APPENDIX O

SOILS SUITABILITY ASSESSMENT

ESA Environmental Science Associates

TECHNICAL MEMORANDUM

TO • Dainis Kleinbergs, CSDLAC

FROM • Tom Barnes and Clint Meyer (in consultation with Dr. Charles Burt)

DATE • January 14, 2005

SUBJECT • Soils Interpretation in the Preliminary Study Area
Palmdale WRP 2025 Plan EIR (ESA #204135)

Environmental Science Associates (ESA) has prepared this assessment of soil types within the Preliminary Study Area (study area) east of Little Rock Wash as part of the County Sanitation District No. 20 of Los Angeles County (District No. 20) Palmdale Water Reclamation Plant (PWRP) 2025 Plan Alternatives Screening process. District No. 20 is assessing constraints for development of agriculture and storage reservoirs within a large area between Little Rock Wash to the west, Big Rock Wash to the east, Avenue H to the north and the town of Littlerock to the south.

GIS data was obtained for soil types in the project area from the USDA Natural Resources Conservation Service's (NRCS) Soil Survey Geographic data set (SSURGO, 2004) for the Antelope Valley. The data is based on the 1970 Soil Survey for the Antelope Valley Area. Exhibit A identifies the study area and the soil types from the soil survey. Exhibits B through G summarize characteristics of the soils.

Soils in the area are generally formed by eolian and, to a lesser degree, alluvial deposition of medium and coarse-textured materials derived from granitic rocks located in San Gabriel Mountains. The principal soil limitations within the study area are generally attributed to salinity at the surface or sub-surface in isolated locations (Exhibit C), excessive erosion from wind (see Exhibit D), and excessive drainage caused by high proportions of sand and/or gravel in the sub-surface (Exhibits F and G).

Agricultural Suitability

Exhibit B identifies the Land Capability Classifications (LCC) in the study area. The Classifications are defined in **Table 1** below. Much of the land base under consideration is generally suitable for irrigated agriculture using tertiary-treated wastewater effluent. Much of the study area is rated as IIe; where erosion, specifically from wind, represents the primarily limitation to agricultural production. There are also soils rated as I, IIIe, and IIIs. Several scattered, but isolated, areas are mapped as LCC VIII and correlate with locations mapped as sand dunes, which are not suitable for agricultural production. These classifications are based on the assumption of a readily available irrigation water supply.

Soils rated as LCC III or greater generally present one or more severe limitations to agricultural production and will require one or more forms of conservation management. The principle limitations found in areas rated as III are generally attributed to excessive erosion (especially from wind), salinity

at the surface or sub-surface, and excessive drainage [i.e., low available water capacity (AWC)] caused by high proportions of sand and/or gravel in the sub-surface. Exhibits C, D, and E specifically illustrate these soil characteristics based on values provided in the Soil Survey for electrical conductivity, wind erodibility, and drainage. Each of these limitations could preclude irrigated agriculture by virtue of the costs of maintenance. For example, areas characterized by excessive drainage will drastically limit the crop variety and, more importantly, may allow for the downward migration of treated-effluent into the shallow, alluvial aquifer. Additionally, in more saline locations, drain waters may require some form of treatment or dilution prior to discharge off-site. Hazards of wind erosion are primarily related to the potential devastation of crops during dust storms and, to a lesser extent, removal and off-site transport of topsoil and/or applied fertilizers or herbicides.

In conclusion, only small confined areas within the study area show severe restrictions to agricultural production. Most of the area is classified as generally suitable for cultivation with erosion from wind a factor throughout the area. District No. 20 may be able to determine the soil types on each parcel within the study area by obtaining an assessors parcel GIS layer. District No 20 may be able to remove individual parcels from the study area based on a GIS analysis of individual parcels exhibiting poorer LCC ratings.

Table 1: Land Capability Classification Definitions

Class I	Soils in Class I have few limitations that restrict their use
Class II	Soils in Class II have some limitations that reduce the choice of plants or require moderate conservation practices
Class III	Soils in Class III have severe limitations that reduce the choice of plants or require special conservation practices or both
Class IV	Soils in Class IV have very severe limitations that restrict the choice of plants, require very careful management or both.
Class V	Soils in Class V have little or no erosion hazard but have other limitations that are impractical to remove
Class VI	Soils in Class VI have severe limitations that make them generally unsuited for cultivation
Class VII	Soils in Class VII have very severe limitations that make them unsuited for cultivation
Class VIII	Soils and land forms in Class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or aesthetic purposes
Subclasses	
e	Erosion
w	Wetness
s	Soil limitation
c	Climatic limitation

Source: USDA, Soil Conservation Service, Los Angeles County California Report and General Soil Map, 1969

Impoundment Suitability

Exhibits E, F, and G provide information on permeability of soils. All of the soils in the study area are well drained to excessively well drained. Exhibit F identifies clay content of characteristic soils. The Rosamond series generally exhibit greater concentrations of clay and thereby are exhibit a slower permeability. **Table 2** identifies suitability limitations of soil for use as sewage lagoon impoundment floors and embankment materials. Generally speaking, soils exhibiting permeability rates greater than two inches per hour have severe limitations for use as impoundment floors. Exhibit G identifies soils in

Table 2: Soil Limitations

	Degree of Limitation		
	Slight	Moderate	Severe
Soil as a Floor for Impoundment Areas			
Permeability (in/hr)	Less than 0.63	0.63 – 2.0	Greater than 2.0
Depth to hard rock (ft)	More than 5	3 – 5	Less than 3
Slope and relief (%)	Less than 2	2 – 9	More than 9
Soil Texture (USDA method)	Clay, silty clay, silty clay loam, clay loam, sandy clay loam, silty loam, loam	Clay, silty loam, very fine silty loam, sandy loam, gravelly silty material	Gravels and sands (organic material 15-30%), silts and clays, peat and mucks
Soil as a Source of Embankment Material			
Soil Texture (USDA method)	Clay, clay loam, sandy clay loam	Clay, silty clay, silty clay loam, silty loam, very fine silty loam, loam, sandy loam	Gravels and sands (organic material 15-30%), silts and clays, peat and mucks

Source: USDA, Report and General Soil Map, Los Angeles County, 1969

the study area. Most of the soils in the study area, except for the Rosamond series, exhibit severe permeability limitations. The Rosamond soils exhibit moderate limitations for use as impoundment floors.

