS of any area to be used to produce an agricultural commodity that has not been cropped, managed, or maintained for 5 years or more.				
14. Artificial Wetlands (AW) - Artificial Wetlands includes irrigation induced wetlands. These Wetlands are not subject to FSA.				
15. Minimal Effect Wetlands (MW) - These wetlands are to be farmed according to the minimal effect agreement signed at the time the minimal effect determination was made.				
NON-EXEMPTED WETLANDS:				
16. Converted Wetlands (CW) - In any year that an agricultural commodity is planted on these Converted Wetlands, you will be ineligible for USDA benefits. If you believe that the conversion was commenced before December 23, 1985, or that the conversion was caused by a third party, contact the ASCS office to request a maintenance or third party determination.				

17. The planned alteration measures on wetlands in fields _____ are considered maintenance and are in compliance with FSA.

18. The planned alteration measures on wetlands in fields _____ are not considered to be maintenance and if installed will cause the area to become a Converted Wetland (CW). See item 16 for information on CW.

19. This wetland determination was completed in the: Office [X] Field [ ]

20. This determination was: Delivered [X] Mailed [ ] To the Person on Date: _____

NOTE: If you do not agree with this determination, you may request a reconsideration from the person that signed this form in Block 22 below. The reconsideration is a prerequisite for any further appeal. The request for the reconsideration must be in writing and must state your reasons for the request. The request must be mailed or delivered within 15 days after this determination is mailed to or otherwise made available to you. Please see reverse side of the producer's copy of this form for more information on appeals procedure.

NOTE: If you intend to convert additional land to cropland, or alter any wetlands you must initiate another Form AD-1026 at the local office of ASCS. Abandonment is where land has not been cropped, managed, or maintained for 5 years or more. You should inform SCS if you plan to produce an agricultural commodity on abandoned wetlands.

Remarks

22. Signature of SCS District Conservationist
Bobby K. Havens

23. Date
2-22-88

Assistance and programs of the Soil Conservation Service available without regard to race, religion, color, sex, age, handicap, etc.

AD-1026
(07-86)

UNITED STATES DEPARTMENT OF AGRICULTURE

HIGHLY E[ROD]BLE LAND AND WETLAND CONSERVAT[ION] CERTIFICATION

NOTE: *The following statements are made in accordance with the Privacy Act of 1974 (5 USC 552a). The authority for requesting the information to be supplied on this form is the Food Security Act of 1985, P.L. 99-198, and regulations promulgated under the Act (7CFR Part 12). The information will be used to determine eligibility for program benefits and other financial assistance administered by USDA agencies. The information may be furnished to other USDA agencies, IRS, Department of Justice, or other State and Federal law enforcement agencies, and in response to orders of a court magistrate or administrative tribunal. Furnishing the Social Security Number is voluntary. Furnishing the other requested information is voluntary; however, failure to furnish the correct, complete information will result in a determination of ineligibility for certain program benefits and other financial assistance administered by USDA agencies. The provisions of criminal and civil fraud statutes, including 18 USC 286, 287, 371, 641, 1001; 15 USC 714m and 31 USC 3729, may be applicable to information provided by the producer on this form.*

PART A - PRODUCER'S INTENTIONS FOR USE OF LAND

1. NAME AND ADDRESS OF PRODUCER	2. SOCIAL SECURITY NUMBER (or tax ID number)	3. CROP YEAR
Sam Teague		1987

FARM NUMBER(S) 4	COUNTY(IES) WHERE LOCATED 5
260	Luna, New Mexico
	Deaf Smith, Texas Hereford
	Gaines County, Texas Seminole

