APPENDIX A

USDA Soils Survey

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 Tulare County, Western Part, California

Cordeniz Basin

December 12, 2014

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://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) 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://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

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 Web Soil Survey, the site for 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.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,680 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Tulare County, Western Part, California
Survey Area Data: Version 8, Sep 30, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 27, 2010—Jul 3, 2011

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

Tulare County, Western Part, California (CA659)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
130	Nord fine sandy loam, 0 to 2 percent slopes	78.1	97.0%
137	Tagus loam, 0 to 2 percent slopes	2.4	3.0%
Totals for Area of Interest		**80.5**	**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.

Tulare County, Western Part, California

130—Nord fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hp51
Elevation: 190 to 520 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Nord and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nord

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex, linear
Parent material: Alluvium derived from mixed

Typical profile

Ap - 0 to 11 inches: fine sandy loam
C1 - 11 to 38 inches: stratified sandy loam to loam
C2 - 38 to 50 inches: stratified loamy coarse sand to coarse sandy loam
2Btb - 50 to 72 inches: stratified sandy loam to silt loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Negligible
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: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Very low (about 0.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B

Minor Components

Grangeville, saline-sodic
Percent of map unit: 3 percent
Landform: Alluvial fans, flood plains

Hanford
Percent of map unit: 3 percent
Landform: Flood plains, alluvial fans

Tujunga
Percent of map unit: 3 percent
Landform: Flood plains

Tagus
Percent of map unit: 2 percent
Landform: Fan remnants

Akers
Percent of map unit: 2 percent
Landform: Fan remnants

Colpien
Percent of map unit: 2 percent
Landform: Fan remnants

137—Tagus loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: hp58
Elevation: 230 to 400 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 250 to 300 days
Farmland classification: Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition
Tagus and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tagus

Setting
Landform: Fan remnants
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granitic rock sources

Typical profile

Ap - 0 to 17 inches: loam
Bk1 - 17 to 40 inches: loam
Bk2 - 40 to 63 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
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: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B

Minor Components

Tujunga

Percent of map unit: 5 percent
Landform: Flood plains

Hanford

Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains

Grangeville

Percent of map unit: 3 percent
Landform: Alluvial fans, flood plains

Colpien

Percent of map unit: 2 percent
Landform: Fan remnants

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations 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 interpretation.

Land Classifications

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.

California Revised Storie Index (CA)

The Storie Index is a soil rating based on soil properties that govern a soil's potential for cultivated agriculture in California.

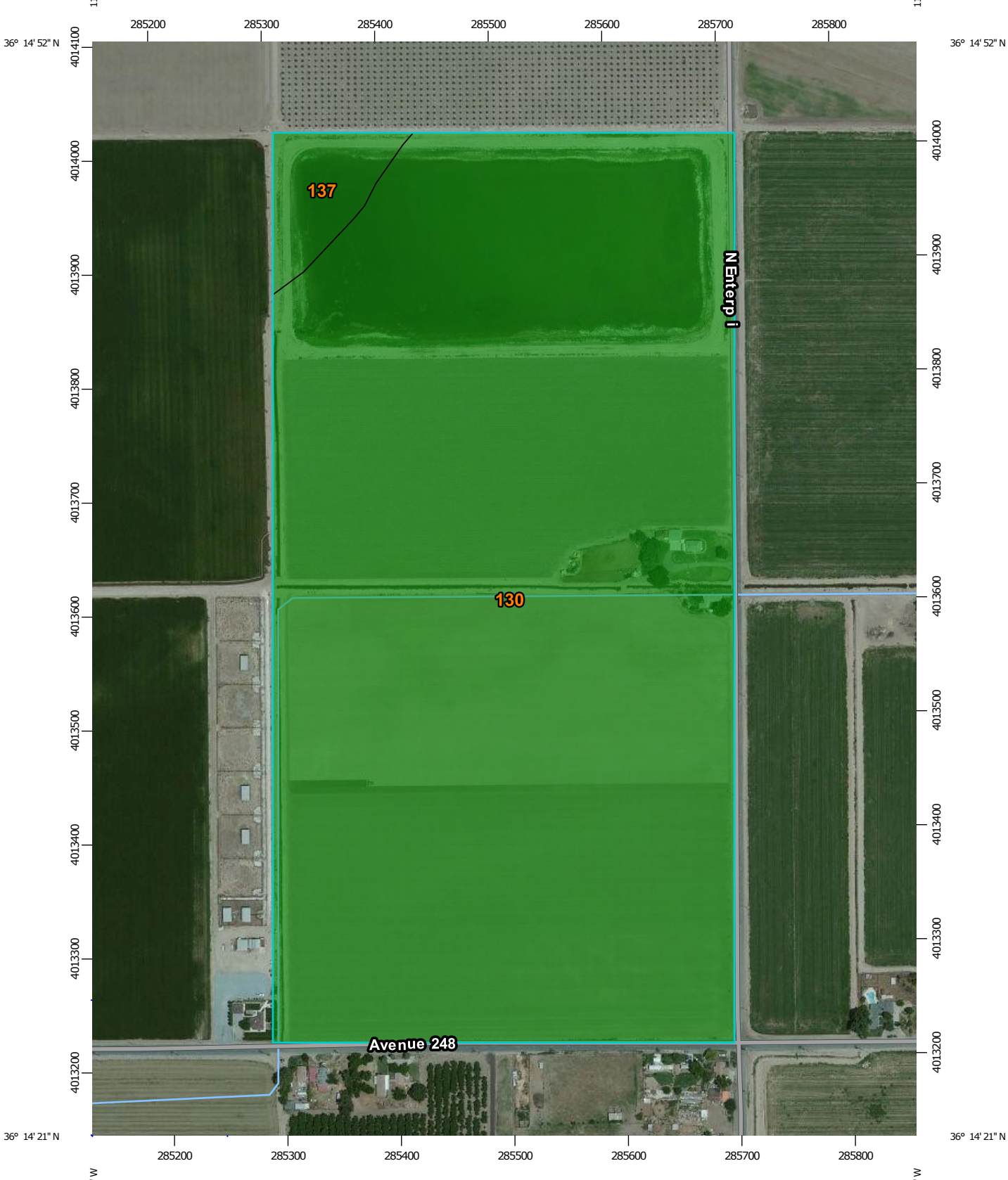
The Storie Index assesses the productivity of a soil from the following four characteristics: Factor A, degree of soil profile development; factor B, texture of the surface layer; factor C, slope; and factor X, manageable features, including drainage, microrelief, fertility, acidity, erosion, and salt content. A score ranging from 0 to 100 is determined for each factor, and the scores are then multiplied together to derive an index rating.

For simplification, Storie Index ratings have been combined into six grade classes as follows: Grade 1 (excellent), 81 to 100; grade 2 (good), 61 to 80; grade 3 (fair), 41 to 60; grade 4 (poor), 21 to 40; grade 5 (very poor), 11 to 20; and grade 6 (nonagricultural), 10 or less.

The components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined

by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one shown for the map unit. The percent composition of each component in a particular map unit is given to help the user better understand the extent to which the rating applies to the map unit.

Other components with different ratings may occur in each map unit. The ratings for all components, regardless the aggregated rating of the map unit, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.



Map Scale: 1:4,680 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Lines

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Soil Rating Points

- Grade 1 - Excellent
- Grade 2 - Good
- Grade 3 - Fair
- Grade 4 - Poor
- Grade 5 - Very Poor
- Grade 6 - Nonagricultural
- Not rated
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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Table—California Revised Storie Index (CA)

California Revised Storie Index (CA)— Summary by Map Unit — Tulare County, Western Part, California (CA659)					
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Acres in AOI**	**Percent of AOI**
130	Nord fine sandy loam, 0 to 2 percent slopes	Grade 1 - Excellent	Nord (85%)	78.1	97.0%
137	Tagus loam, 0 to 2 percent slopes	Grade 1 - Excellent	Tagus (85%)	2.4	3.0%
Totals for Area of Interest				**80.5**	**100.0%**

Rating Options—California Revised Storie Index (CA)

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the "National Soil Survey Handbook."

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3
Low: 3 to 6
Moderate: 6 to 9
High: 9 to 12
Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change

in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age,

the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of

streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth’s surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown.

The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2
Low: 0.2 to 0.4
Moderately low: 0.4 to 0.75
Moderate: 0.75 to 1.25
Moderately high: 1.25 to 1.75
High: 1.75 to 2.5
Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^{1}/_{3}$- or $^{1}/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth’s crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent
Low: 0.5 to 1.0 percent
Moderately low: 1.0 to 2.0 percent
Moderate: 2.0 to 4.0 percent
High: 4.0 to 8.0 percent
Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5
Extremely acid: 3.5 to 4.4
Very strongly acid: 4.5 to 5.0
Strongly acid: 5.1 to 5.5
Moderately acid: 5.6 to 6.0
Slightly acid: 6.1 to 6.5
Neutral: 6.6 to 7.3
Slightly alkaline: 7.4 to 7.8
Moderately alkaline: 7.9 to 8.4
Strongly alkaline: 8.5 to 9.0
Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they

form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where “Rock outcrop” is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which "severely eroded," "very severely eroded," or "gullied" is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds

and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1

Moderate: 13-30:1

Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0
Coarse sand: 1.0 to 0.5
Medium sand: 0.5 to 0.25
Fine sand: 0.25 to 0.10
Very fine sand: 0.10 to 0.05
Silt: 0.05 to 0.002
Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents

the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated

Prismatic: Vertically elongated and having flat tops

Columnar: Vertically elongated and having rounded tops

Angular blocky: Having faces that intersect at sharp angles (planes)

Subangular blocky: Having subrounded and planar faces (no sharp angles)

Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand

Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth’s surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.

APPENDIX B

CalEEMod

Cordeniz Basin

Tulare County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
User Defined Industrial	85.00	User Defined Unit	85.00	0.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	51
Climate Zone	3			**Operational Year**	2016
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - The Project is anticipated to distrub 85 acres.

Construction Phase - Construction could take up to 22 months.

Vehicle Trips - 30 vehicle round trips per year are anticipated to the site.

Trips and VMT - An average of 18-20 worker trips per day during construction with an average of 5 vendor trips per day during the building construction phase.

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	1,550.00	174.00
tblConstructionPhase	NumDays	155.00	261.00
tblConstructionPhase	NumDays	60.00	44.00
tblConstructionPhase	PhaseEndDate	9/30/2016	10/2/2016
tblGrading	AcresOfGrading	652.50	387.50
tblLandUse	LotAcreage	0.00	85.00
tblProjectCharacteristics	OperationalYear	2014	2016
tblTripsAndVMT	VendorTripNumber	0.00	5.00
tblTripsAndVMT	WorkerTripNumber	0.00	20.00
tblVehicleTrips	CW_TTP	0.00	100.00
tblVehicleTrips	DV_TP	0.00	19.00
tblVehicleTrips	PB_TP	0.00	1.00
tblVehicleTrips	PR_TP	0.00	80.00
tblVehicleTrips	ST_TR	0.00	0.08
tblVehicleTrips	SU_TR	0.00	0.08
tblVehicleTrips	WD_TR	0.00	0.08

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2015	0.3579	3.8266	2.6503	2.9600e-003	1.3971	0.1916	1.5887	0.6749	0.1763	0.8511	0.0000	280.8249	280.8249	0.0821	0.0000	282.5479
2016	0.7995	8.2874	5.5703	7.2000e-003	1.0132	0.4157	1.4289	0.4600	0.3837	0.8437	0.0000	670.5857	670.5857	0.1926	0.0000	674.6301
2017	0.1933	1.4675	1.0687	1.6300e-003	0.0105	0.0975	0.1080	2.8100e-003	0.0916	0.0944	0.0000	143.5225	143.5225	0.0326	0.0000	144.2059
Total	**1.3506**	**13.5815**	**9.2892**	**0.0118**	**2.4208**	**0.7048**	**3.1256**	**1.1377**	**0.6515**	**1.7892**	**0.0000**	**1,094.9331**	**1,094.9331**	**0.3072**	**0.0000**	**1,101.3839**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2015	0.3575	3.8221	2.6472	2.9600e-003	1.3971	0.1914	1.5885	0.6749	0.1761	0.8509	0.0000	280.4998	280.4998	0.0820	0.0000	282.2207
2016	0.7986	8.2776	5.5638	7.1900e-003	1.0132	0.4152	1.4284	0.4600	0.3832	0.8432	0.0000	669.8137	669.8137	0.1924	0.0000	673.8532
2017	0.1931	1.4658	1.0675	1.6200e-003	0.0105	0.0974	0.1079	2.8100e-003	0.0915	0.0943	0.0000	143.3672	143.3672	0.0325	0.0000	144.0499
Total	**1.3491**	**13.5655**	**9.2785**	**0.0118**	**2.4208**	**0.7040**	**3.1247**	**1.1377**	**0.6507**	**1.7884**	**0.0000**	**1,093.6807**	**1,093.6807**	**0.3068**	**0.0000**	**1,100.1238**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.1111**	**0.1184**	**0.1151**	**0.1696**	**0.0000**	**0.1178**	**0.0272**	**0.0000**	**0.1182**	**0.0436**	**0.0000**	**0.1144**	**0.1144**	**0.1204**	**0.0000**	**0.1144**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0185	0.0198	0.0664	1.2000e-004	7.5100e-003	2.7000e-004	7.7800e-003	2.0200e-003	2.5000e-004	2.2700e-003	0.0000	9.8649	9.8649	3.7000e-004	0.0000	9.8727
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0186**	**0.0199**	**0.0672**	**1.2000e-004**	**7.5100e-003**	**2.7000e-004**	**7.7800e-003**	**2.0200e-003**	**2.5000e-004**	**2.2700e-003**	**0.0000**	**9.8665**	**9.8665**	**3.7000e-004**	**0.0000**	**9.8743**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0185	0.0198	0.0664	1.2000e-004	7.5100e-003	2.7000e-004	7.7800e-003	2.0200e-003	2.5000e-004	2.2700e-003	0.0000	9.8649	9.8649	3.7000e-004	0.0000	9.8727
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0186**	**0.0199**	**0.0672**	**1.2000e-004**	**7.5100e-003**	**2.7000e-004**	**7.7800e-003**	**2.0200e-003**	**2.5000e-004**	**2.2700e-003**	**0.0000**	**9.8665**	**9.8665**	**3.7000e-004**	**0.0000**	**9.8743**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Site Preparation	Site Preparation	8/1/2015	10/1/2015	5	44	
2	Grading	Grading	10/2/2015	10/2/2016	5	261	
3	Building Construction	Building Construction	10/3/2016	6/1/2017	5	174	

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	2	8.00	162	0.38
Grading	Graders	1	8.00	174	0.41
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Scrapers	2	8.00	361	0.48
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	20.00	5.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Site Preparation - 2015

Unmitigated Construction On-Site

Acres of Grading: 0

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.3975	0.0000	0.3975	0.2185	0.0000	0.2185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1157	1.2516	0.9379	8.6000e-004		0.0679	0.0679		0.0625	0.0625	0.0000	82.0625	82.0625	0.0245	0.0000	82.5769
Total	**0.1157**	**1.2516**	**0.9379**	**8.6000e-004**	**0.3975**	**0.0679**	**0.4654**	**0.2185**	**0.0625**	**0.2810**	**0.0000**	**82.0625**	**82.0625**	**0.0245**	**0.0000**	**82.5769**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.3000e-003	2.2900e-003	0.0227	4.0000e-005	3.1500e-003	3.0000e-005	3.1800e-003	8.4000e-004	3.0000e-005	8.6000e-004	0.0000	2.8490	2.8490	1.7000e-004	0.0000	2.8526
Total	**8.3000e-003**	**2.2900e-003**	**0.0227**	**4.0000e-005**	**3.1500e-003**	**3.0000e-005**	**3.1800e-003**	**8.4000e-004**	**3.0000e-005**	**8.6000e-004**	**0.0000**	**2.8490**	**2.8490**	**1.7000e-004**	**0.0000**	**2.8526**

3.2 Site Preparation - 2015

Mitigated Construction On-Site

Acres of Grading: 0

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.3975	0.0000	0.3975	0.2185	0.0000	0.2185	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1156	1.2501	0.9368	8.6000e-004		0.0679	0.0679		0.0624	0.0624	0.0000	81.9648	81.9648	0.0245	0.0000	82.4787
Total	**0.1156**	**1.2501**	**0.9368**	**8.6000e-004**	**0.3975**	**0.0679**	**0.4653**	**0.2185**	**0.0624**	**0.2809**	**0.0000**	**81.9648**	**81.9648**	**0.0245**	**0.0000**	**82.4787**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.3000e-003	2.2900e-003	0.0227	4.0000e-005	3.1500e-003	3.0000e-005	3.1800e-003	8.4000e-004	3.0000e-005	8.6000e-004	0.0000	2.8490	2.8490	1.7000e-004	0.0000	2.8526
Total	**8.3000e-003**	**2.2900e-003**	**0.0227**	**4.0000e-005**	**3.1500e-003**	**3.0000e-005**	**3.1800e-003**	**8.4000e-004**	**3.0000e-005**	**8.6000e-004**	**0.0000**	**2.8490**	**2.8490**	**1.7000e-004**	**0.0000**	**2.8526**