Table 2 identifies soil texture as a key limitation of soil for use as impoundment embankments. Soil textures can vary substantially. More site specific information is needed to assess suitability of soils within the study area for use as embankments. However, each of the soil groups generally fall within the moderate suitability category for use as impoundment embankments.

Table 3 summarizes general soil characteristics. **Attachment A** provides additional detailed information available on the soil types found within the study area.

Table 3: Soil Characteristics and Qualities

Soil Name	Position	Soil Profile			Natural drainage	Subsoil permeability	Runoff	Erosion hazard	Effective depth	AWC	Inherent fertility
		Surface layer	Subsoil	Sub-stratum							
Cajon	Nearly level and gently sloping alluvial fans and valley floors	Very pale brown, neutral, grav, loamy sand	Very pale brown, mildly alkaline fine sand and sand, calc. in lower part		excessive	rapid	Very slow	Moderate to high wind	60	4.0-5.0	low
Rosamond	Nearly level alluvial fans and valley floors	Light brownish gray and pale brown, moderately alkaline, stratified loams and silty clay loams that are calcareous in the lower part. Some areas are saline-alkalai affected			Moderately well	moderate	medium	Moderate wind	60	10.0-12.0	moderate
Hesperia	Nearly level alluvial fans and valley floors	Pale brown, slightly acidic, loamy fine sand, fine sandy loam or loam	Pale brown mildly alkaline and moderately alkaline fine sandy loam and sandy loam that is calcareous in the lower part		well	Moderately rapid	slow	Moderate wind	60	6.0-9.0	moderate

Source: USDA, Report and General Soil Map, Los Angeles County, 1969

ATTACHMENT a: Soil Profile Descriptions

Source: NRCS, 2001. Nature Resource Conservation Service, Official Soil Series Descriptions, Web Site Accessed July 20, 2001

ROSAMOND LOAMY FINE SAND (Rm and Rm2), ROSAMOND FINE SANDY LOAM (Ro), ROSAMOND LOAM (Rp), ROSAMOND LOAM, SALINE-ALKALI (Rr), ROSAMOND LOAM, SANDY LOAM SUBSTRATUM (Rt) AND ROSAMOND SILTY CLAY LOAM, SALINE-ALKALI (Ru)

The Rosamond series consists of deep, well-drained soils that formed in material weathered mainly from granitic alluvium. Rosamond soils are on the lower margin of the alluvial fans between the sloping fans and the playas and have slopes of 0 to 2 percent at elevations from 2,200 to 2,900 feet. The climate is arid. These soils are characterized by moderate runoff; and moderate to moderately-slow permeability. (NRCS, 2001) Rosamond soils are very low in organic matter, with the organic matter content decreasing irregularly with increasing depth.

Some pedons have weak A1 horizons, other Ap horizons or lack either of these. The color is about the same throughout the soil; however, a few strata have colors of higher chroma. The surface layer is sandy loam to silty clay loam. The 10 to 40 inch control section averages loam, clay loam or silty clay loam and contains 18 to 30 percent clay and more than 15 percent sand. The soil is stratified but lacks contrasting textures within the control section (NRCS, 2001).

Some pedons have contrasting textures below the control section. The structure is weak or the horizons are massive. Usually the soil is calcareous and moderately alkaline throughout except that the upper few inches of some undisturbed pedons are mildly alkaline and noncalcareous. All parts below depths of 10 to 20 inches are calcareous. A few small soft to hard concretions or filaments of lime are common, but they are not definitive for the series. Some pedons contain some salt and alkali but the soil is not typically strongly saline alkali (NRCS, 2001).

Large areas are used for desert range. Other extensive areas are irrigated and cropped to alfalfa and row crops. Native vegetation is rabbit brush, big sagebrush, a small amount of Atriplex and a little annual and perennial grass and weeds. (NRCS, 2001)

Rosamond SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, thermic Typic Torrifluvents

TYPICAL PEDON: Rosamond fine sandy loam, desert range. (Colors are for dry soil unless otherwise noted.)

C1 0 to 4 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many very fine and few fine pores; mildly alkaline (pH 7.8); abrupt smooth boundary. (4 to 6 inches thick)

C2 4 to 8 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine and few fine pores; slightly effervescent, disseminated lime; moderately alkaline (pH 7.9); clear smooth boundary. (4 to 6 inches thick)

2C3 8 to 28 inches; pale brown (10YR 6/3) light silty clay loam, dark brown (10YR 4/3) moist; weak medium angular blocky structure; hard, friable, sticky and plastic; few fine, medium and coarse roots; many very fine and few fine pores; strongly effervescent;, disseminated lime, few soft spherical concretions of lime; moderately alkaline (pH 8.2); clear wavy boundary. (18 to 24 inches thick)

3C4 28 to 34 inches; pale brown (10YR 6/3) light sandy clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; few fine and medium roots; many very fine and few fine pores; slightly effervescent; disseminated lime and few fine filaments of lime; moderately alkaline (pH 8.2); clear wavy boundary. (4 to 10 inches thick)