	Yes	No
6. During either the crop year entered in item 3 above, or the term of a requested USDA loan, will an agricultural commodity be produced on fields of the farm(s) that were not used for the production of any agricultural commodity (see instructions) or not enrolled in an USDA set-aside or diversion program during any crop year 1981 through 1985? If "yes," list the farm and field numbers.		✓
7. Will an agricultural commodity be produced on any land on the farm(s) listed above that was a wet area but was improved, drained, or modified, or converted after December 23, 1985? If "yes," list the farm and field numbers.		✓
8. Do you plan to convert any land including wet areas for the production of an agricultural commodity this year or during the term of a requested USDA loan or other program benefit? If "yes," list the farm and field numbers.		✓

I hereby certify that the above information is true and correct to the best of my knowledge and belief.	9. SIGNATURE OF PRODUCER	DATE
	Sam Teague	June 22, 1987

PART B - REFERRAL TO SCS

	CHECK
10. Based on county office information, a SCS determination is:	
a. Needed prior to the producer's certification in Part C.	
b. Needed before January 1, 1990.	

NOTE: If the producer answers "No" to Part A, items 6, 7, and 8, and the agency so agrees, the producer may complete the certification in Part C without a SCS determination. However, beginning January 1, 1990, or 2 years after a soil survey is completed, the producer must be actively applying an approved conservation plan on all highly erodible fields. Therefore, a SCS determination regarding the existence of any highly erodible fields on the farm(s) listed above is necessary before January 1, 1990.

11. DATE REFERRED TO SCS FOR DETERMINATION	12. SIGNATURE OF AGENCY REPRESENTATIVE	DATE
	John Burris	6-22-87

PART C - USE CERTIFICATION (Completed by producer)

13. As a condition of eligibility for any USDA loans or other program benefits, I hereby certify that:

a. I will not produce an agricultural commodity on highly erodible fields (except fields that, in any crop year between 1981 and 1985, were used to produce any agricultural commodity or were enrolled in a USDA set-aside or diversion program); and I will not use the proceeds of any FmHA loan, insured or guaranteed, received after December 23, 1985, for a purpose that will contribute to production of an agricultural commodity on these highly erodible fields, as determined by SCS, unless an approved conservation system has been fully applied.

b. I will not produce an agricultural commodity on converted wetlands or use proceeds from any FmHA farm loan, insured or guaranteed, received after December 23, 1985, for a purpose that will contribute to the conversion of a wetland to produce an agricultural commodity, as determined by SCS.

c. I will not convert wetlands or bring new lands into production for the purpose of producing an agricultural commodity without first consulting all USDA agencies with which (1) I have a current contract or loan agreement, insured or guaranteed, or (2) I have a crop insurance contract issued by or reinsured by the Federal Crop Insurance Corporation.

d. USDA representatives may enter upon my land for the purpose of confirming any of the above statements.

SIGNATURE OF PRODUCER	DATE
Sam Teague	June 22, 1987

14. REMARKS

SCS COPY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-CPA-027
(11-87)

CERTIFICATION OF HIGHLY ERODIBLE LAND CONSERVATION PLAN(S) AND SYSTEM(S)

1. NAME AND ADDRESS OF PERSON
SAM TEAGUE
902 VENTURE OUT
MESA, AZ 85205

2. FARM NO.
260 TR. 140

3. COUNTY
LUNA

CONSERVATION PLAN APPROVED

4. TRACT NUMBER(S)	5. FIELD NUMBER(S)	6. ACRES	7. PLAN APPROVED (Date)	8. CONSERVATION SYSTEM APPLIED (Date)	9. REMARKS
140	1, 2, 4, 5 & W 150 AC. 6	571.3	2/18/88		