3.3 Grading - 2015

Unmitigated Construction On-Site

Acres of Grading: 387.5

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.9914	0.0000	0.9914	0.4542	0.0000	0.4542	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2202	2.5690	1.6523	2.0100e-003		0.1236	0.1236		0.1137	0.1137	0.0000	191.2372	191.2372	0.0571	0.0000	192.4361
Total	**0.2202**	**2.5690**	**1.6523**	**2.0100e-003**	**0.9914**	**0.1236**	**1.1149**	**0.4542**	**0.1137**	**0.5679**	**0.0000**	**191.2372**	**191.2372**	**0.0571**	**0.0000**	**192.4361**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0136	3.7600e-003	0.0373	6.0000e-005	5.1800e-003	5.0000e-005	5.2200e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.6763	4.6763	2.8000e-004	0.0000	4.6823
Total	**0.0136**	**3.7600e-003**	**0.0373**	**6.0000e-005**	**5.1800e-003**	**5.0000e-005**	**5.2200e-003**	**1.3800e-003**	**4.0000e-005**	**1.4200e-003**	**0.0000**	**4.6763**	**4.6763**	**2.8000e-004**	**0.0000**	**4.6823**

3.3 Grading - 2015

Mitigated Construction On-Site

Acres of Grading: 387.5

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.9914	0.0000	0.9914	0.4542	0.0000	0.4542	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2199	2.5660	1.6503	2.0000e-003		0.1234	0.1234		0.1136	0.1136	0.0000	191.0097	191.0097	0.0570	0.0000	192.2072
Total	**0.2199**	**2.5660**	**1.6503**	**2.0000e-003**	**0.9914**	**0.1234**	**1.1148**	**0.4542**	**0.1136**	**0.5677**	**0.0000**	**191.0097**	**191.0097**	**0.0570**	**0.0000**	**192.2072**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0136	3.7600e-003	0.0373	6.0000e-005	5.1800e-003	5.0000e-005	5.2200e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.6763	4.6763	2.8000e-004	0.0000	4.6823
Total	**0.0136**	**3.7600e-003**	**0.0373**	**6.0000e-005**	**5.1800e-003**	**5.0000e-005**	**5.2200e-003**	**1.3800e-003**	**4.0000e-005**	**1.4200e-003**	**0.0000**	**4.6763**	**4.6763**	**2.8000e-004**	**0.0000**	**4.6823**

3.3 Grading - 2016

Unmitigated Construction On-Site

Acres of Grading: 387.5

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.9914	0.0000	0.9914	0.4542	0.0000	0.4542	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.6350	7.3318	4.8155	6.0500e-003		0.3513	0.3513		0.3232	0.3232	0.0000	570.3181	570.3181	0.1720	0.0000	573.9307
Total	**0.6350**	**7.3318**	**4.8155**	**6.0500e-003**	**0.9914**	**0.3513**	**1.3426**	**0.4542**	**0.3232**	**0.7773**	**0.0000**	**570.3181**	**570.3181**	**0.1720**	**0.0000**	**573.9307**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0371	9.9200e-003	0.0979	1.8000e-004	0.0156	1.3000e-004	0.0157	4.1500e-003	1.2000e-004	4.2700e-003	0.0000	13.5674	13.5674	7.6000e-004	0.0000	13.5833
Total	**0.0371**	**9.9200e-003**	**0.0979**	**1.8000e-004**	**0.0156**	**1.3000e-004**	**0.0157**	**4.1500e-003**	**1.2000e-004**	**4.2700e-003**	**0.0000**	**13.5674**	**13.5674**	**7.6000e-004**	**0.0000**	**13.5833**

3.3 Grading - 2016

Mitigated Construction On-Site

Acres of Grading: 387.5

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.9914	0.0000	0.9914	0.4542	0.0000	0.4542	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.6342	7.3230	4.8097	6.0400e-003		0.3508	0.3508		0.3228	0.3228	0.0000	569.6397	569.6397	0.1718	0.0000	573.2480
Total	**0.6342**	**7.3230**	**4.8097**	**6.0400e-003**	**0.9914**	**0.3508**	**1.3422**	**0.4542**	**0.3228**	**0.7769**	**0.0000**	**569.6397**	**569.6397**	**0.1718**	**0.0000**	**573.2480**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0371	9.9200e-003	0.0979	1.8000e-004	0.0156	1.3000e-004	0.0157	4.1500e-003	1.2000e-004	4.2700e-003	0.0000	13.5674	13.5674	7.6000e-004	0.0000	13.5833
Total	**0.0371**	**9.9200e-003**	**0.0979**	**1.8000e-004**	**0.0156**	**1.3000e-004**	**0.0157**	**4.1500e-003**	**1.2000e-004**	**4.2700e-003**	**0.0000**	**13.5674**	**13.5674**	**7.6000e-004**	**0.0000**	**13.5833**

3.4 Building Construction - 2016

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1107	0.9265	0.6015	8.7000e-004		0.0639	0.0639		0.0601	0.0601	0.0000	78.6999	78.6999	0.0195	0.0000	79.1098
Total	**0.1107**	**0.9265**	**0.6015**	**8.7000e-004**		**0.0639**	**0.0639**		**0.0601**	**0.0601**	**0.0000**	**78.6999**	**78.6999**	**0.0195**	**0.0000**	**79.1098**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.3900e-003	0.0160	0.0230	4.0000e-005	1.0500e-003	2.8000e-004	1.3300e-003	3.0000e-004	2.6000e-004	5.6000e-004	0.0000	3.5009	3.5009	3.0000e-005	0.0000	3.5016
Worker	0.0123	3.2900e-003	0.0325	6.0000e-005	5.1800e-003	4.0000e-005	5.2200e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.4994	4.4994	2.5000e-004	0.0000	4.5047
Total	**0.0167**	**0.0193**	**0.0555**	**1.0000e-004**	**6.2300e-003**	**3.2000e-004**	**6.5500e-003**	**1.6800e-003**	**3.0000e-004**	**1.9800e-003**	**0.0000**	**8.0003**	**8.0003**	**2.8000e-004**	**0.0000**	**8.0063**

3.4 Building Construction - 2016

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1106	0.9254	0.6008	8.7000e-004		0.0639	0.0639		0.0600	0.0600	0.0000	78.6063	78.6063	0.0195	0.0000	79.0157
Total	**0.1106**	**0.9254**	**0.6008**	**8.7000e-004**		**0.0639**	**0.0639**		**0.0600**	**0.0600**	**0.0000**	**78.6063**	**78.6063**	**0.0195**	**0.0000**	**79.0157**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.3900e-003	0.0160	0.0230	4.0000e-005	1.0500e-003	2.8000e-004	1.3300e-003	3.0000e-004	2.6000e-004	5.6000e-004	0.0000	3.5009	3.5009	3.0000e-005	0.0000	3.5016
Worker	0.0123	3.2900e-003	0.0325	6.0000e-005	5.1800e-003	4.0000e-005	5.2200e-003	1.3800e-003	4.0000e-005	1.4200e-003	0.0000	4.4994	4.4994	2.5000e-004	0.0000	4.5047
Total	**0.0167**	**0.0193**	**0.0555**	**1.0000e-004**	**6.2300e-003**	**3.2000e-004**	**6.5500e-003**	**1.6800e-003**	**3.0000e-004**	**1.9800e-003**	**0.0000**	**8.0003**	**8.0003**	**2.8000e-004**	**0.0000**	**8.0063**

3.4 Building Construction - 2017

Unmitigated Construction On-Site

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Off-Road	0.1691	1.4391	0.9880	1.4600e-003		0.0971	0.0971		0.0912	0.0912	0.0000	130.5161	130.5161	0.0321	0.0000	131.1907
Total	**0.1691**	**1.4391**	**0.9880**	**1.4600e-003**		**0.0971**	**0.0971**		**0.0912**	**0.0912**	**0.0000**	**130.5161**	**130.5161**	**0.0321**	**0.0000**	**131.1907**

Unmitigated Construction Off-Site

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.6400e-003	0.0236	0.0337	6.0000e-005	1.7600e-003	4.0000e-004	2.1600e-003	5.1000e-004	3.6000e-004	8.7000e-004	0.0000	5.7662	5.7662	5.0000e-005	0.0000	5.7672
Worker	0.0185	4.8100e-003	0.0470	1.0000e-004	8.6800e-003	7.0000e-005	8.7500e-003	2.3100e-003	6.0000e-005	2.3700e-003	0.0000	7.2402	7.2402	3.8000e-004	0.0000	7.2481
Total	**0.0242**	**0.0284**	**0.0806**	**1.6000e-004**	**0.0104**	**4.7000e-004**	**0.0109**	**2.8200e-003**	**4.2000e-004**	**3.2400e-003**	**0.0000**	**13.0063**	**13.0063**	**4.3000e-004**	**0.0000**	**13.0153**

3.4 Building Construction - 2017

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1689	1.4374	0.9869	1.4600e-003		0.0970	0.0970		0.0911	0.0911	0.0000	130.3609	130.3609	0.0321	0.0000	131.0346
Total	**0.1689**	**1.4374**	**0.9869**	**1.4600e-003**		**0.0970**	**0.0970**		**0.0911**	**0.0911**	**0.0000**	**130.3609**	**130.3609**	**0.0321**	**0.0000**	**131.0346**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.6400e-003	0.0236	0.0337	6.0000e-005	1.7600e-003	4.0000e-004	2.1600e-003	5.1000e-004	3.6000e-004	8.7000e-004	0.0000	5.7662	5.7662	5.0000e-005	0.0000	5.7672
Worker	0.0185	4.8100e-003	0.0470	1.0000e-004	8.6800e-003	7.0000e-005	8.7500e-003	2.3100e-003	6.0000e-005	2.3700e-003	0.0000	7.2402	7.2402	3.8000e-004	0.0000	7.2481
Total	**0.0242**	**0.0284**	**0.0806**	**1.6000e-004**	**0.0104**	**4.7000e-004**	**0.0109**	**2.8200e-003**	**4.2000e-004**	**3.2400e-003**	**0.0000**	**13.0063**	**13.0063**	**4.3000e-004**	**0.0000**	**13.0153**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0185	0.0198	0.0664	1.2000e-004	7.5100e-003	2.7000e-004	7.7800e-003	2.0200e-003	2.5000e-004	2.2700e-003	0.0000	9.8649	9.8649	3.7000e-004	0.0000	9.8727
Unmitigated	0.0185	0.0198	0.0664	1.2000e-004	7.5100e-003	2.7000e-004	7.7800e-003	2.0200e-003	2.5000e-004	2.2700e-003	0.0000	9.8649	9.8649	3.7000e-004	0.0000	9.8727

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
User Defined Industrial	6.80	6.80	6.80	19,931	19,931
Total	6.80	6.80	6.80	19,931	19,931

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
User Defined Industrial	9.50	7.30	7.30	100.00	0.00	0.00	80	19	1

4.4 Fleet Mix

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.408191	0.071408	0.163262	0.194536	0.057230	0.008238	0.019334	0.064751	0.001899	0.001501	0.006208	0.001196	0.002246

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

Land Use	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	kBTU/yr	tons/yr										MT/yr					
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

Land Use	Electricity Use	Total CO2	CH4	N2O	CO2e
	kWh/yr	MT/yr			
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Mitigated	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003
Unmitigated	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003
Total	**8.0000e-005**	**1.0000e-005**	**8.0000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**1.5200e-003**	**1.5200e-003**	**0.0000**	**0.0000**	**1.6100e-003**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	8.0000e-005	1.0000e-005	8.0000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	1.5200e-003	1.5200e-003	0.0000	0.0000	1.6100e-003
Total	**8.0000e-005**	**1.0000e-005**	**8.0000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**1.5200e-003**	**1.5200e-003**	**0.0000**	**0.0000**	**1.6100e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Industrial	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Industrial	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Industrial	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

APPENDIX C

Biological Resources Report

LIVE OAK ASSOCIATES, INC.

an Ecological Consulting Firm

CORDENIZ RECHARGE BASIN PROJECT
BIOLOGICAL RESOURCES REPORT
TULARE IRRIGATION DISTRICT, TULARE COUNTY, CALIFORNIA

Prepared by

LIVE OAK ASSOCIATES, INC.

Austin Pearson, Director of Ecological Services
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Rebekah Jensen, Project Manager

Prepared for

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Senior Planner
Provost & Pritchard Consulting Group
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May 2015 PN 1909-01

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EXECUTIVE SUMMARY

Live Oak Associates, Inc. (LOA) conducted an investigation of the biological resources of the Cordeniz Recharge Basin Project site in Tulare County, California, and evaluated likely impacts to such resources resulting from the Tulare Irrigation District's proposed construction of an 80-acre recharge basin, realignment of a segment of the Serpa Ditch, and construction of five deep monitoring wells on lands surrounding the proposed basin. The following report is an analysis of impacts to the biological resources on or within the vicinity of the project.

The project site comprises the 80-acre Cordeniz Basin site and five individual well sites located to the north, east, and southwest of the Cordeniz Basin site. The six project components are located 0.5 to 2.5 miles west to northwest of the City of Tulare, within a region dominated by agricultural uses. The Cordeniz Basin site was surveyed by LOA biologist Jeff Gurule on December 9, 2014, and the five well sites were surveyed by LOA biologist Rebekah Jensen on April 28, 2015. At the time of the field surveys, the Cordeniz Basin site consisted of agricultural fields, the existing Enterprise Basin, Serpa Ditch, portions of two residential areas, and ruderal habitats, while the five well sites consisted entirely of ruderal habitats.

Any native habitats once present on the project site have been heavily altered by human enterprise such that the site no longer provides suitable habitat for any locally occurring special status plant species; hence, the proposed project will not impact special status plants. Project impacts will have no adverse effect on wildlife movement corridors, jurisdictional waters, sensitive habitats, and many special status animal species that may occasionally forage on the project site. The five well sites are all located immediately adjacent to waterways, including Cameron Creek and several Tulare Irrigation District canals, and well construction has the potential to result in the degradation of water quality in these channels. This project impact will be mitigated through the development and implementation of a Storm Water Pollution Prevention Plan. Potential project impacts to Swainson's hawk foraging habitat have been analyzed and determined to have little to no effect on Swainson's hawks. However, project construction during the nesting season has a small potential to result in disturbance to nesting Swainson's hawks such that nest failure may result. Mitigations to reduce or eliminate direct and indirect impacts to nesting Swainson's hawks include avoidance of project construction during the nesting season, and preconstruction surveys and buffers around active nests if construction activity is to occur within the nesting season.

The project may also result in impacts to nesting birds protected under the federal Migratory Bird Treaty Act. Birds nesting on or adjacent to the project site have the potential to be killed or disturbed by construction activities. Preconstruction surveys and avoidance, should active nests be found, will reduce impacts to nesting birds to a less than significant level. Preconstruction surveys and avoidance or passive relocation will reduce impacts to burrowing owls to a less then significant level. Construction related mortality of San Joaquin kit fox poses a potentially significant impact/adverse effect. Preconstruction surveys and avoidance and minimization measures consistent with the USFWS *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* will reduce the magnitude of these impacts to a less than significant level.

Cumulative impacts to sensitive or federally regulated biological resources are considered insignificant.

TABLE OF CONTENTS

1.0 INTRODUCTION

The technical report that follows describes the biotic resources of the Tulare Irrigation District (District) Cordeniz Recharge Basin Project site (hereafter referred to as the "project site" or "site"), and evaluates possible impacts to those resources that could result from project implementation. The project consists of the construction of a groundwater recharge basin and five deep monitoring wells at six separate locations in Tulare County, between 0.5 and 2.5 miles west to northwest of the City of Tulare (Figure 1). The site may be found on the *Paige, Goshen, Visalia,* and *Tulare* U.S. Geological Survey (USGS) 7.5-minute quadrangle, in Sections 20, 22, 28, 29, and 34 of Township 19 South, Range 24 East, and Section 7 of Township 20 South, Range 24 East, Mount Diablo Base and Meridian (Figure 2).