4C5 34 to 60 inches; light brownish gray (10YR 6/2) loam, dark brown (10YR 4/3) moist; weak medium angular blocky structure; very hard, firm, sticky and plastic; few fine roots; many very fine, few fine and few medium pores; violently effervescent with disseminated lime and common irregular soft bodies of lime; moderately alkaline (pH 8.2). (NRCS, 2001)

CAJON LOAMY SAND (CaA and CaC), CAJON LOAMY SAND, LOAMY SUBSTRATUM (CbA), CAJON LOAMY FINE SAND, HUMMOCKY (CcA2)

The Cajon series consists of very deep, somewhat excessively drained soils that formed in sandy alluvium from dominantly granitic rocks. Cajon soils are on alluvial fans, fan aprons, fan skirts, inset fans and river terraces on slopes gradients of 0 to 15 percent. These soils are somewhat excessively drained, have negligible to low runoff, and rapid permeability. Cajon soils with sandy loam surface textures have moderately rapid to overly rapid permeability (NRCS, 2001).

Rock fragments at the surface and throughout the profile consist of pebbles and gravel and may comprise as much 15 to 35 percent of the soil volume. There is weak stratification of sandy material in some or all parts. Typically the soil is slightly effervescent to strongly effervescent throughout although some pedons are non-effervescent in the A horizon. Typically the profile is slightly alkaline or moderately alkaline although some pedons are neutral. Some pedons are strongly alkaline and mildly saline-alkali to strongly saline-alkali. Electrical conductivity ranges up to 16 mmhos/cm and the SAR to 20. (NRCS, 2001)

These soils are used mostly for range, watershed, and recreation. A few areas are irrigated and are used for growing alfalfa and other crops. Native vegetation is mostly desert shrubs including creosotebush, saltbush, Mormon-tea, Joshua trees, some Indian ricegrass, annual grasses and forbs. (NRCS, 2001)

Cajon SERIES

TAXONOMIC CLASS: Mixed, thermic Typic Torripsamments

TYPICAL PEDON: Cajon sand, on a 1 1/2 percent slope under creosotebush, spiny hopsage, and Mormon-tea at 3,060 feet elevation. (Colors are for dry soil unless otherwise stated. When described on 4/29/75 the soil was moist to 18 inches and dry below).

A 0 to 2 inches; light gray (10YR 7/2) sand, light brownish gray (10YR 6/2) moist; weak fine and medium subangular blocky structure; soft, very friable; few fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary. (0 to 14 inches thick).

C1 2 to 7 inches; very pale brown (10YR 7/3) sand, light gray (10YR 7/2) moist; single grained; loose; common fine roots; many very fine interstitial pores; 1 to 2 percent 3/8 to 1/2 inch pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 6 inches thick).

C2 7 to 13 inches; very pale brown (10YR 7/3) sand, brown (10YR 5/3) moist; single grained; loose; common fine roots; common very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 7 inches thick).

C3 13 to 18 inches; very pale brown (10YR 7/3) sand, brown (10YR 5/3) moist; single grained; loose; common fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 7 inches thick).

C4 18 to 25 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; single grained; loose; common fine roots; many very fine interstitial pores; about 4 percent 1/2 inch pebbles; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary. (3 to 8 inches thick).

2C5 25 to 38 inches; very pale brown (10YR 7/4) gravelly sand, light yellowish brown (10YR 6/4) moist; single grained; loose; common fine roots; many fine interstitial pores; 25 percent 1/2 to 1 inch pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (10 to 15 inches thick).

2C6 38 to 45 inches; very pale brown (10YR 7/3) gravelly sand, pale brown (10YR 6/3) moist; single grained; loose; few very fine roots; many fine interstitial pores; 20 percent 1/2 to 1 inch pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 8 inches thick).

2C7 45 to 60 inches; very pale brown (10YR 7/4) sand, light yellowish brown (10YR 6/4) moist; single grained; loose; few very fine roots; common fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.0). (NRCS, 2001)

HESPERIA LOAMY FINE SAND (HgA, HgA2 and HgB), HESPERIA FINE SANDY LOAM (HkA), HESPERIA FINE SANDY LOAM (HkB), LOAMY SUBSTRATUM (HmA), HESPERIA LOAM (HnA)

The Hesperia series consists of very deep, well-drained soils that formed in alluvium derived primarily from granite and related rocks. Hesperia soils are on alluvial fans, valley plains and stream terraces and have slopes of 0 to 9 percent. These soils re characterized by negligible to low runoff and moderately rapid permeability (NRCS, 2001). The organic matter content is very low and decreases regularly with increasing depth. The soils are typically calcareous between depths of 16 and 40 inches. (NRCS, 2001)

The A horizon consists of a loamy sand, loamy fine sand, or sandy loam, and has 0 to 5 percent rock fragments ranging from 2 mm to 2 cm. This horizon is slightly acid to moderately alkaline (NRCS, 2001). The C horizon is similar in color to the A horizon. It is fine sandy loam, sandy loam or coarse sandy loam. Rock fragments 2 mm to 2 cm in diameter range from 0 to 15 percent. The soil is slightly acid to moderately alkaline. Lime is usually disseminated but a few pedons have lime veins in the lower part of the profile. Some pedons have loamy sand substratums (NRCS, 2001).

These soils are used for desert range, and for production of irrigated orchards, row crops, field crops, grain, hay, pasture and grapes. Native vegetation consists of creosotebush in the high desert and sparse annuals in the valley. (NRCS, 2001)

Hesperia SERIES

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, nonacid, thermic Xeric Torriorthents

TYPICAL PEDON: Hesperia fine sandy loam--disturbed site. (Colors are for dry soil unless otherwise stated).