10. REMARKS

11. SIGNATURE OF SCS DISTRICT CONSERVATIONIST

12. DATE

CONSERVATION PLAN MAP

Owner: SAM TEAGUE Operator: SAME

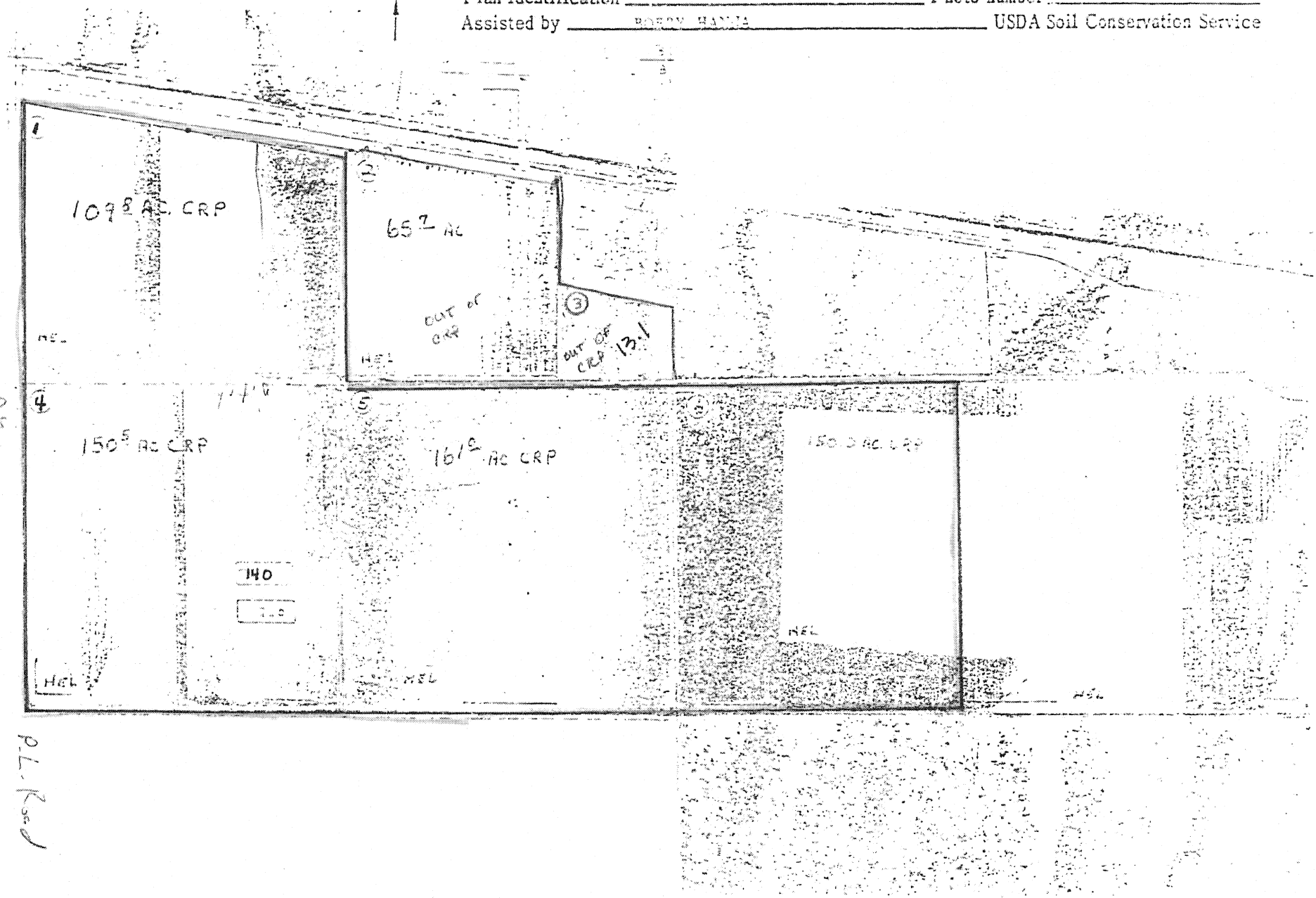
County: LUNA State: NEW MEXICO Date: 2-17-83