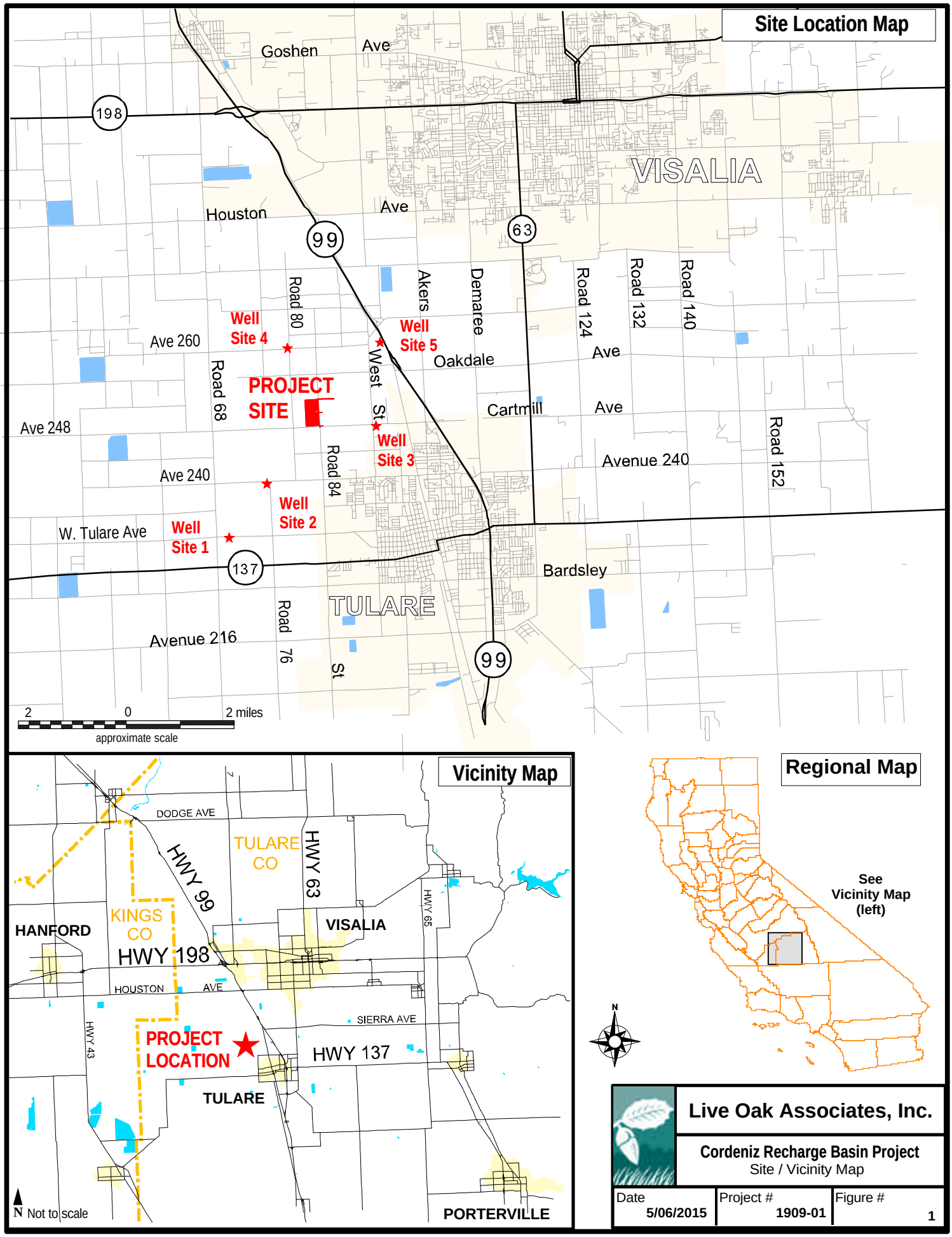
1.1 PROJECT DESCRIPTION

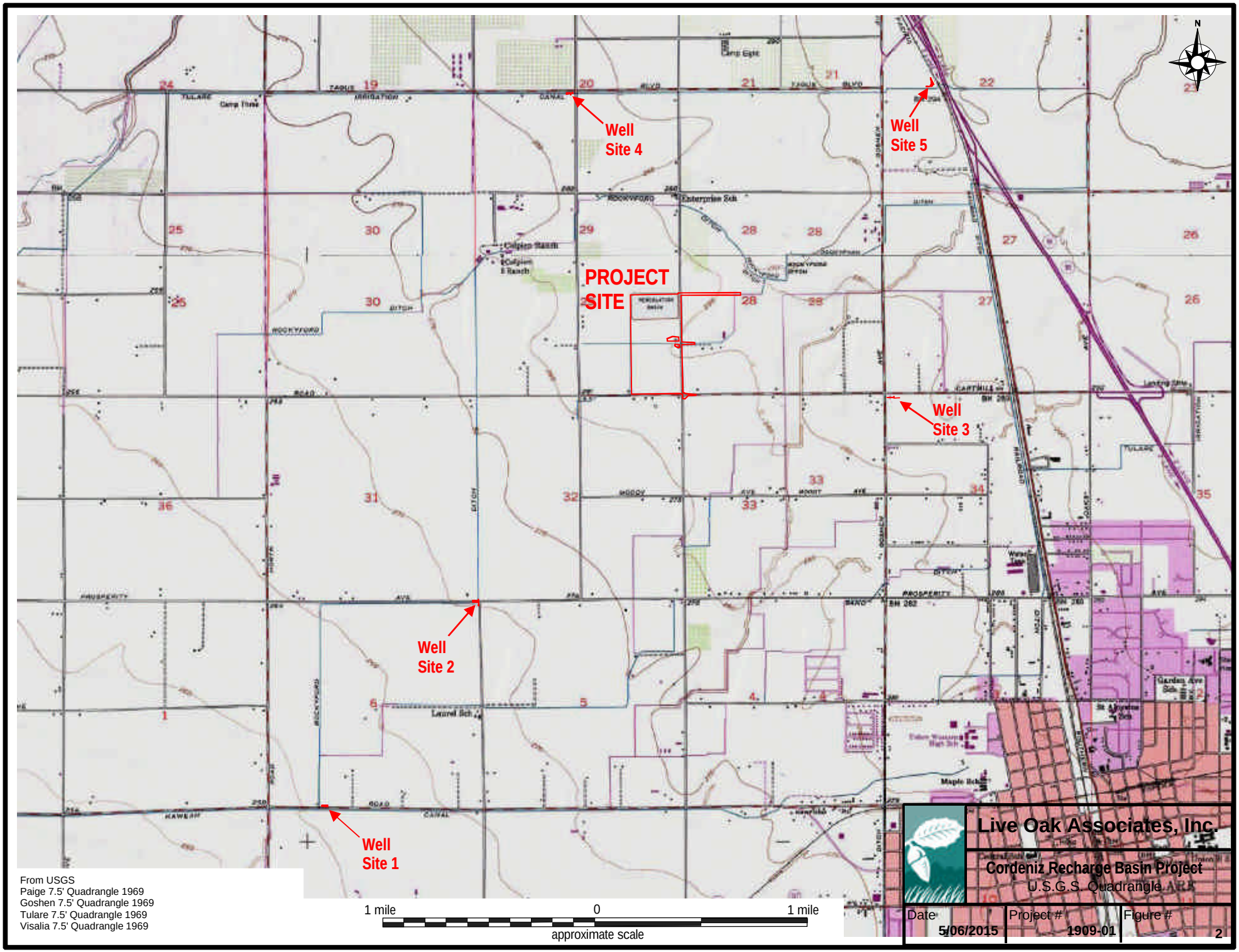
The District is proposing to build a groundwater recharge facility located on the northwestern corner of the Avenue 248 (Cartmill Avenue) and Road 84 (Enterprise Street) intersection (Figure 3a). The purpose of the project is to expand the existing 20-acre Enterprise Basin into an 80-acre, two-cell facility ("Cordeniz Basin"), significantly increasing the District's groundwater recharge capability. The District also proposes construction of five deep monitoring wells on lands surrounding the Cordeniz Basin to monitor the deep percolation impacts the facility has on the groundwater aquifer. These wells are identified as Well Nos. 1 through 5 on Figures 4 through 8, respectively, and are located as follows:

- Well No. 1: Located on the north bank of Cameron Creek and the east bank of Rockyford Ditch at the Rockyford Ditch/Cameron Creek junction south of Avenue 232 (Tulare Avenue)

- Well No. 2: Located primarily on the south bank of Rockyford Ditch, at the southwestern corner of the Avenue 240 (Prosperity Avenue) and Road 76 intersection

- Well No 3: Located near a culvert crossing for Sand Ditch at N. West Street between Cartmill Avenue and Elster Avenue


Site Location Map
Goshen
Ave
198
VISALIA
Houston
Ave
99
63
Road 80
Akers
Demaree
Road 124
Road 132
Road 140
Well Site 4
Well Site 5
Ave 260
Oakdale
Ave
Road 68
PROJECT SITE
West St
Cartmill
Ave
Ave 248
Well Site 3
Road 152
Ave 240
Road 84
Avenue 240
Well Site 2
W. Tulare Ave
Well Site 1
137
Bardsley
TULARE
Road 76
Avenue 216
St
99
2
0
2 miles
approximate scale
Vicinity Map
DODGE AVE
TULARE CO
HWY 99
HWY 63
KINGS CO
HANFORD
VISALIA
HWY 65
HWY 198
HOUSTON
AVE
SIERRA AVE
HWY 43
PROJECT LOCATION
HWY 137
TULARE
N
Not to scale
PORTERVILLE
Regional Map
See Vicinity Map (left)
N
Live Oak Associates, Inc.
Cordeniz Recharge Basin Project
Site / Vicinity Map
Date
5/06/2015
Project #
1909-01
Figure #
1

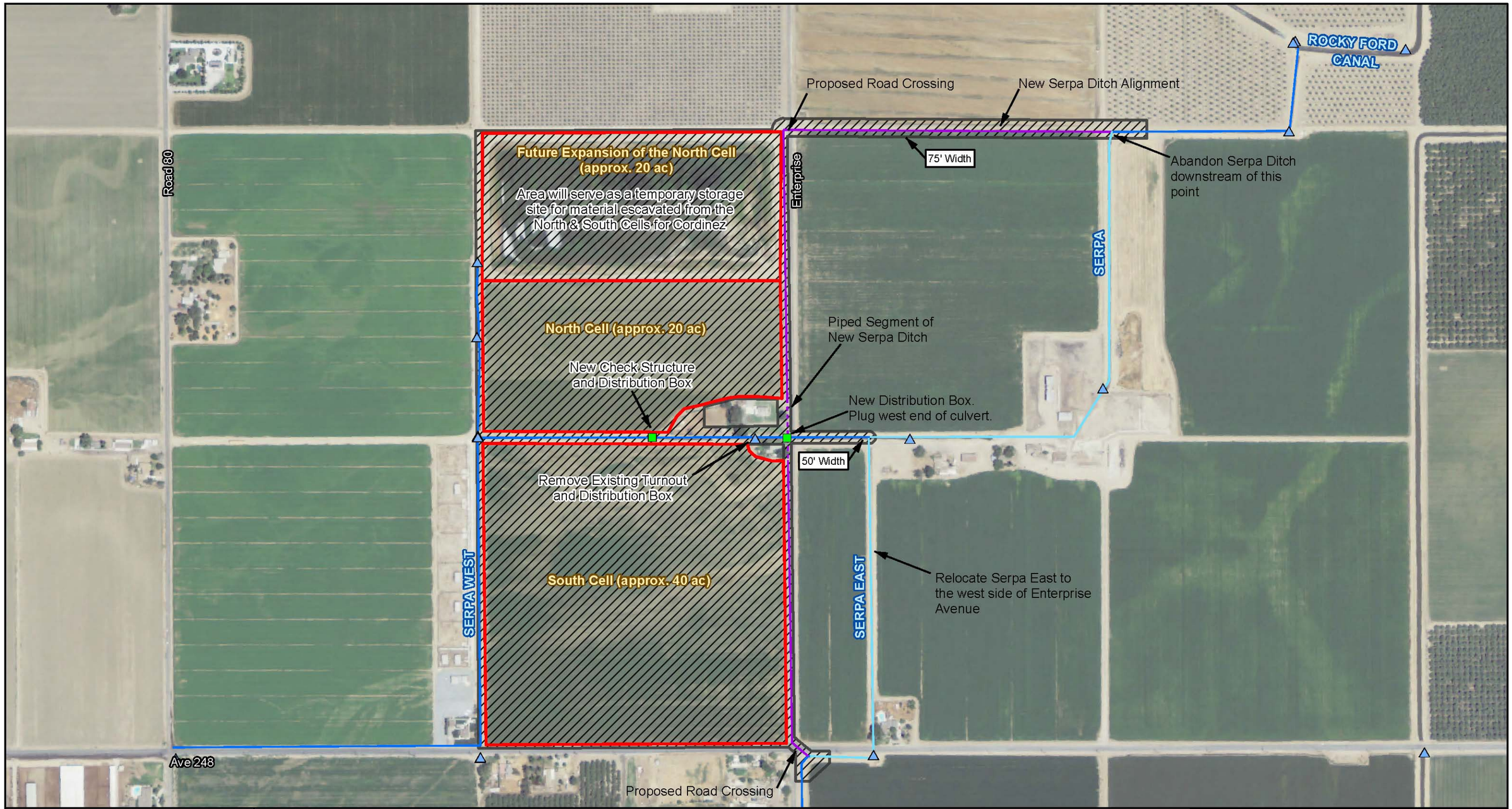


From USGS
Paige 7.5' Quadrangle 1969
Goshen 7.5' Quadrangle 1969
Tulare 7.5' Quadrangle 1969
Visalia 7.5' Quadrangle 1969

Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
U.S.G.S. Quadrangle Area

Date	Project #	Figure #
5/06/2015	1909-01	2



0 200 400 600 Feet

Legend

- Proposed Basin
- Area of Potenial Effect
- Existing Facility
- Abandoned Ditch
- Proposed Facility
- Proposed Pipe
- Existing Turnout
- New Check Structure/Distribution Box

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Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Cordeniz Basin

Date	Project #	Figure #
5/7/15	1909-01	3a

9/5/2014 : V:\Clients\Tulare ID-1248\124814V2-Cordeniz Basin\GIS\Map\site_facilities_ape.mxd

- Well No. 4: Located near a culvert structure for the Little Tulare Canal, on the southwestern corner of the Avenue 260 and Road 80 intersection

- Well No. 5: Located on the Little Tulare Canal immediately west of Highway 99 and the Southern Pacific Railroad

The recharge basin and deep monitoring well project components are discussed in more detail below.

Recharge Basin. The recharge basin site consists of a 60-acre parcel used as furrow-irrigated agricultural land and, immediately to the north, the existing 20-acre Enterprise Basin, which is currently utilized by the District for groundwater recharge activities. The site is bisected from east to west by the Serpa Ditch, which is a District owned and operated canal. The recharge basin project component will consist of constructing a new 39-acre basin south of the Serpa Canal ("south cell"), and expanding the existing Enterprise Basin to encompass an area of 38 acres north of the Serpa Canal ("north cell").

The construction of the two basin cells will include the excavation of earthen material, which will be temporarily stockpiled in the existing Enterprise Basin until it can be removed. Following the removal of the stockpiled excavation material, the southern embankment of the Enterprise Basin will be removed, such that it will become contiguous with newly-excavated portion of the north cell. The depth of the basin cells is anticipated to be approximately 7 feet. Compacted embankments will be installed around the perimeter of the basin complex and extend approximately 2 to 3 feet above the existing grade around the property. Levees will have a top width of approximately 18 feet and will serve as an access road for operations and maintenance purposes. Internal slopes are anticipated to be approximately 6 to 1 and outer toe slopes of embankments are anticipated to be approximately 2 to 1. The entire basin complex may be surrounded by a wire fence.

The basin cells will be outfitted with inlet facilities from the Serpa Ditch. The inlet facilities will include the use of reinforced concrete pipe with canal gate, control structures, and flow meters to measure the inflow of water. Each basin cell will also be designed with Supervisory Control and

Data Acquisition (SCADA) equipment to monitor the flow of water and the basin levels. SCADA equipment will require the installation of a vandal proof enclosure, radio antenna, pressure transducer casings located in the basins, and the required conduit and wiring to each piece of equipment. The SCADA equipment will be powered by a solar panel mounted to the radio antenna.

In order to facilitate the efficient conveyance of surface water to the basin complex, the District intends to redesign and relocate the Serpa Ditch to the west side of Road 84. East of Road 84, a portion of the Serpa Ditch will be abandoned in-place with the underlying property owner potentially filling in the abandoned canal and incorporating this area into existing farm operations. The realignment of the Serpa Ditch will involve the installation of a pipeline (plastic or reinforced concrete), up to 48 inches in diameter, from where the existing Serpa Ditch turns south at the Road 86 alignment to the west side of Road 84. This pipeline will be buried approximately 3 feet below grade and located within a newly established easement that generally conforms to an existing dirt roadway. A new reinforced concrete headworks will be built on the east end of the pipeline and generally consist of metal trash rack, slide gate, canal rip rap and potentially other improvements to the canal prism.

Once the relocated Serpa Ditch alignment is across Road 84 it will turn to the south and parallel Road 84 (on the west side of the road) until it intersects the existing Serpa Ditch that travels in an east/west direction. This portion of the alignment will continue as pipeline or be converted to an open channel, depending on hydraulics and cost. At the intersection with the existing Serpa Ditch, a portion of the Serpa Ditch (pipe or open channel) will turn to the west and travel beyond the existing homes and terminate into a distribution structure that will divert water into the two basins and downstream into the existing Serpa Ditch.

A small depression in the outer toe of the south basin cell will be installed to carry water to a turnout located on the southeast corner of Road 84 and Avenue 248. This small canal shall start from the Serpa Ditch junction between the two homes and travel south to the intersection of Road 84 and Avenue 248. A small pipeline will be installed from the northwest corner to the southeast corner of the intersection and discharge into an existing canal that serves downstream users.

Construction activity for this project component is anticipated to be split into two phases with activity commencing during the spring of 2015. The first phase of construction will focus on Serpa Ditch improvements, the south basin cell, the southern half of the north basin cell, and other improvements needed to convey water to the basin complex. This initial phase of construction is anticipated to last approximately 10 months. During the second phase of construction, material stockpiled in the Enterprise Basin will be removed and the north cell will be reshaped to its buildout footprint of approximately 38 acres. Assuming Phases 1 and 2 are able to occur concurrently, construction activities would be completed in about 15 months. If stockpiled material cannot be removed in a timely manner, then Phase 2 construction activity may have a delay of about 12 months, increasing the overall duration of the project to approximately 27 months.