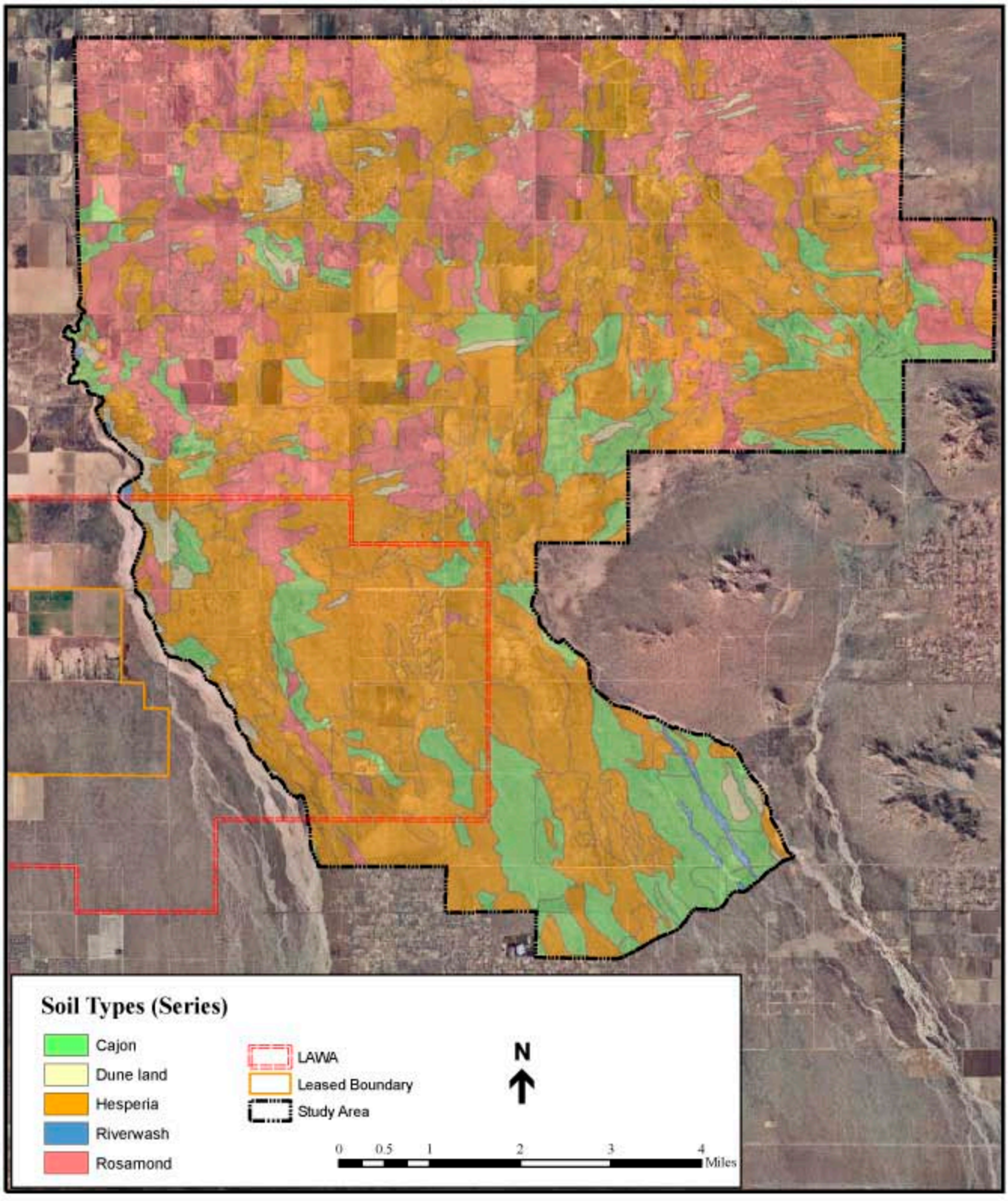
Ap 0 to 4 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; common very fine interstitial and few very fine tubular pores; slightly acid (pH 6.3); abrupt smooth boundary. (4 to 10 inches thick).

C1 4 to 22 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and few fine roots; common very fine interstitial and few very fine tubular pores; slightly alkaline (pH 7.5); gradual smooth boundary. (16 to 20 inches thick).

C2 22 to 54 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and few fine roots; common very fine interstitial, and few very fine tubular pores; slightly effervescent with disseminated lime moderately alkaline (pH 8.0); gradual smooth boundary. (30 to 34 inches thick).

C3 54 to 77 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine, few fine roots; common very fine interstitial, few very fine tubular pores; strongly effervescent with disseminated lime; moderately alkaline (pH 8.0). (NRCS, 2001)