Approximate acres: 571.3 Approximate scale: _____

Cooperating with: DEMING SOIL AND WATER Conservation District

Plan identification: _____ Photo number: _____

Assisted by: BOBBY HANNA USDA Soil Conservation Service



U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

ART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/14/09
Name Of Project SAPPHIRE ENERGY	Federal Agency Involved USDA
Proposed Land Use INTEGRATED ALGA BIO-REFINERY FACILITY	County And State LUNA NEW MEXICO
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).* Yes [ ] No [X] RTS		Acres Irrigated 0	Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined in FPPA Acres: %
Name Of Land Evaluation System Used N/A	Name Of Local Site Assessment System N/A		Date Land Evaluation Returned By NRCS

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	400.0			
B. Total Acres To Be Converted Indirectly	442.4			
C. Total Acres In Site	842.4	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0			
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	0			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	10			
7. Size Of Present Farm Unit Compared To Average	10	10			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	0			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	65	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	65	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	65	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes [ ] No [ ]

Reason For Selection:

Contains no prime, unique, statewide or locally designated cropland. 8/31/09

KENNETH F. SCHEFFE, STATE Soil Scientist

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

Part VI Site Assessment Criteria

1. Area In Non-urban Use – 100% of the land is in non-urban use within 1.0 mile from where the project is intended. The nearest urban center is 2 miles away. Maximum Total Points 15, Points earned 15.

2. Perimeter In Non-urban Use – 100% of the land perimeter borders non-urban use. The nearest urban center is 2 miles away. Maximum Total Points 10, Points earned 10.

3. Percentage of Site Being Farmed – 0% of the land is being farmed. The last time the land was farmed was 1978. Maximum Total Points 20, Points earned 0.

4. Protection Provided By State And Local Governments – 0% of the site is subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland. Maximum Total Points 20, Points earned 0.

5. Distance to Urban Built-up Area – The site is 2 miles or more from an urban built-up area. Maximum Total Points 15, Points earned 15.

6. Distance to Urban Support Services – Some services such as electricity, fire and police protection and schools are more than 1 mile but less than 3 miles from the site. Maximum Total Points 15, points earned 10.

7. Size of Present Farm Unit Compared to Average – The farm unit is as large as the average size farm unit in the area. Maximum Total Points 10, Points earned 10.

8. Creation of Non-Farmable Farmland – The land currently is not farmed but upon closure of the facility the land will be returned to its pre-development conditions. Maximum Total Points 10, Points earned 0.

9. Availability of Farm Support Services – The site will not have an adverse affect on the available farm support services. Currently those services are not being used because no farming has been done since 1978. Maximum Total Points 5, Points earned 5.

10. On-Farm Investments – There are no structures on the site or irrigation systems that are operational. Maximum Total Points 20, Points Earned 0.

11. Effects Of Conversion On Farm Support Services – The site would actually require many support services and possibly create demand some new services. Maximum Total Points 10, points Earned 0.

12. Compatibility With Existing Agricultural Use – The site is currently not being farmed. The site use would be compatible with the surrounding area and would not have any long-term environmental effect. Maximum Total Points 10, Points earned 0.

APPENDIX F

Laboratory Test Summary

SAPPHIRE ENERGY
PROJECT NO. 14848.000.0
PERMEABILITY TESTING FOR COLUMBUS SITE

Sample	ESS-13 Compound	Application	$\gamma_{initial}$ (pcf)	$wc_{initial}$ (%)	$RC_{initial}$ (%)	γ_{final} (pcf)	wc_{final} (%)	$RC_{initial}$ (%)	k_{avg} (cm/s)	Improvement
B-1	None	N/A	114.5	11.0	95.0%	120.8	14.6	100.2%	7.25E-06	N/A
B-1	White/100	Treat and Compact with Spray On	114.5	11.0	95.0%	115.8	16.8	96.1%	4.70E-07	93.5%
B-1	Brown/100	Treat and Compact with Spray On	114.5	11.0	95.0%	115.9	16.8	96.2%	1.16E-06	84.0%
B-1	Yellow/1000	Treat and Compact with Spray On	114.5	11.0	95.0%	116.2	16.7	96.4%	1.71E-06	76.4%

3