Deep Monitoring Wells. The five proposed deep monitoring wells will be placed to the north, east, and southwest of the Cordeniz Basin. Because the groundwater gradient within the District generally flows from northeast to southwest, placing the monitoring wells along a northeast-to-southwest trajectory centered on the Cordeniz Basin should allow the District to monitor the project's deep percolation and changes in groundwater gradient. The depths of the monitoring wells will be determined during pilot hole borings at each well site, and will be based on depth to water and locations of water-bearing strata. Although temporary impacts may extend out to 150 feet from each well location, the monitoring wells will each occupy no more than a 10' by 10' area once constructed (Figures 3b-3f).

0 15 30 Feet

N

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Legend

- Area of Potential Effect
- Approximate Well Location
- Existing Turnout
- New Check Structure/Distribution Box

Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Well No. 1

Date	Project #	Figure #
5/7/15	1909-01	3b

3/18/2015 : V:\Clients\Tulare ID-1248\124814V2-Cordeniz Basin\GIS\Map\Wells\Well1.mxd

0 25 50 Feet

Legend

- Area of Potential Effect
- Approximate Well Location
- Existing Turnout
- New Check Structure/Distribution Box

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Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Well No. 2

Date	Project #	Figure #
5/7/15	1909-01	3c

3/23/2015 : V:\Clients\Tulare ID-1248\124814V2-Cordeniz Basin\GIS\Map\Wells\Well2.mxd

0 25 50 Feet

Legend

- Area of Potential Effect
- Approximate Well Location
- Existing Turnout
- New Check Structure/Distribution Box

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Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Well No. 3

Date	Project #	Figure #
5/7/15	1909-01	3d

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0 15 30 Feet

N

Legend

- Area of Potential Effect
- Approximate Well Location
- Existing Turnout
- New Check Structure/Distribution Box

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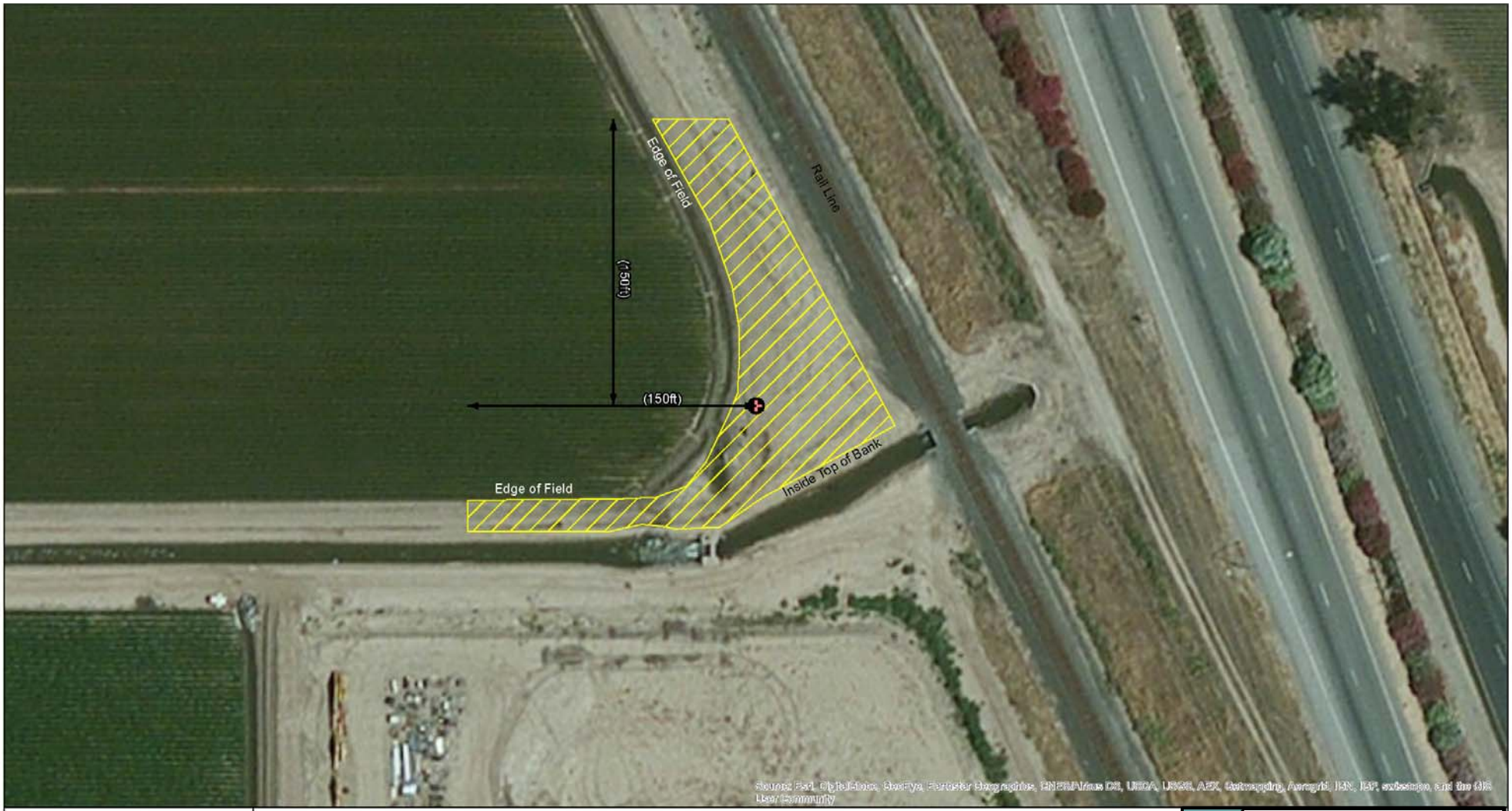
Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Well No. 4

Date	Project #	Figure #
5/7/15	1909-01	3e

3/24/2015 : V:\Clients\Tulare ID-1248\124814V2-Cordeniz Basin\GIS\Map\Wells\Well4.mxd



0 25 50 Feet

Legend

- Area of Potential Effect
- Approximate Well Location
- Existing Turnout
- New Check Structure/Distribution Box

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Live Oak Associates, Inc.

Cordeniz Recharge Basin Project
Site Plan: Well No. 5

Date	Project #	Figure #
5/7/15	1909-01	3f

3/23/2015 : V:\Clients\Tulare ID-1248\124814V2-Cordeniz Basin\GIS\Map\Wells\Well5.mxd

1.2 REPORT OBJECTIVES

Water projects such as that proposed by the District may damage or modify biotic habitats used by sensitive plant and wildlife species. In such cases, site development may be regulated by state or federal agencies, subject to review under the California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA), and/or subject to local policies and ordinances. This report addresses issues related to: 1) sensitive biotic resources occurring on the project site; 2) the federal, state, and local laws regulating such resources; and 3) mitigation measures that may be required to reduce the magnitude of anticipated impacts and/or comply with permit requirements of state and federal resource agencies. As such, the objectives of this report are to:

- Summarize all site-specific information related to existing biological resources.
- Make reasonable inferences about the biological resources that could occur onsite based on habitat suitability and the proximity of the site to a species' known range.
- Summarize all state and federal natural resource protection laws that may be relevant to possible future site development.
- Identify and discuss project impacts to biological resources likely to occur on the site within the context of CEQA and NEPA guidelines and relevant state and federal laws.
- Identify avoidance and mitigation measures that would reduce the magnitude of project impacts in a manner consistent with the requirements of CEQA and NEPA and that are generally consistent with recommendations of the resource agencies regulating affected biological resources.

1.3 STUDY METHODOLOGY

The analysis of impacts, as discussed in Section 3.0 of this report, is based on the known and potential biotic resources of the project site discussed in Section 2.0. Sources of information used in the preparation of this analysis included: (1) the *California Natural Diversity Data Base* (CDFW 2014), (2) the *Online Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2014), and (3) manuals, reports, and references related to plants and animals of the San Joaquin Valley region. A reconnaissance-level field survey of the recharge basin site was conducted on December 9, 2014 by Live Oak Associates, Inc. (LOA) biologist Jeff Gurule. A reconnaissance-level field survey of the five well sites was conducted on April 28, 2015 by LOA

biologist Rebekah Jensen. The surveys consisted of walking the project area and identifying the principal land uses of the project site and the constituent plants and animals of each land use. The field surveys conducted for this study were sufficient to assess the significance of possible biological impacts associated with the development plans for the project site.

2.0 EXISTING CONDITIONS

2.1 REGIONAL SETTING

The project site is located in the interior of the Southern San Joaquin Valley of California. The San Joaquin Valley is bordered by the Sierra Nevada to the east, the Tehachapi Mountains to the south, the California coastal ranges to the west, and the Sacramento-San Joaquin Delta to the north.

Like most of California, the southern San Joaquin Valley (and the project site) experiences a Mediterranean climate. Warm, dry summers are followed by cool, moist winters. Summer temperatures in the project vicinity commonly exceed 100 degrees Fahrenheit, and the relative humidity is generally very low. Winter temperatures rarely exceed 70 degrees Fahrenheit. Annual precipitation in the project vicinity is about 10 to 12 inches, about 85% of which falls between the months of October and March. Nearly all precipitation falls in the form of rain.

The project site is situated within the historic flood plain of the Kaweah and Tule Rivers. These river systems have been dammed, channelized and diverted for agricultural and flood control purposes. Both of these rivers originate in the Sierra Nevada and flow in an east-west direction. Historically these rivers drained to Tulare Lake west of the project site, which has since been drained and converted to agricultural and urban uses. The nearest natural drainage is Packwood Creek, which flows past the project site approximately 1 mile to the north of the northernmost of the well locations. Current land use within the region is agriculture and urban development.

Lands surrounding the project site consist of orchards, agricultural fields, residential/industrial uses, and a livestock facility. The urban center of the City of Tulare lies between 0.5 to 2.5 miles southeast of the project site.

2.2 PHYSICAL SETTING

At the time of the survey, the project site consisted of agricultural land, the existing Enterprise Basin, and levee roads and ruderal areas adjoining District canals (see Figures 3a-3f). The topography of the project site is relatively flat with elevations ranging from 298 feet National

Geodetic Vertical Datum (NGVD) at Well No. 5 to 263 feet NGVD at Well No. 1. The proposed Cordeniz Basin site averages 287 feet NGVD.

The project site contains three soil mapping units representing three soil series: Colpien loam, 0 to 2 percent slopes; Nord fine sandy loam, 0 to 2 percent slopes; and Tagus loam, 0 to 2 percent slopes. None of these soil mapping units are classified as hydric in the California Hydric Soils List. Furthermore, all soils of the site have been significantly altered through decades of agricultural and water conveyance and storage practices such as grading, discing, and excavation. As such, any native soil characteristics potentially supporting sensitive biological resources have been destroyed or significantly altered.

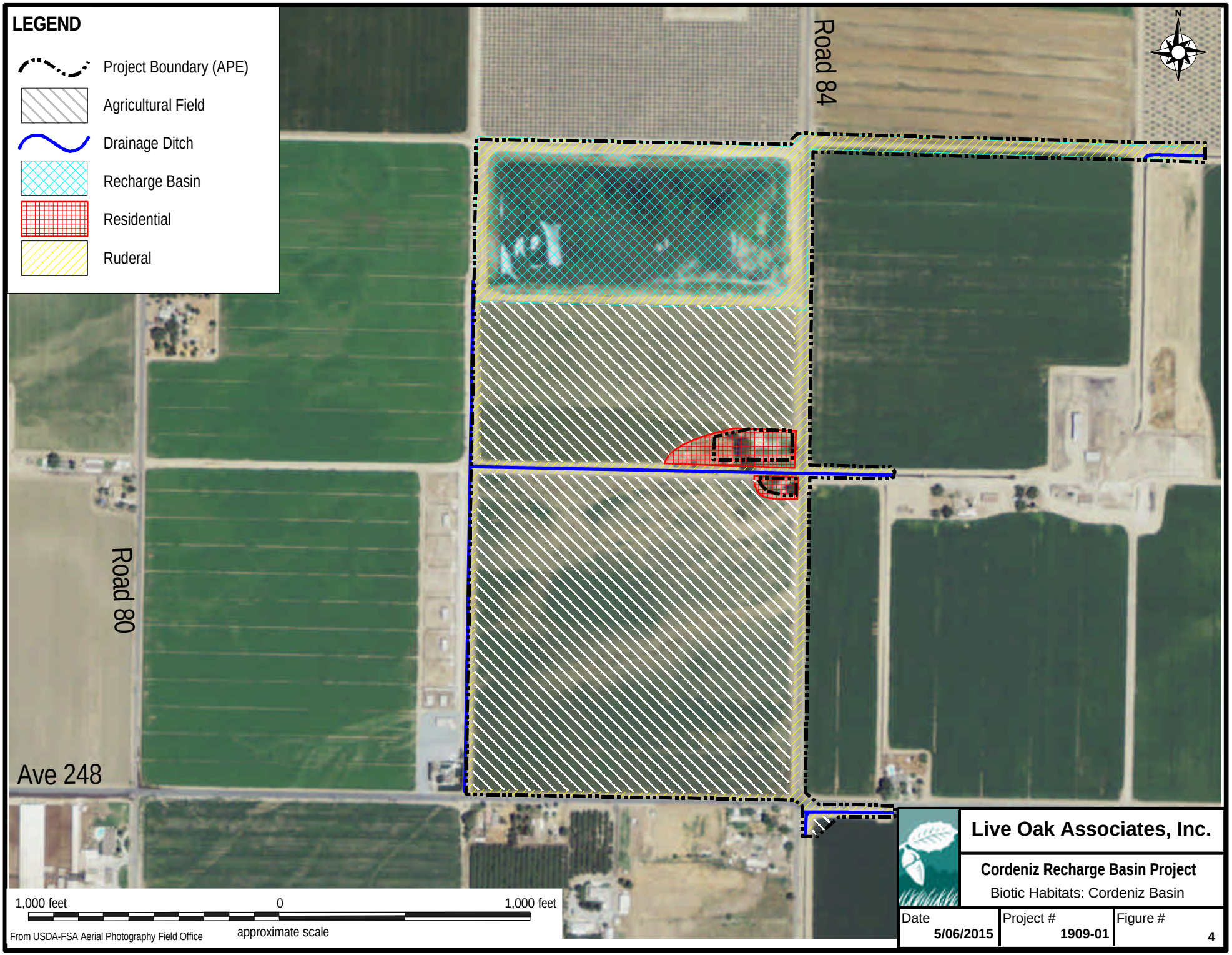
2.3 BIOTIC HABITATS/LAND USES

Five habitat/land use types were observed on the Cordeniz Basin site during the December 2014 biological field survey; agricultural field, recharge basin, ruderal, residential, and irrigation ditch (Figure 4). Only one habitat/land use type, ruderal, was observed on the five well sites. A list of the vascular plant species observed within the project site and the terrestrial vertebrates using, or potentially using, the site are provided in Appendices A and B, respectively. Photos of the project site are presented in Appendix C.

2.3.1 Agricultural Field

Agricultural field comprised much of the proposed Cordeniz Basin site. These fields have historically been planted to corn (*Zea mays* ssp. *mays*) and wheat (*Triticum* sp.), with the most recent crop consisting of wheat. At the time of LOA's December field survey the agricultural fields contained little vegetation besides the agricultural crop. Some weedy vegetation occurred sparingly within the interior and along the field edges consisting of Canada horseweed (*Erigeron canadensis*), Johnson grass (*Sorghum halepense*), mallow (*Malva sp.*), redroot amaranth (*Amaranthus retroflexus*), and fiddleneck (*Amsinckia sp.*).

Intensive agricultural practices in these fields limit their value to wildlife; however, some wildlife species undoubtedly occur in the fields. Amphibians with the potential to use agricultural fields include Pacific chorus frogs (*Pseudacris regilla*) and western toads (*Bufo*


LEGEND
Project Boundary (APE)
Agricultural Field
Drainage Ditch
Recharge Basin
Residential
Ruderal
Road 84
Road 80
Ave 248
N
1,000 feet
0
1,000 feet
From USDA-FSA Aerial Photography Field Office
approximate scale
Live Oak Associates, Inc.
Cordeniz Recharge Basin Project
Biotic Habitats: Cordeniz Basin
Date
5/06/2015
Project #
1909-01
Figure #
4

boreas), both of which may breed in nearby irrigation ditches and subsequently disperse through the fields. Reptiles that could occur in the fields include the side-blotched lizard (*Uta stansburiana*), Pacific gopher snake (*Pituophis catenifer catenifer*), and common kingsnake (*Lampropeltis getulus*).

Agricultural fields also provide foraging habitat for a number of avian species. Common resident species likely to forage in the agricultural fields include mourning doves (*Zenaida macroura*) (observed) and American crows (*Corvus brachyrhynchos*) (observed), as well as mixed flocks of Brewer's blackbirds (*Euphagus cyanocephalus*), brown-headed cowbirds (*Molothrus ater*), and European starlings (*Sturnus vulgaris*) (observed). Summer migrants that would be common on agricultural lands include the western kingbird (*Tyrannus verticalis*), while common winter migrants include the savannah sparrow (*Passerella sandwichensis*) (observed) and American pipit (*Anthus rubescens*) (observed).