Exhibits



SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2004

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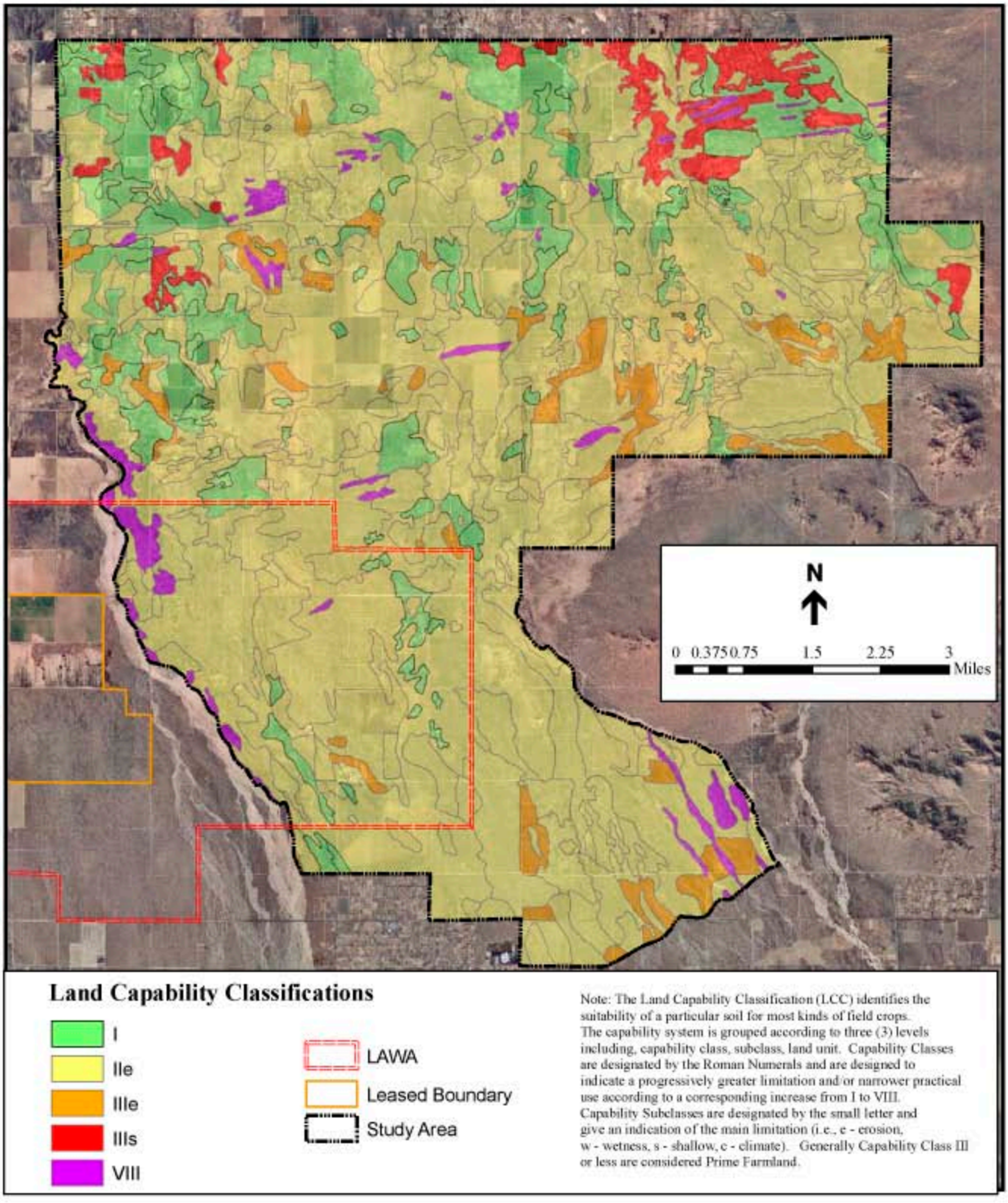
Exhibit A

Soil Types (Series)



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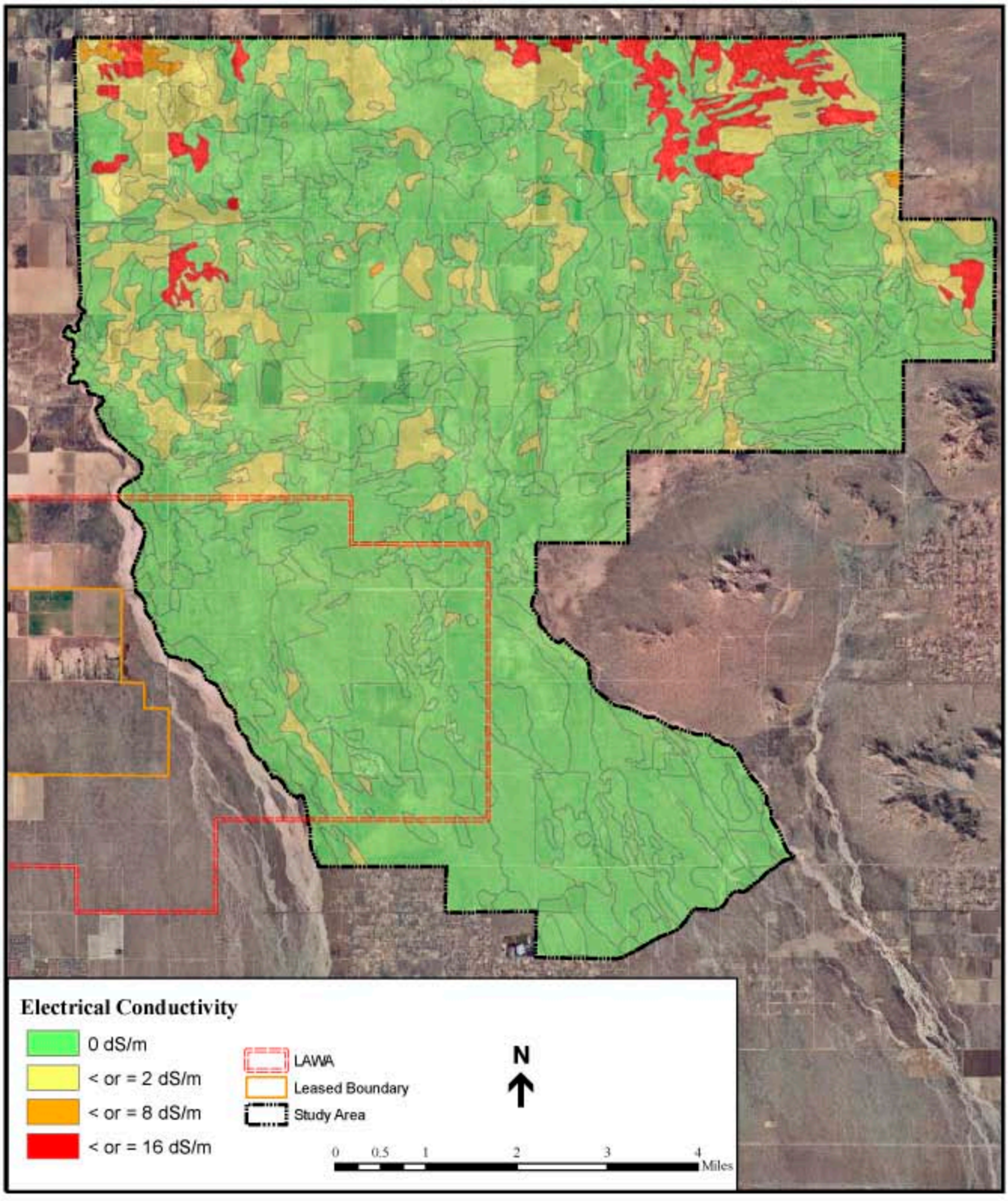
SOURCE: NRCS SSURGO, 2004; ESA, 2004