Although less common, certain birds may use agricultural fields for nesting. For example, both red-winged blackbirds (*Agelaius phoeniceus*) and tricolored blackbirds (*Agelaius tricolor*) may nest in wheat.

A few mammal species may also occur within the agricultural fields. Small mammals such as deer mice (*Peromyscus maniculatus*) and California voles (*Microtus californicus*) would occur in fluctuating numbers depending on the season and yearly agricultural practices. Botta's pocket gopher (*Thomomys bottae*) burrows were observed, and California ground squirrels (*Otospermophilus beecheyi*), while not observed, could burrow around the perimeter of active fields, or within fields during fallow periods. Audubon cottontail rabbits (Sy*lvilagus audubonii*) may also occasionally occur here. Various species of bat may also forage over the fields for flying insects.

The presence of amphibians, reptiles, birds and small mammals is likely to attract foraging raptors and mammalian predators. Raptors such as red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*), and American kestrels (*Falco sparverius*) would likely forage over agricultural fields. Mammalian predators occurring in agricultural fields would most likely be limited to raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), coyotes (*Canis*

latrans) and red foxes (*Vulpes vulpes*), as these species are relatively tolerant of human disturbance.

2.3.2 Recharge Basin

The Enterprise recharge basin occurs in the northern portion of the proposed Cordeniz Basin site. At the time of the December 2014 field survey, the basin had been disced and contained only uprooted, remnant vegetation. Vegetation identified in the disced basin consisted of curly dock (*Rumex crispus*), knotweed (*Persicaria sp.*), and common sunflower (*Helianthus annuus*).

Wildlife use of the recharge basin would vary depending on the timing and degree to which the basin is inundated or saturated. During periods of inundation, amphibians such as the Pacific chorus frog and western toad could opportunistically breed in the basins and subsequently disperse through surrounding lands. During dry periods, reptile and amphibian use of the basins would be similar to that described for agricultural fields of the site.

Birds expected to use the basin during periods of inundation may include the great blue heron (*Ardea herodias*) and great egret (*Ardea alba*), assuming amphibian and/or invertebrate prey is present. Black phoebes (*Sayornis nigricans*) may glean insects from the surface of the water, or extract mud from the banks for nest-building. When the basin is saturated but not inundated, avian use may include those species that feed on mudflats, such as the killdeer (*Charadrius vociferus*). When the basin is dry, avian use would be similar to that described for agricultural fields of the study area.

Periodic inundation likely precludes occupation of the basin floors by burrowing rodents; however, Botta's pocket gophers and California ground squirrels could burrow on the banks. Deer mice and western harvest mice (*Reithrodontomys megalotis*) could also inhabit the margins of the basin and could forage for insects, seeds, and plant parts in the basin when the basin is dry. Mammalian predator and raptor use of the basin would be similar to that described for agricultural areas of the site.

2.3.3 Ruderal

Ruderal (disturbed) areas comprised the entirety of the proposed well sites, consisting of levee roads, road shoulders, and the margins of agricultural fields and orchards. Ruderal areas of the proposed Cordeniz Basin site consisted of roads and the margins of agricultural fields and the existing recharge basin. In general, ruderal areas were barren or sparsely vegetated with common agricultural weeds, which included puncture vine (*Tribulus terrestris*), common tarweed (*Centromadia pungens*) pigweed amaranth (*Amaranthus albus*), common sunflower, and Canada horseweed, among others. However, at several of the proposed well sites, the ruderal margins of off-site agricultural fields experienced intermittent saturation from agricultural runoff, and contained dense growth of bearded sprangletop (*Leptochloa fusca* ssp. *uninervia*), purple flat sedge (*Cyperus rotundus*), dwarf nettle (*Urtica urens*), and mallow.

Although the wildlife habitat value of ruderal lands is relatively low, these lands certainly support some wildlife species. The reptile and amphibian species listed for agricultural fields could potentially use ruderal habitats, as well. Mourning doves (observed) and northern mockingbirds (*Mimus polyglottos*) could be expected to occur on these ruderal lands, as could the disturbance-tolerant killdeer (observed), which often nests on gravel or bare ground.

Small mammals that would be expected to occur on ruderal lands of the site include California ground squirrels, Botta's pocket gophers, deer mice, California voles, and house mice (*Mus musculus*). Several California ground squirrels were observed on the levee road at the Well No. 5 site, and gopher burrows were commonly observed in the ruderal margins of agricultural fields. Mammalian predators with the potential to occur on ruderal lands of the study area include disturbance-tolerant species such as the raccoon, red fox, and coyote.

2.3.4 Residential

Residential areas comprised a small portion of the proposed Cordeniz Basin site. A portion of two residences are within project disturbance areas; however, all dwelling structures are outside the project disturbance areas. Residential areas within the project site included turf, ornamental and native shade trees, and an animal paddock. Ornamental trees consisted of chinaberry (*Melia*

azedarach), mulberry (*Morus alba*), and common fig (*Ficus carica*). Several native valley oak trees (*Quercus lobata*) were found in the residential area.

A number of wildlife species adapted to human disturbance could be expected to occur in the residential land of the site. For example, amphibians such as Pacific chorus frogs and western toads might disperse through residential land during the winter and spring, and reptiles such as the western fence lizard (*Sceloporus occidentalis*) and common garter snake (*Thamnophis sirtalis*) could forage in this land use type. Buildings and other human-made structures located within the residential land of the site provide potential nesting habitat for a number of avian species such as the house finch (*Haemorhous mexicanus*), house sparrow (*Passer domesticus*), and Eurasian collared dove (*Streptopelia decaocto*), all of which were observed in the field surveys. Trees and shrubs associated with the two residences could be used for nesting by a variety of avian species, including the Bullock's oriole (*Icterus bullockii*), northern mockingbird, and Anna's hummingbird (*Calypte anna*). Mammal species attracted to this land use type may include the house mouse, Norway rat (*Rattus norvegicus*), and Virginia opossum (*Didelphis virginiana*).

Birds of prey such as the red-tailed hawk and American kestrel may occasionally forage over the residential area.

2.3.5 Irrigation Ditch

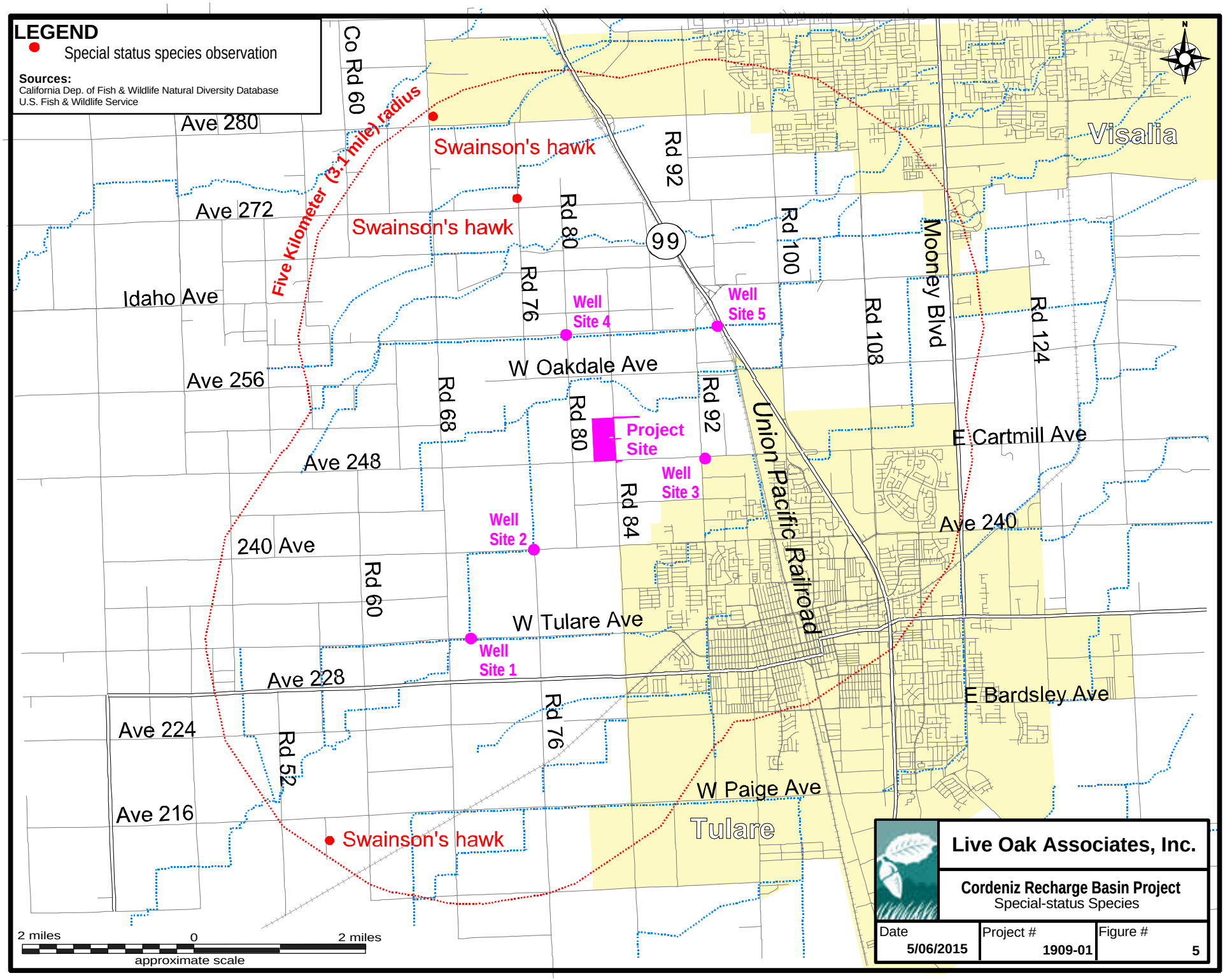
An earthen irrigation ditch known as the Serpa Ditch runs through the proposed recharge basin site. The ditch was mostly dry during the December field survey. The density of vegetation varied from abundant to sparse. Vegetation observed within the ditch included bearded sprangletop, flaxed-leaved horseweed (*Erigeron bonariensis*), and Canada horseweed.

Many native wildlife species utilizing other habitats of the site could make use of the ditch. Amphibians such as the Pacific chorus frog and the western toad could utilize areas of the ditch for breeding. Ground foraging birds could use the dich for cover and forage. Small mammal burrows, primarily Botta's pocket gopher, were abundant on the ditch banks.

2.4 SPECIAL STATUS PLANTS AND ANIMALS

Several species of plants and animals within the state of California have low populations and/or limited distributions. Such species may be considered "rare" and are vulnerable to extirpation as the state's human population grows and the habitats these species occupy are converted to agricultural and urban uses. As described more fully in Section 3.2, state and federal laws have provided the California Department of Fish and Wildlife (CDFW) and the U.S. Fish and Wildlife Service (USFWS) with a mechanism for conserving and protecting the diversity of plant and animal species native to the state. A sizable number of native plants and animals have been formally designated as "threatened" or "endangered" under state and federal endangered species legislation. Others have been designated as candidates for such listing. Still others have been designated as "species of special concern" by the CDFW. The California Native Plant Society (CNPS) has developed its own set of lists of native plants considered rare, threatened, or endangered (CNPS 2015). Collectively, these plants and animals are referred to as "special status species."

The *California Natural Diversity Data Base* (CDFW 2015) was queried for special status species occurrences in the sixteen USGS 7.5-minute quadrangle containing and surrounding the project site (*Paige*, *Goshen*, *Visalia*, *Tulare*, *Burris Park*, *Traver*, *Monson*, *Ivanhoe*, *Exeter*, *Cairns Corner*, *Woodville*, *Tipton*, *Taylor Weir*, *Corcoran*, *Waukena*, and *Remnoy*). The U.S. Fish and Wildlife Service's Information for Planning and Conservation (IPac) system was queried for federally listed species with the potential to be affected by the project, based on a general polygon encompassing all project components (USFWS 2015). These species, and their potential to occur on the project site, are listed in Table 1 on the following pages. Sources of information for this table included *California's Wildlife, Volumes I, II, and III* (Zeiner et. al 1988-1990), *Special Animals* (CDFW 2014a), *Special Vascular Plants, Bryophytes, and Lichens* (CDFW 2014b), and *The California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2015). Special status species occurrences within 3.1 miles (5 kilometers) of the project site are depicted in Figure 5 and San Joaquin kit fox (*Vulpes macrotis mutica*) occurrences within 10 miles of the project site are depicted in Figure 6.


LEGEND
Special status species observation
Sources:
California Dep. of Fish & Wildlife Natural Diversity Database
U.S. Fish & Wildlife Service
Five Kilometer (3.1 mile) radius
Swainson's hawk
Swainson's hawk
Swainson's hawk
Well Site 1
Well Site 2
Well Site 3
Well Site 4
Well Site 5
Project Site
Visalia
Tulare
Ave 280
Ave 272
Idaho Ave
Ave 256
Ave 248
240 Ave
Ave 228
Ave 224
Ave 216
W Oakdale Ave
W Tulare Ave
W Paige Ave
E Cartmill Ave
Ave 240
E Bardsley Ave
Co Rd 60
Rd 92
Rd 80
Rd 76
Rd 100
Rd 108
Mooney Blvd
Rd 124
Rd 68
Rd 84
Rd 60
Rd 52
99
Union Pacific Railroad
2 miles
0
2 miles
approximate scale
Live Oak Associates, Inc.
Cordeniz Recharge Basin Project
Special-status Species
Date 5/06/2015
Project # 1909-01
Figure # 5

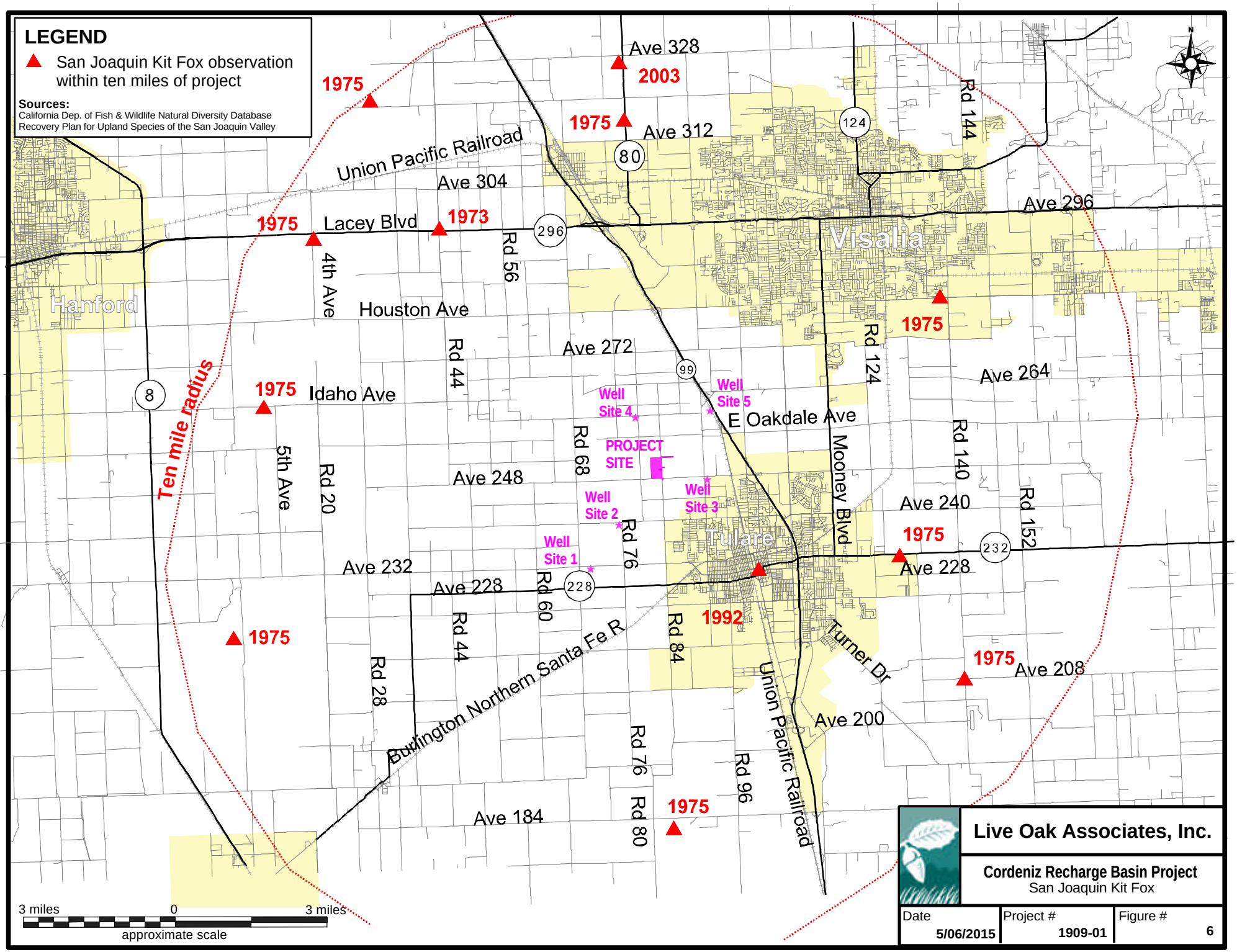

LEGEND
San Joaquin Kit Fox observation within ten miles of project
Sources:
California Dep. of Fish & Wildlife Natural Diversity Database
Recovery Plan for Upland Species of the San Joaquin Valley
1975
1975
2003
1975
1975
1973
1975
1975
1992
1975
1975
Ave 328
Ave 312
Ave 304
Ave 296
Ave 272
Ave 264
Ave 248
Ave 240
Ave 232
Ave 228
Ave 208
Ave 200
Ave 184
Union Pacific Railroad
Lacey Blvd
Houston Ave
Idaho Ave
E Oakdale Ave
Ten mile radius
Hanford
Visalia
Tulare
Burlington Northern Santa Fe R
Union Pacific Railroad
Turner Dr
Mooney Blvd
4th Ave
5th Ave
Rd 20
Rd 28
Rd 44
Rd 44
Rd 56
Rd 60
Rd 68
Rd 76
Rd 76
Rd 80
Rd 84
Rd 96
Rd 124
Rd 140
Rd 144
Rd 152
Well Site 1
Well Site 2
Well Site 3
Well Site 4
Well Site 5
PROJECT SITE
8
80
99
124
296
228
232
3 miles
0
3 miles
approximate scale
Live Oak Associates, Inc.
Cordeniz Recharge Basin Project
San Joaquin Kit Fox
Date
5/06/2015
Project #
1909-01
Figure #
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TABLE 1. LIST OF SPECIAL STATUS SPECIES THAT COULD OCCUR IN THE PROJECT VICINITY

PLANTS (adapted from CDFW 2015 and CNPS 2015)

Species Listed as Threatened or Endangered under the State and/or Federal Endangered Species Act

Species	Status	Habitat	*Occurrence on the Project site
California Jewel-flower (*Caulanthus californicus*)	FE, CE, CNPS 1B.1	Chenopod scrub, pinyon and juniper woodland, and sandy valley and foothill grassland at elevations up to 3000 ft. Blooms February-May.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.
Hoover's Spurge (*Euphorbia hooveri*)	FT, CNPS 1B.2	Occurs in vernal pools of California's Central Valley; blooms July-September; elevation 80-820 ft.	**Absent.** Vernal pools are absent from the project site and adjacent lands.
San Joaquin Valley Orcutt Grass (*Orcuttia inaequalis*)	FT, CE, CNPS 1B.1	Occurs in vernal pools of the Central Valley; blooms April-September; elevation 100-2480 ft.	**Absent.** Vernal pools are absent from the project site and adjacent lands.
San Joaquin Adobe Sunburst (*Pseudobahia peirsonii*)	FT, CE, CNPS 1B.1	Occurs in grasslands of the western foothills of the Sierra Nevada in heavy clay soils of the Porterville, Cibo, Mt. Olive and Centerville series. Blooms March-April.	**Absent.** The habitat and soils occurring onsite are unsuitable for this species.

CNPS Listed Plants

Heartscale (*Atriplex cordulata var. cordulata*)	CNPS 1B.2	Occurs in cismontane woodland and valley and foothill grasslands of the San Joaquin Valley; saline or alkaline soils; blooms April-October; elevations below 1,230 ft.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.
Earlimart Orache (*Atriplex cordulata var. erecticaulis*)	CNPS 1B.2	Occurs in valley and foothill grasslands between 130 and 330 ft. in elevation; blooms August-September.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.
Brittlescale (*Atriplex depressa*)	CNPS 1B.2	Occurs in relatively barren areas with alkaline clay soils in chenopod scrub, playas, valley grasslands, and vernal pools of the Central Valley.	**Absent.** The habitat and soils occurring onsite are unsuitable for this species.
Lesser Saltscale (*Atriplex minuscula*)	CNPS 1B.1	Occurs in cismontane woodland and valley and foothill grasslands of the San Joaquin Valley; alkaline/sandy soils; blooms May-October; elevation 50-660 ft.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.
Vernal Pool Smallscale (*Atriplex persistens*)	CNPS 1B.2	Occurs in alkaline vernal pools; blooms July-October; elevations below 400 ft.	**Absent.** Vernal pools are absent from the project site and adjacent lands.
Subtle Orache (*Atriplex subtilis*)	CNPS 1B.2	Occurs in valley and foothill grasslands of the San Joaquin Valley; blooms August-October; elevation 130-330 ft.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.

TABLE 1. LIST OF SPECIAL STATUS SPECIES THAT COULD OCCUR IN THE PROJECT VICINITY

PLANTS – cont'd.

CNPS Listed Plants

Species	Status	Habitat	*Occurrence on the Project site
Recurved Larkspur (*Delphinium recurvatum*)	CNPS 1B.2	Occurs in cismontane woodland and valley and foothill grass-lands; blooms March-June; alkaline soils; elevations below 2,500 ft.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.
Spiny-sepaled Button-celery (*Eryngium spinosepalum*)	CNPS 1B.2	Occurs in vernal pools and valley and foothill grasslands of the San Joaquin Valley and the Tulare Basin; blooms April-May; elevation 330-840 ft.	**Absent.** Suitable habitat for this species is absent from the project site. Any suitable habitat that may have once been present has been highly modified by years of agricultural and water conveyance practices on the site.

ANIMALS (adapted from CDFW 2015 and USFWS 2015)

Species Listed as Threatened or Endangered under the State and/or Federal Endangered Species Act

Conservancy Fairy Shrimp (*Branchinecta conservatio*)	FE	Occurs in vernal pools of California's Central Valley.	**Absent.** Vernal pools required by this species are absent from the project site. Furthermore, this species has never been documented in Tulare County.
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	FT	Occurs in vernal pools of California.	**Absent.** Vernal pool habitat required by this species is absent from the project site and adjacent lands.
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	FE	Primarily found in vernal pools of California's Central Valley.	**Absent**. Vernal pool habitat required by this species is absent from the project site and adjacent lands.
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	FT	Lives in mature elderberry shrubs of California's Central Valley and Sierra foothills.	**Absent.** The newly revised range of this species by the USFWS does not include Tulare County.
Delta Smelt (*Hypomesus transpacificus*)	FT	This slender-bodied fish is endemic to the San Francisco Bay and Sacramento-San Joaquin Delta upstream through Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties.	**Absent.** The project site is situated well outside of the known distribution of this species.
Little Kern Golden Trout (*Oncorhynchus aguabonita whitei*)	FT	Native to high elevation streams and lakes in the Little Kern River in the southern Sierra Nevada.	**Absent.** The project site is situated well outside of the known distribution of this species.
California Tiger Salamander (*Ambystoma californiense*)	FT , CSC	Found primarily in annual grasslands. Breeds in vernal/ seasonal pools or perennial pools which lack fish or bullfrogs. Requires rodent burrows for refuge.	**Absent.** Historic and current use of the project site has rendered it unsuitable for this species. Breeding pools required by this species are absent from the project site and surrounding lands. Furthermore, the project site is well south of this species' known range within the San Joaquin Valley.
California Red-Legged Frog (*Rana aurora draytonii*)	FT	Perennial rivers, creeks and stock ponds of the Coast Range and northern Sierra foothills with overhanging vegetation.	**Absent.** The project site does not provide suitable habitat for this species and is outside of its current known range.

TABLE 1. LIST OF SPECIAL STATUS SPECIES THAT COULD OCCUR IN THE PROJECT VICINITY

ANIMALS – cont'd

Species Listed as Threatened or Endangered under the State and/or Federal Endangered Species Act

Species	Status	Habitat	*Occurrence on the Project site
Blunt-nosed Leopard Llizard (*Gambelia silus*)	FE, CE, CFP	Frequents grasslands, alkali meadows and chenopod scrub of the San Joaquin Valley from Merced south to Kern County.	**Absent.** Habitats required by this species have been highly disturbed or eliminated as a result of agricultural activities.
Giant Garter Snake (*Thamnophis gigas*)	FT	Occurs in marshes, sloughs, drainage canals, irrigation ditches, rice fields, and adjacent uplands. Occasionally found in slow-moving creeks. Prefers locations with emergent vegetation for cover and open areas for basking.	**Absent.** The project site does not provide suitable habitat for this species and is outside of this species' current known range.
Swainson's Hawk (*Buteo swainsoni*)	CT	Breeds in stands with few trees in juniper-sage flats, riparian areas, and in oak savannah. Requires adjacent suitable foraging areas such as grasslands or alfalfa fields supporting rodent populations.	**Possible.** The CNDDB lists three recorded observations of nesting Swainson's hawks within 3 miles of the project site. The 60 acres of onsite wheat fields and the existing 20-acre Enterprise Basin provide suitable foraging habitat for this species. The onsite trees provide atypical nesting habitat due to the proximity of the trees to active residences. Suitable foraging and nesting habitat for this species is absent from the five proposed well sites.
Tricolored Blackbird (*Agelaius tricolor*)	CE, CSC	Breeds near fresh water, primarily emergent wetlands, with tall thickets. Forages in grassland and cropland habitats.	**Possible.** Potential foraging habitat for this species occurs on the Cordeniz Basin site. Marginal breeding habitat occurs in the form of onsite wheat fields.
Fresno Kangaroo Rat (*Dipodomys nitratoides exilis*)	FE, CE	Inhabits grassland on gentle slopes generally less than 10°, with friable, sandy-loam soils.	**Absent.** Habitats required by this species are absent from the project site and surrounding agricultural lands due to intensive agricultural use.
Tipton Kangaroo Rat (*Dipodomys nitratoides nitratoides*)	FE, CE	Inhabits grassland on gentle slopes generally less than 10°, with friable, sandy-loam soils.	**Absent.** Habitats required by this species are absent from the project site and surrounding agricultural lands due to intensive agricultural use.
San Joaquin Kit Fox (*Vulpes macrotis mutica*)	FE, CT	Frequents desert alkali scrub and annual grasslands and may forage in adjacent agricultural habitats. Utilizes enlarged (4 to 10 inches in diameter) ground squirrel burrows as denning habitat.	**Unlikely.** No burrows of suitable size for kit fox were observed on the project site during the field surveys. The project site has been highly modified for agricultural and water conveyance uses and, as a result, provides only marginal foraging habitat for the kit fox. Therefore, kit fox are not expected to breed or regularly forage on the site, but may pass through during dispersal movements.

TABLE 1. LIST OF SPECIAL STATUS SPECIES THAT COULD OCCUR IN THE PROJECT VICINITY

ANIMALS – cont'd.

State Species of Special Concern

Species	Status	Habitat	*Occurrence on the Project site
Western Spadefoot (*Scaphiopus hammondii*)	CSC	Primarily occurs in grasslands, but also occurs in valley and foothill hardwood woodlands. Requires vernal pools or other temporary wetlands for breeding.	**Absent.** No vernal pool habitat required by this species occurs on the project site or surrounding lands.
Western Pond Turtle (*Actinemys marmorata*)	CSC	Intermittent and permanent waterways including streams, marshes, rivers, ponds and lakes possessing basking habitat.	**Unlikely.** The recharge basin and irrigation canal of the Cordeniz Basin provide extremely marginal habitat for this species, due to irregular inundation of these features. Suitable habitat is absent from the five well sites.
Northern Harrier (Nesting) (*Circus cyaneus*)	CSC	Frequents meadows, grasslands, open rangelands, freshwater emergent wetlands; uncommon in wooded habitats.	**Absent (nesting).** While northern harriers may occasionally forage over the Cordeniz Basin site, suitable nesting habitat is absent.
White-tailed Kite (*Elanus leucurus*)	CFP	Open grasslands and agricultural areas throughout central California.	**Possible.** Suitable foraging habitat and atypical breeding habitat occurs on the Cordeniz Basin site. Suitable habitat is absent from the five well sites.
Mountain Plover (*Charadrius montanus*)	CSC	Forages in short grasslands and freshly plowed fields of the Central Valley.	**Possible.** The Cordeniz Basin site provides suitable winter foraging habitat for this species. This species breeds outside of California.
Burrowing Owl (*Athene cunicularia*)	CSC	Frequents open, dry annual or perennial grasslands, deserts, and scrublands characterized by low growing vegetation. Dependent upon burrowing mammals, most notably the California ground squirrel, for nest burrows.	**Unlikely.** The intensively managed habitats of the Cordeniz Basin site and five well sites are marginal to unsuitable for the burrowing owl. Suitable burrows were absent from all but the Well No. 5 site, where several California ground squirrel burrows occurred in the levee road. Burrowing owls would not be expected to nest or roost in burrows on this or other actively-traveled roads. Burrowing owls are relatively uncommon in the project vicinity; the CNDDB lists only one occurrence within a 10 mile radius, located approximately 7 miles southwest of the Well No. 1 site.
Loggerhead Shrike (*Lanius ludovicianus*)	CSC	Frequents open habitats with sparse shrubs and trees, bare ground, and low herbaceous cover. Can often be found in cropland.	**Possible.** Suitable foraging and nesting habitat occurs on the Cordeniz Basin site.
Pallid Bat (*Antrozous pallidus*)	CSC	Found in grasslands, chaparral, and woodlands, where it feeds on ground- and vegetation-dwelling arthropods. Prefers to roost in rock crevices, but may also use tree cavities, caves, bridges, and buildings.	**Possible.** The project site provides no roosting habitat for this species, but bats could forage in the agricultural fields of the Cordeniz Basin site.

TABLE 1. LIST OF SPECIAL STATUS SPECIES THAT COULD OCCUR IN THE PROJECT VICINITY

ANIMALS – cont'd.

State Species of Special Concern

Species	Status	Habitat	*Occurrence on the Project site
Western Mastiff Bat (*Eumops perotis* ssp. *californicus*)	CSC	Frequents open, semi-arid to arid habitats, including conifer, and deciduous woodlands, coastal scrub, grasslands, palm oasis, chaparral and urban. Roosts in cliff faces, high buildings, trees and tunnels.	**Possible.** The project site provides no roosting habitat for this species, but bats could forage over any of the six disjunct locations of the site.
American Badger (*Taxidea taxus*)	CSC	Found in drier open stages of most shrub, forest and herbaceous habitats with friable soils.	**Unlikely.** No burrows of the size and shape suitable for the badger were observed on the project site. The regular agricultural and water conveyance practices occurring on the project site create unsuitable conditions for the badger.

***Explanation of Occurrence Designations and Status Codes**
Present: Species observed on the sites at time of field surveys or during recent past.
Likely: Species not observed on the site, but it may reasonably be expected to occur there on a regular basis.
Possible: Species not observed on the sites, but it could occur there from time to time.
Unlikely: Species not observed on the sites, and would not be expected to occur there except, perhaps, as a transient.
Absent: Species not observed on the sites, and precluded from occurring there because habitat requirements not met.

TABLE 2 STATUS CODES

FE	Federally Endangered	CE	California Endangered
FT	Federally Threatened	CT	California Threatened
FPE	Federally Endangered (Proposed)	CR	California Rare
FC	Federal Candidate	CFP	California Fully Protected
		CSC	California Species of Special Concern

CNPS	California Native Plant Society Listing		
1A	Plants Presumed Extinct in California	3	Plants about which we need more information – a review list
1B	Plants Rare, Threatened, or Endangered in California and elsewhere	4	Plants of limited distribution – a watch list
2	Plants Rare, Threatened, or Endangered in California, but more common elsewhere		

2.5 ENDANGERED, THREATENED, OR SPECIAL STATUS PLANT AND ANIMAL SPECIES MERITING FURTHER DISCUSSION

2.5.1 Swainson's Hawk (*Buteo swainsoni*). Federal Listing Status: None; State Listing Status: Threatened.

The Swainson's hawk is designated as a California Threatened species. The loss of foraging habitat and nesting trees resulting from agricultural and urban development have contributed to the decline of the Central Valley population of Swainson's hawks. However, in recent years the population has been increasing.

Swainson's hawks are large, broad-winged, broad-tailed hawks and have a high degree of mate and territorial fidelity. They arrive at their nesting sites in March or April. In the Central Valley, Swainson's hawks typically nest in large trees in or peripherally to riparian systems adjacent to suitable foraging habitats. The young hatch sometime between March and July and do not leave the nest until some 4 to 6 weeks later. Other suitable nest sites include lone trees, groves of trees such as oaks, other trees in agricultural fields, and mature roadside trees. Central Valley Swainson's hawks forage in large, open fields with abundant prey, including grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands. Their primary food source during the breeding season is voles; however they also prey on other small mammals, birds, and insects during this time.

Potential to occur onsite. Swainson's hawks are known to nest and forage in areas surrounding the project site. The CNDDB lists three nesting occurrences of this species within three miles of the six disjunct locations of the project site (CDFW 2015). The medium-sized trees within the residential area of the Cordeniz Basin site provide atypical nesting habitat, not generally utilized by Swainson's hawks due to the proximity of regular human activity. However, the 60 acres of wheat fields and 20-acre recharge basin on the Cordeniz Basin site provide suitable foraging habitat. LOA investigators drove public roads within a three-mile radius of the Cordeniz Basin site to note the regional abundance of Swainson's hawk foraging habitat. This survey found that suitable Swainson's hawk foraging habitat was plentiful on surrounding lands in the form of alfalfa fields, winter grain, and fallow fields. The ruderal habitats of the five proposed well sites

are not expected to be used by this species owing to regular human disturbance and an insufficient prey base, but hawks may pass over these sites from time to time while foraging on adjacent agricultural lands.