Exhibit B

Soil Land Capability Classifications



SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2004

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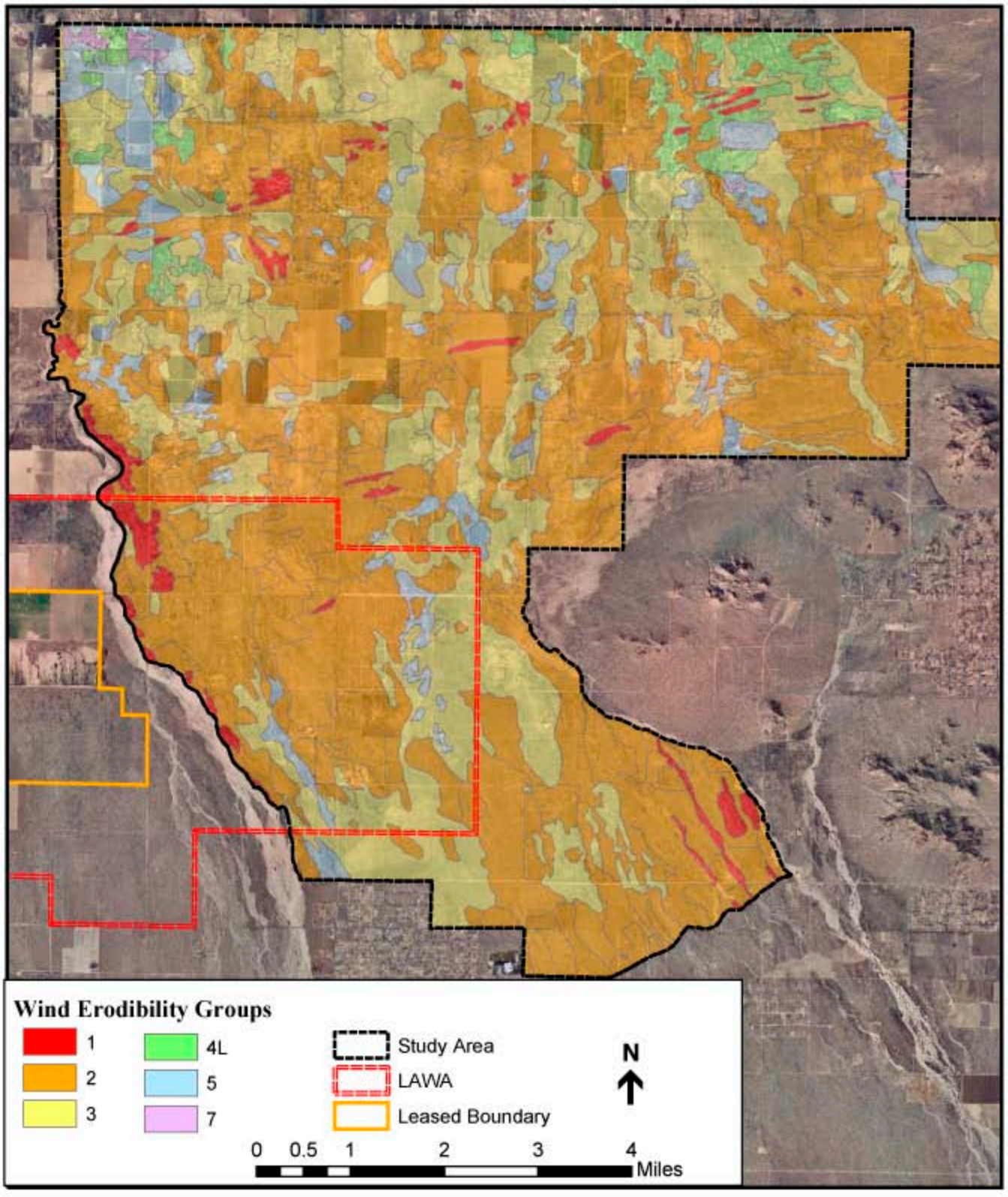
Exhibit C