2.5.3 San Joaquin Kit Fox (*Vulpes macrotus mutica*). Federal Listing Status: Endangered; State Listing Status: Threatened.

By the time the U.S. Fish and Wildlife Service listed it as an endangered species under the authority of the Federal Endangered Species Act on 11 March 1967, the San Joaquin kit fox had been extirpated from much of its historic range. In 1998, the USFWS adopted a final recovery plan for the San Joaquin kit fox. On 27 June 1971, the State of California listed the kit fox as a threatened species.

The San Joaquin kit fox, the smallest North American member of the dog family (Canidae), historically occupied the dry plains of the San Joaquin Valley, from San Joaquin County to southern Kern County (Grinnell et al. 1937). Local surveys, research projects, and incidental sightings indicate that kit fox currently occupy available habitat on the San Joaquin Valley floor and in the surrounding foothills.

Kit fox prefer habitats of open or low vegetation with loose soils. In the southern and central portion of the Central Valley, kit fox are found in valley sink scrub, valley saltbrush scrub, upper Sonoran subshrub scrub, and annual grassland (USFWS 1998). Kit fox may also be found in grazed grasslands, urban settings, and in areas adjacent to tilled or fallow fields (USFWS 1998). They requires underground dens to raise pups, regulate body temperature, and avoid predators and other adverse environmental conditions (Golightly and Ohmart 1984). In the central portion of their range, they usually occupy burrows (6-10" in diameter, approximately 2 feet long) excavated by small mammals, such as California ground squirrels.

Potential to occur onsite. The six disjunct locations of the project site consist of lands managed for decades for agricultural and water conveyance purposes. All six locations are surrounded by intensively managed lands, including agricultural fields, orchards, industrial/residential uses, and a livestock facility. Such uses are not generally compatible with the life history and habitat requirements of the San Joaquin kit fox. At the time of the field surveys, burrows of suitable

dimensions for the San Joaquin kit fox were absent from the project site, and it appeared that regular discing of the on-site fields and recharge basin and ongoing maintenance of roads and other ruderal areas of the project site was limiting burrowing mammal activity. These practices, combined with high levels of ambient disturbance, make it unlikely that kit fox would den on-site. Moreover, the highly-modified habitats of the project site appear to support a limited prey base that would make them marginal, at best, as kit fox foraging habitat.

Of primary interest for this assessment are kit fox occurrence records and survey results from the project vicinity. The CNDDB lists 12 historical sightings within 10 miles of the six disjunct locations of the project site (Figure 4) (CDFW 2015). Nine of these sightings occurred in 1975, one in 1973, one in 1992 within the City of Tulare, and one in 2003. Surveys using dogs trained to detect kit fox scat found no scat evidence of kit fox in Tulare County (Smith, et al. 2006). According to these surveys, the nearest kit fox populations occur in western Kern County.

In summary, although kit fox have historically been present in the project vicinity, the marginal habitats of the project site and surrounding lands are marginal, at best, for the San Joaquin kit fox. Considering the highly disturbed condition of the project site, its isolation from extant kit fox populations, its marginal to poor suitability as foraging habitat, and the absence of suitable denning habitat, the kit fox is not considered resident on the project site. However, the project site may occasionally be used for dispersal of individual kit fox from known populations.

2.6 JURISDICTIONAL WATERS

Jurisdictional waters include rivers, creeks, and drainages that have a defined bed and bank and which, at the very least, carry ephemeral flows. Jurisdictional waters also include lakes, ponds, reservoirs, wetlands, and in some cases irrigation canals. Such waters may be subject to the regulatory authority of the U.S. Army Corps of Engineers (USACE), the CDFW, and the California Regional Water Quality Control Board (RWQCB). See Section 3.2.4 of this report for additional information.

The nearest known Water of the U.S. is Packwood Creek north of the project site. The Serpa Ditch running through the Cordeniz Basin site is a small irrigation canal that receives water from the Rockyford Ditch. The Serpa Ditch feeds the onsite Enterprise recharge basin and local

agricultural fields. It has no downstream connection with any natural drainage features. Therefore, the onsite ditch and recharge basin do not meet the USACE definition of a Water of the U.S. The CDFW typically only asserts jurisdiction over ponds, lakes, and natural drainages or manmade features that replace natural drainages. Therefore, the onsite basin and ditch appear to not meet CDFW jurisdictional requirements. In conclusion, alteration of the Serpa Ditch and Enterprise Recharge Basin are unlikely to be regulated by the USACE or CDFW. However, the RWQCB generally requires notification prior to any alteration of surface waters.

2.7 DESIGNATED CRITICAL HABITAT

As will be discussed further in Section 3.2.3, the USFWS often designates areas of "critical habitat" when it lists species as threatened or endangered. Critical habitat is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Designated critical habitat is absent from the project site and surrounding lands.

2.8 NATURAL COMMUNITIES OF SPECIAL CONCERN

Natural communities of special concern are those that are of limited distribution, distinguished by significant biological diversity, home to special status species, etc. CDFW is responsible for the classification and mapping of all natural communities in California. Natural communities are assigned state and global ranks according to their degree of imperilment. Any natural community with a state rank of 3 or lower (on a 1-5 scale) is considered of special concern. Examples of natural communities of special concern in the vicinity of the project site include vernal pools and various types of riparian forest.

All of the vegetation associations present on the project site are human-altered and dominated by non-native species, and therefore would not be considered natural communities of special concern.

2.9 WILDLIFE MOVEMENT CORRIDORS

Wildlife movement corridors are routes that animals regularly and predictably follow during seasonal migration, dispersal from native ranges, daily travel within home ranges, and inter-population movements. Movement corridors in California are typically associated with valleys, ridgelines, and rivers and creeks supporting riparian vegetation. The small size and the lack of vegetation along the small Serpa Ditch would not be conducive to significant terrestrial wildlife movements, and the ditch would therefore not be considered a movement corridor. The Pacific flyway, one of four major bird migration routes in North America, passes over the project site and much of the rest of California.

3.0 IMPACTS AND MITIGATIONS

3.1 SIGNIFICANCE CRITERIA

NEPA

Federal projects are subject to the provisions of NEPA. The purpose of NEPA is to assess the effects of a proposed action on the human environment, assess the significance of those effects, and recommend measures that if implemented would mitigate those effects. As used in NEPA, a determination that certain effects on the human environment are "significant" requires considerations of both context and intensity (see 40 CFR 1508.27).

Context means that significance must be analyzed in terms of the affected environment in which a proposed action would occur ("action area"). For the purposes of assessing effects of an action on biological resources, the relevant context is often local. The analysis requires a comparison of the action area's biological resources to the biological resources of the local area within which the action area is located. The analysis may, however, require a comparison of the action area's biological resources with the biological resources of an entire region.

Intensity refers to the severity of impact. In considering the intensity of impact to biological resources, it is necessary to address the unique qualities of wetlands and ecologically critical areas that may be affected by the action, the degree to which the action will be controversial, the degree to which the effects of the action will be uncertain, the degree to which the action will establish a precedent for future actions that may result in significant effects, and the potential for the action to result in cumulatively significant effects.

The effects of an action on some biological resources are generally considered to be "significant." Actions that adversely affect federally listed threatened and endangered species and Waters of the U.S. are two examples. Other examples include actions that impede the migratory movements of fish and wildlife, and actions that substantially reduce the areal extent of fish and wildlife habitat, especially if habitat loss occurs in areas identified by state and federal governments as ecologically sensitive or of great scenic value.

NEPA requires mitigation for the effects of an action on the environment. Suitable measures include the following:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the project.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

This report identifies likely project impacts, identifies those that may be considered "significant" per the provisions of NEPA, and recommends mitigation measures that would avoid significant impact to biological resources.

CEQA

Approval of general plans, area plans, and specific projects is subject to the provisions of CEQA. The purpose of CEQA is to assess the impacts of proposed projects on the environment before they are carried out. CEQA is concerned with the significance of a proposed project's impacts. For example, a proposed development project may require the removal of some or all of a site's existing vegetation. Animals associated with this vegetation could be destroyed or displaced. Animals adapted to humans, roads, buildings, pets, etc., may replace those species formerly occurring on the site. Plants and animals that are state and/or federally listed as threatened or endangered may be destroyed or displaced. Sensitive habitats such as wetlands and riparian woodlands may be altered or destroyed.

Whenever possible, public agencies are required to avoid or minimize environmental impacts by implementing practical alternatives or mitigation measures. According to Section 15382 of the CEQA Guidelines, a significant effect on the environment means a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the

project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic interest."

Specific project impacts to biological resources may be considered "significant" if they would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service.

- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service.

- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.

- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.

- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

Furthermore, CEQA Guidelines Section 15065(a) states that a project may trigger the requirement to make "mandatory findings of significance" if the project has the potential to:

> "Substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare or threatened species, or eliminate important examples of the major periods of California history or prehistory."

3.2 RELEVANT GOALS, POLICIES, AND LAWS

3.2.1 General Plan Policies

In compliance with CEQA, the lead agency must consider conformance with applicable goals and policies of the General Plan of the County of Tulare. The Tulare County General Plan released an update in 2003 that is valid through 2030. Implementation of goals in the Tulare County General Plan is accomplished via a set of policies specific to each goal. Please refer to Appendix E for a copy of the plan.

Relevant biological resource goals of the Tulare County General Plan include:

- protecting rare and endangered species;
- limiting development in environmentally sensitive areas;
- encouraging cluster development in areas with moderate to high potential for sensitive habitat;
- encouraging the planting of native trees, shrubs, and grasslands preserve;
- requiring open space buffers between development projects and significant watercourse, riparian vegetation, wetlands, and other sensitive habitats and natural communities;
- coordinating with other government land management agencies to preserve and protect biological resources;
- supporting the establishment and administration of a mitigation banking program.

3.2.2 Threatened and Endangered Species

As discussed, state and federal "endangered species" legislation has provided CDFW and USFWS with a mechanism for conserving and protecting plant and animal species of limited distribution and/or low or declining populations. Permits may be required from the CDFW and/or USFWS if activities associated with a proposed project will result in the "take" of a species listed under the federal or state Endangered Species Acts (FESA). "Take" is defined by the state of California as "to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill" (California Fish and Game Code, Section 86). "Take" is more broadly defined by the federal Endangered Species Act to include "harm" (16 USC, Section 1532(19), 50

CFR, Section 17.3). Furthermore, the CDFW and the USFWS are responding agencies under CEQA. Both agencies review CEQA documents in order to determine the adequacy of their treatment of endangered species issues and to make project-specific recommendations for their conservation.

3.2.3 California Fully Protected Species

The classification of certain animal species as "fully protected" was the State of California's initial effort in the 1960s, prior to the passage of the California Endangered Species Act, to identify and provide additional protection to those species that were rare or faced possible extinction. Following CESA enactment in 1970, many fully protected species were also listed as California threatened or endangered. The list of fully protected species are identified, and their protections stipulated, in California Fish and Game Code Sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and fish (5515). Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take, except in conjunction with necessary scientific research and protection of livestock.

3.2.4 Designated Critical Habitat

The USFWS often designates areas of "critical habitat" when it lists species as threatened or endangered. Critical habitat is defined by section 3(5)(A) of the federal Endangered Species Act as "(i) The specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." The Act goes on to define "conservation" as "the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which listing under the Act is no longer necessary."

The designation of a specific area as critical habitat does not directly affect its ownership. Federal actions that result in destruction or adverse modification of critical habitat are, however, prohibited in the absence of prior consultation with the USFWS according to provisions of the

act. Furthermore, recent appellate court cases require that federal actions affecting critical habitat promote the recovery of the listed species protected by the critical habitat designation.

The USFWS designates critical habitat for a species by identifying general areas likely to contain the species' "primary constituent elements," or physical or biological features of the landscape that the species needs to survive and reproduce. Although a unit of critical habitat for a particular species may be quite large, only those lands within the unit that contain the species' primary constituent elements are actually considered critical habitat by the USFWS.

3.2.5 Migratory Birds

The Federal Migratory Bird Treaty Act (FMBTA: 16 USC 703-712) prohibits killing, possessing, or trading in any bird species covered in one of four international conventions to which the United States is a party, except in accordance with regulations prescribed by the Secretary of the Interior. The name of the act is misleading, as it actually covers almost all birds native to the United States, even those that are non-migratory. The FMBTA encompasses whole birds, parts of birds, and bird nests and eggs. Additionally, California Fish and Game Code makes it unlawful to take or possess any non-game bird covered by the FMBTA (Section 3513), as well as any other native non-game bird (Section 3800).

3.2.6 Birds of Prey

Birds of prey are protected in California under provisions of the Fish and Game Code (Section 3503.5), which states that it is unlawful to take, possess, or destroy any birds in the order Falconiformes (hawks and eagles) or Strigiformes (owls), as well as their nests and eggs. The bald eagle and golden eagle are afforded additional protection under the federal Bald and Golden Eagle Protection Act (16 USC 668), which makes it unlawful to kill birds or their eggs.

3.2.7 Nesting Birds

In California, protection is afforded to the nests and eggs of all birds. California Fish and Game Code (Section 3503) states that it is "unlawful to take, possess, or needlessly destroy the nest or eggs of any bird except as otherwise provided by this code or any regulation adopted pursuant

thereto." Breeding-season disturbance that causes nest abandonment and/or loss of reproductive effort is considered a form of "take" by the CDFW.

3.2.8 Wetlands and Other Jurisdictional Waters

Natural drainage channels and adjacent wetlands may be considered "Waters of the United States" (hereafter referred to as "jurisdictional waters") subject to the jurisdiction of the USACE. The extent of jurisdiction has been defined in the Code of Federal Regulations but has also been subject to interpretation of the federal courts. Jurisdictional waters generally include:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide.
- All interstate waters including interstate wetlands.
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce.
- All impoundments of waters otherwise defined as waters of the United States under the definition.
- Tributaries of waters identified in the bulleted items above.

As determined by the United States Supreme Court in its 2001 *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* (SWANCC) decision, channels and wetlands isolated from other jurisdictional waters cannot be considered jurisdictional on the basis of their use, hypothetical or observed, by migratory birds. Similarly, in its 2006 consolidated *Carabell/Rapanos* decision, the U.S. Supreme Court ruled that a significant nexus between a wetland and other navigable waters must exist for the wetland itself to be considered a navigable and therefore jurisdictional water.

The USACE regulates the filling or grading of jurisdictional waters under the authority of Section 404 of the Clean Water Act. The extent of jurisdiction within drainage channels is defined by "ordinary high water marks" on opposing channel banks. All activities that involve the discharge of fill into jurisdictional waters are subject to the permit requirements of the

USACE. Such permits are typically issued on the condition that the applicant agrees to provide mitigation that result in no net loss of wetland functions or values. No permit can be issued until the RWQCB issues a certification (or waiver of such certification) that the proposed activity will meet state water quality standards.

The filling of isolated wetlands, over which the USACE has disclaimed jurisdiction, is regulated by the RWQCB. It is unlawful to fill isolated wetlands without filing a Notice of Intent with the RWQCB. The RWQCB is also responsible for enforcing National Pollution Discharge Elimination System (NPDES) permits, including the General Construction Activity Storm Water Permit. All projects requiring federal money must also comply with Executive Order 11990 (Protection of Wetlands).

CDFW has jurisdiction over the bed and bank of natural drainages and lakes according to provisions of Section 1601 and 1602 of the California Fish and Game Code (2003). Activities that would disturb these waters are regulated by the CDFW via a Streambed Alteration Agreement. Such an agreement typically stipulates that certain measures will be implemented which protect the habitat values of the drainage in question.

3.3 POTENTIALLY SIGNIFICANT PROJECT IMPACTS/EFFECTS AND ASSOCIATED MITIGATION

The project considered in this evaluation of impacts to biological resources is the expansion of the existing 20-acre Enterprise Basin into an 80-acre, two-cell groundwater recharge facility, the realignment of a segment of the Serpa Ditch, and the construction of five deep monitoring wells on lands surrounding the proposed groundwater recharge facility. Potentially significant project impacts/effects to biological resources and associated mitigations to reduce the magnitudes of these impacts/effects are discussed below.

3.3.1 Project Impacts to Swainson's Hawks

Effect/Impact. Swainson's hawks are known to forage and nest within the vicinity of the project site. The nearest recorded Swainson's hawk nest is located approximately 2 miles north of the Well No. 4 site. However, an investigation of the reported nest site found no stick nests in trees at that location, and no trees of the species identified in the CNDDB report as containing

the nest (cypress). Suitable foraging habitat occurs on the Cordeniz Basin site in the form of wheat fields and the existing recharge basin. Atypical nesting habitat occurs in the valley oak trees within the residential areas of the Cordeniz Basin site. Trees in such close proximity to human activity are seldom used by Swainson's hawks for nesting (M. Bradbury, pers. comm., 2012). No stick nests were observed in these trees by the LOA field investigator. Construction activities will avoid all trees on the project site with the possible exception of the removal of a diseased non-native chinaberry tree overhanging the Serpa Ditch. However, in the unlikely event that a Swainson's hawk happens to nest in the onsite trees prior to construction, construction activities near these trees could result in the abandonment of active Swainson's hawk nests or direct mortality to these birds. Project-related mortality of individual Swainson's hawks would violate the federal Migratory Bird Treaty Act, related state laws, and the California Endangered Species Act, and is considered a potentially adverse effect/significant impact of this project.