Electrical Conductivity



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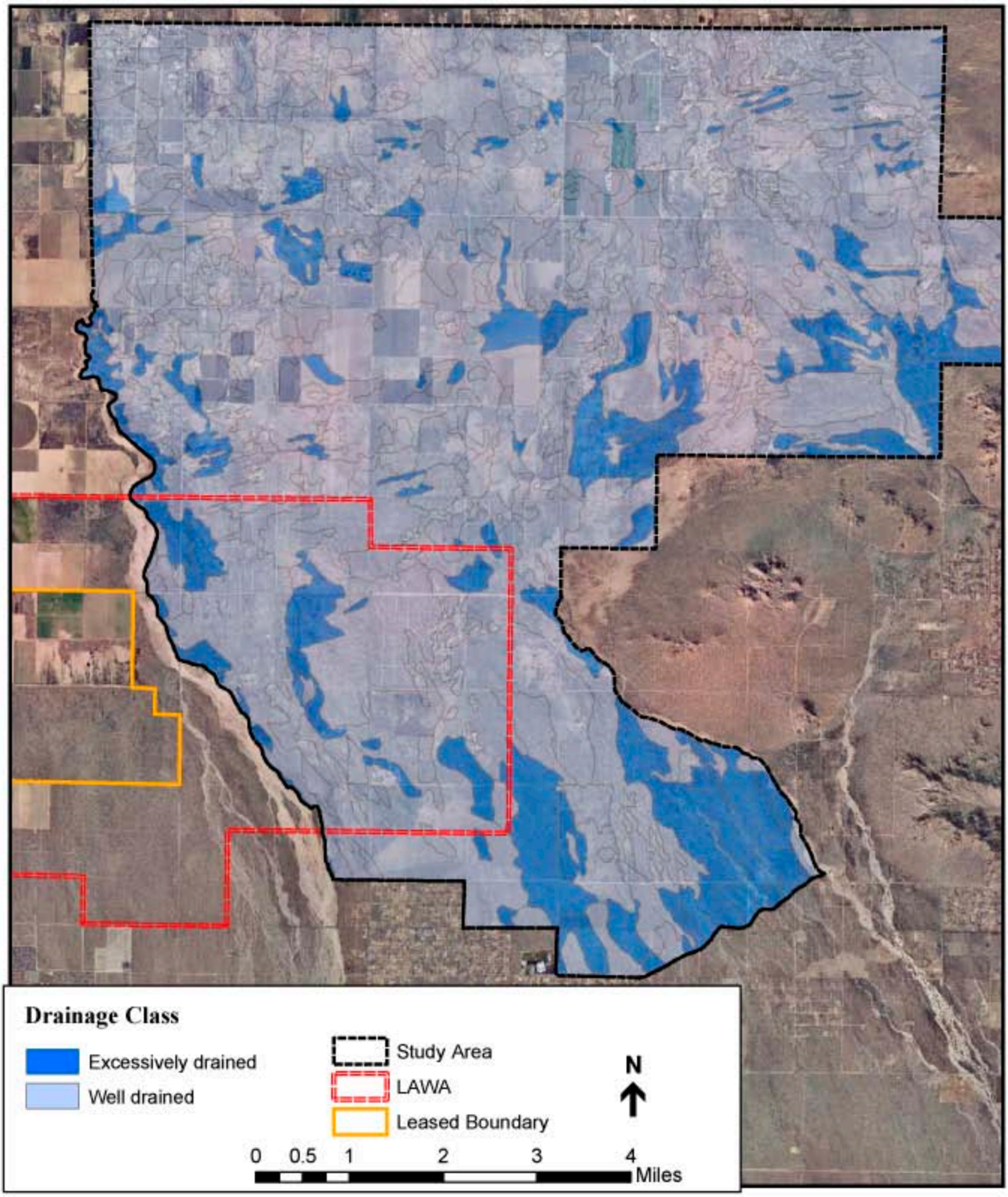
SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2005

Exhibit D
Soil Wind Erodibility Groups



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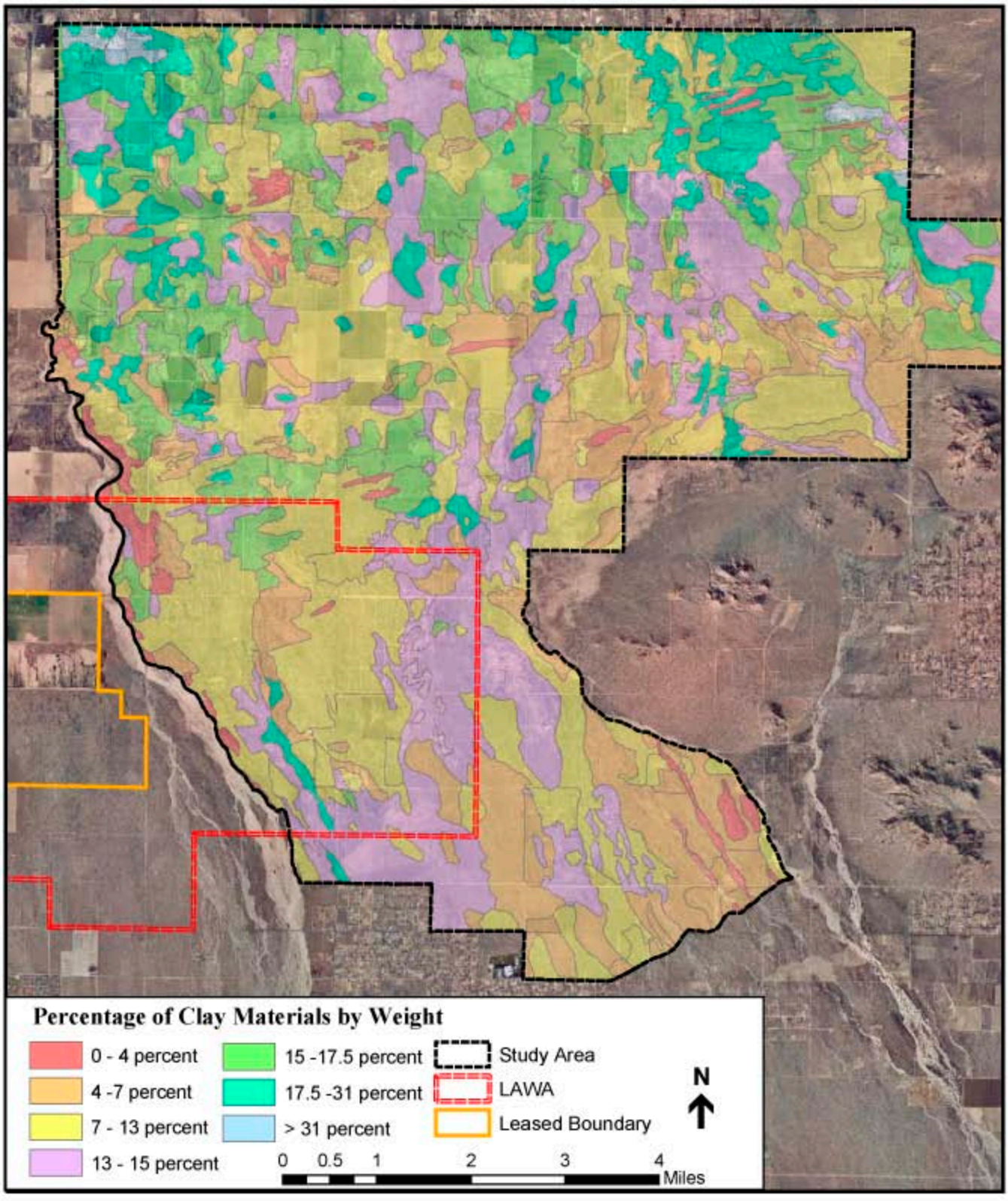
SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2005

Exhibit E
Soil Drainage Classes



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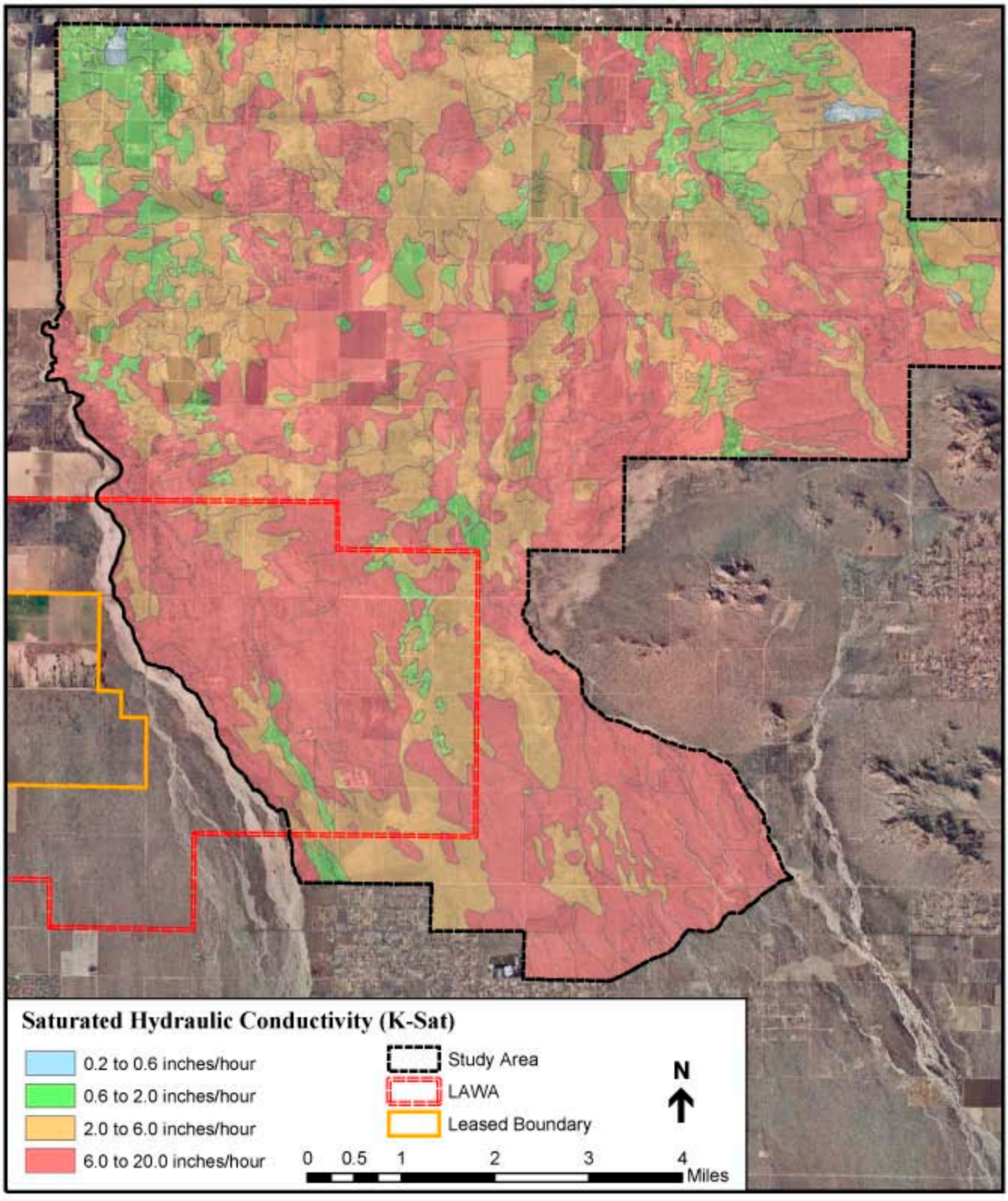
SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2005

Exhibit F
Percent Clay By Weight



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SOURCE: NRCS SSURGO Soil Data, 2004; ESA, 2005

Exhibit G
Soil Permeability