The construction of an 80-acre recharge basin would, at most, provide slightly lower quality foraging habitat for the Swainson's hawk because foraging opportunities would not be available during periods of inundation. According to the District engineer, the basins will be designed to percolate, rather than hold, water; therefore, they will be dry during most of the year. Moreover, because the source of water in the basins will be excess water during above average rainfall years, the basins can be expected to experience little to no inundation in drier years. Therefore, habitat for small mammals and invertebrates, and therefore foraging habitat for Swainson's hawks, should be available for the most part of most years. Additionally, a driving survey of surrounding lands by LOA identified thousands of acres of similar foraging habitat consisting of alfalfa, winter grain, and fallow fields. Given the regional abundance of foraging habitat, and the foraging opportunities that will remain on the site after construction, project impacts to Swainson's hawk foraging habitat are considered less than significant. Implementation of the following mitigations will ensure that the project does not adversely affect Swainson's hawks through construction-related mortality or disturbance, and that the project is in compliance with state and federal laws protecting this species.

Mitigation. Prior to the construction of the project the applicant will implement the following measure(s) as necessary.

> ***Mitigation 3.3.1a* (*Avoidance*).** In order to avoid impacts to Swainson's hawks from project construction, construction at each of the six disjunct locations of the project site will commence outside of the nesting season, between September 16 and the last day of February.
>
> ***Mitigation 3.3.1b* (*Pre-construction Surveys*).** If construction at one or more of the six disjunct locations of the project site must commence between March 1 and September 15, a qualified biologist will conduct pre-construction surveys for nesting Swainson's hawks within 30 days of the onset of activities at each of those locations. The surveys will focus on mature trees on and within ½ mile of the applicable project locations. If construction at a particular location does not commence within 30 days of the pre-construction surveys, a repeat survey for that location must be conducted prior to the start of any work during the nesting season. Pre-construction surveys for nesting Swainson's hawks are also required for any project location at which there is a lapse of construction of more than 30 days, and construction is to resume during the nesting season.
>
> ***Mitigation 3.3.1c* (*Establish Buffers*).** Should any active nests be discovered in or near proposed construction zones, the biologist will consult with the CDFW to identify a suitable construction-free buffer around the nest. This buffer will be identified on the ground with flagging or fencing, and will be maintained until the biologist has determined that the young have fledged.

Implementation of these measures would reduce impacts to Swainson's hawks to a less then significant level.

3.3.2 Project-Related Mortality or Disturbance of Burrowing Owls

Effect/Impact. While potentially suitable burrowing owl foraging habitat is located on the project site, no ground squirrel burrows or any other burrows were found on the site or surrounding lands that would be large enough to be occupied by burrowing owls. Furthermore, no sign of this species such as whitewash, cough pellets, and feathers was observed. Although it is unlikely that burrowing owls ever use the site, a small chance remains that a burrowing owl may take up residence prior to construction. In this unlikely event, project activities could result in nest failure or mortality of individual owls. These small raptors are protected under the federal Migratory Bird Treaty Act and related state laws. Mortality of individual birds would be

a violation of state and federal law, and is considered a potentially adverse effect/significant impact of this project.

Mitigation. In order to minimize construction related impacts to burrowing owls, the applicant will implement the following measures:

> ***Mitigation Measure 3.3.2a (Take Avoidance Surveys).*** A pre-construction "take avoidance" survey will be conducted by a qualified biologist for burrowing owls no less than 14 days from the onset of construction at each of the six disjunct locations of the project site according to methods described in the *Staff Report on Burrowing Owl Mitigation* (CDFW 2012). The survey will be conducted on and within 500 feet of each of the six locations. Repeat surveys for a particular location will be required if construction at that location does not begin within 14 days of the initial surveys, or if there has been a lapse in construction of more than 14 days at that location.
>
> ***Mitigation Measure 3.3.2b (Avoidance of Active Nests).*** If project activities are undertaken during the breeding season (February 1 to August 31) and active nest burrows are located within or near construction zones, a suitable construction-free buffer will be established around all active burrowing owl nests. The buffer areas will be enclosed with temporary fencing to prevent the entry of construction equipment and workers. Buffers will remain in place for the duration of the breeding season, unless otherwise arranged with CDFW. After the breeding season (i.e. once all young have left the nest), passive relocation of any remaining owls may take place as described below.
>
> ***Mitigation Measure 3.3.2c (Passive Relocation of Resident Owls).*** In the unlikely event that burrowing owls occupy areas proposed for development, they may be relocated to alternative habitat during the non-breeding season (September 1 to January 31). The relocation of resident burrowing owls must be conducted according to a relocation plan prepared by a qualified biologist. Passive relocation will be the preferred method of relocation.

Compliance with the above mitigation measures will ensure that the project does not adversely affect burrowing owl individuals or regional populations, and that the project is in compliance with state and federal laws protecting this species.

3.3.3 Project-Related Mortality or Disturbance of White-tailed Kite, Loggerhead Shrike, Tricolored Blackbird, and Other Nesting Migratory Birds

Effect/Impact. The Cordeniz Basin site contains several small to medium sized ornamental trees that could be used for nesting by white-tailed kites, loggerhead shrikes, and other migratory birds. Onsite wheat fields provide potential nesting habitat for the tricolored blackbird, which

was recently afforded provisional protection under the California Endangered Species Act. Ground-nesting birds such as the western meadowlark (*Sturnella neglecta*) could nest in the recharge basin or field margins, and the killdeer could nest in even the most disturbed habitats of the project site. If nesting birds are present at the time of construction, construction activities would have the potential to destroy nests, eggs, and chicks. Construction activities may also disturb nesting birds such that they would abandon their nests, leading to the mortality of nestlings. Activities that result in the mortality of nesting birds would be in violation of the federal Migratory Bird Treaty Act, related state laws, and/or the California Endangered Species Act. Mortality/disturbance of nesting migratory birds is considered a potentially adverse effect/significant impact of the project.

Mitigation. In order to minimize construction disturbance to active migratory bird nests, the applicant will implement the following measures:

> ***Measure 3.3.3a (Avoidance).*** In order to avoid impacts to nesting migratory birds from construction disturbance, construction at each of the six disjunct locations of the project site will commence outside of the typical avian nesting season, or between September 1 and January 31.
>
> ***Measure 3.3.3b (Pre-construction Surveys*).** If construction at one or more of the six project locations must be initiated between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for active migratory bird nests within 14 days of the onset of construction at those locations. If construction at a particular location does not commence within 14 days of the pre-construction surveys, a repeat survey for that location must be conducted prior to the start of any work during the nesting season. Pre-construction surveys for active migratory bird nests are also required for any project location at which there is a lapse of construction of more than 14 days, and construction is to resume during the nesting season.
>
> ***Measure 3.3.3c (Establish Buffers).*** Should any active nests be discovered in or near proposed construction zones, the biologist will identify a suitable construction-free buffer around the nest. This buffer will be identified on the ground with flagging or fencing, and will be maintained until the biologist has determined that the young have fledged.

Implementation of the above measures will ensure that the project does not adversely affect white-tailed kites, loggerhead shrikes, tricolored blackbirds, and other migratory birds, and that the project is in compliance with state and federal laws protecting these species.

3.3.4 Project-Related Mortality of San Joaquin Kit Fox

Effect/Impact. As discussed in Section 2.5.3, kit fox are unlikely to occur on the project site and surrounding lands. Although unlikely, an individual kit fox may pass through and possibly forage on the site from time to time during regular dispersal movements. If kit fox were present at the time of construction, then construction related activities would have the potential to cause kit fox mortality. Construction-related injury or mortality of any kit fox would constitute a violation of the state and federal Endangered Species Acts, and is considered a potentially adverse effect/significant impact of the project.

Mitigation. Prior to or during (as appropriate) the construction of the project, the applicant will implement the following measures derived from the *U.S. Fish and Wildlife Service Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance* (USFWS 2011), provided in Appendix D.

> ***Mitigation Measure 3.3.4a (Pre-construction Surveys).*** Pre-construction surveys at each of the six disjunct locations of the project site shall be conducted no less than 14 days and no more than 30 days prior to the beginning of ground disturbance, construction activities, and/or any project activity at those locations that are likely to impact the San Joaquin kit fox. The primary objective is to identify kit fox habitat features (e.g., potential dens and refugia) on the project site and evaluate their use by kit foxes. If an active kit fox den is detected within or immediately adjacent to the area of work, the USFWS shall be contacted immediately to determine the best course of action.
>
> ***Mitigation Measure 3.3.4b (Avoidance).*** Should active kit fox dens be detected during pre-construction surveys, the Sacramento Field Office of the USFWS and the Fresno Field Office of CDFW will be notified. A disturbance-free buffer will be established around the burrows in consultation with the USFWS and CDFW, to be maintained until an agency-approved biologist has determined that the burrows have been abandoned.
>
> ***Mitigation Measure 3.3.4c (Minimization).*** The project will implement protection measures derived from the *USFWS Standardized Recommendations*. Such measures include, but are not limited to: restriction of project-related vehicle traffic to established roads, construction areas, and other designated areas; inspection and covering of structures (e.g., pipes), as well as installation of escape structures, to prevent the inadvertent entrapment of kit foxes; restriction of rodenticide and herbicide use; and proper disposal of food items and trash. See Appendix D for more details.
>
> ***Mitigation Measure 3.3.4d (Employee Education Program).*** Prior to the start of construction, the applicant will retain a qualified biologist to conduct a tailgate meeting to

train all construction staff that will be involved with the project on the San Joaquin kit fox. This training will include a description of the kit fox and its habitat needs; a report of the occurrence of kit fox in the project area; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of the measures being taken to reduce impacts to the species during project construction and implementation.

Mitigation Measure 3.3.4e (Mortality Reporting). The Sacramento Field Office of the USFWS and the Fresno Field Office of CDFW will be notified in writing within three working days in case of the accidental death or injury to a San Joaquin kit fox during project-related activities. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and any other pertinent information.

Implementation of these measures will ensure that the project does not adversely affect San Joaquin kit fox individuals and that the project is in compliance with state and federal laws protecting this species.

3.3.5 Degradation of Water Quality in Seasonal Creeks, Reservoirs and Downstream Waters

Effect/Impact. Extensive grading often leaves the soils of construction zones barren of vegetation and therefore vulnerable to erosion. Eroded soil is generally carried as sediment in surface runoff to be deposited in natural creek beds, canals, and adjacent wetlands. The project includes work within the Serpa Ditch, and the proposed well sites are located immediately adjacent to a number of Tulare Irrigation District canals and channelized creeks, including Rockyford Ditch, Sand Ditch, Little Tulare Canal, and Cameron Creek. These waterways have the potential to be adversely affected by project-generated runoff of sediment or pollutants.

Mitigation. Prior to the start of construction, the Applicant will implement the following mitigation measure.

Mitigation Measure 3.3.5 (SWPPP). The Applicant will develop and implement a Storm Water Pollution Prevention Plan (SWPPP) per the State Water Quality Control Board Stormwater Permit.

Implementation of this measure will ensure that the project does not adversely affect water quality in canals, ditches, and channelized creeks on or adjacent to the project site.

3.4 NO EFFECT, NOT LIKELY TO ADVERSELY AFFECT / LESS THAN SIGNIFICANT PROJECT IMPACTS

3.4.1 Impacts to Special Status Plant Species

Effect/Impact. Twelve (12) special status plant species for which occurrence records exist in the project vicinity would not occur on the project site due to lack of suitable habitat (see Table 1). The project site is located on lands that have been farmed or used in groundwater recharge or water conveyance for decades. Historic and current land use practices have rendered onsite lands and surrounding lands unsuitable for these special status plant species. Therefore, the proposed project will have no effect on these species.

Mitigation. Site development will result in no effect on special status plant species. Mitigation is not warranted.

3.4.2 Loss of Habitat for Special Status Animal Species

Effect/Impact. Twenty-five (25) special status animal species occur regionally (see Table 1). Potential impacts to these species from project-related loss of habitat are discussed below:

<u>Species Absent From the Site, or Unlikely to Occur on the Project Site.</u>

Eighteen (18) special status animal species occurring regionally would be absent or unlikely to occur on the project site due to an absence of suitable habitat. These include the Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, valley elderberry longhorn beetle, Delta smelt, Little Kern golden trout, California tiger salamander, California red-legged frog, western spadefoot, western pond turtle, blunt-nosed leopard lizard, giant garter snake, northern harrier (nesting), burrowing owl, Fresno kangaroo rat, Tipton kangaroo rat, San Joaquin kit fox, and American badger (see Table 1). Loss of habitat as a result of future development of the project site would have no effect on these species because there is little or no likelihood that they are present. The project will have no effect on regional populations of these species.

<u>Species That May Utilize the Project Site.</u>

Seven special status animal species from Table 1 potentially forage, breed, nest, and/or roost on site. These include the Swainson's hawk (also, see discussion in Section 3.3.1), white-tailed kite (also, see discussion in Section 3.3.3), mountain plover, loggerhead shrike (also, see discussion in Section 3.3.3), tricolored blackbird (also, see discussion in Section 3.3.3), pallid bat (foraging only), and western mastiff bat (foraging only). Given the small area of the project site (approximately 80 acres) compared to the vast amount of similar habitat in the area and the fact that many of these species could continue to utilize the site after project build-out, the proposed project would not have an adverse effect on foraging, nesting, and/or roosting habitat for these species.

Mitigation. Mitigation is not warranted.

3.4.3 Impacts to Waters of the U.S.

Effect/Impact. As discussed in Section 2.6, no areas of the site appear to meet the criteria of a water of the U.S. Therefore, the project will have no effect on waters of the U.S.

Mitigation. Mitigation is not warranted.

3.4.4 Impacts to Wildlife Movement Corridors

Effect/Impact. As discussed in Section 2.9, the project site does not possess any features that could be considered a wildlife movement corridor.

Mitigation. Site development will have no effect on wildlife movement corridors. Mitigation is not warranted.

3.4.5 Impacts to Critical Habitat

Effect/Impact. No portion of the project site or surrounding land is designated critical habitat for any plant or wildlife species. Site development will have no effect on designated critical habitat.

Mitigation. Mitigation is not warranted.

3.4.6 Local Policies or Habitat Conservation Plans

Effect/Impact. It appears that all future development within the project area would be in compliance with the provisions of Tulare County General Plan polices. See Appendix E for the Tulare County Environmental policies. No known Habitat Conservation Plans are in effect for the area.

Mitigation. No mitigations are warranted.

3.5 CUMULATIVE EFFECTS/MITIGATION

Effect/Impact. Due to the disturbed nature of the project site and the measures that will be taken to avoid and/or minimize impacts to special status species and other sensitive biological resources, including federally protected species and waters of the U.S., project impacts or effects to such resources are expected to be minimal to absent. As such, the proposed project will not meaningfully contribute to cumulative effects on sensitive biological resources of the region.

Mitigation. Mitigations are not warranted.

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APPENDIX A: VASCULAR PLANTS OF THE PROJECT SITE

APPENDIX A: VASCULAR PLANTS OF THE PROJECT SITE

The plants species listed below were observed on the project site during surveys conducted by Live Oak Associates, Inc. on December 9, 2014 and/or April 28, 2015. The U.S. Fish and Wildlife Service wetland indicator status of each plant has been shown following its common name.

OBL - Obligate
FACW - Facultative Wetland
FAC - Facultative
FACU - Facultative Upland
UPL - Upland
+/- - Higher/lower end of category
NR - No review
NA - No agreement
NI - No investigation

ASTERACEAE – Sunflower Family		
Amaranthus albus	Tumbleweed	FACU
Amaranthus retroflexus	Red-root Amaranth	FACU
Erigeron bonariensis	Flax-leaved Horseweed	FACU
Erigeron canadensis	Canada Horseweed	FACU
Helianthus annuus	Common Sunflower	FACU
Centromedia pungens	Common Tarweed	FAC
Senecio vulgaris	Common Groundsel	FACU
Xanthium strumarium	Rough Cocklebur	FAC
BORAGINACEAE – Borage Family		
Amsinckia sp.	Fiddleneck	UPL
BRASSICACEAE – Mustard Family		
Capsella bursa-pastoris	Shepherd's Purse	UPL
CHENOPODIACEAE – Goosefoot Family		
Salsola tragus	Russian Thistle	FACU
CUCURBITACEAE – Melon Family		
Cucurbita foetidissima	Wild gourd	UPL
CYPERACEAE – Sedge Family		
Cyperus rotundus	Purple Flat Sedge	FAC
FAGACEAE – Oak Family		
Quercus lobata	Valley Oak	FACU
MALVACEAE – Mallow Family		
Malva sp.	Mallow	UPL
MELIACEAE – Mohagany Family		
Melia azedarach	Chinaberry Tree	UPL
MORACEAE – Mulberry Family		
Ficus carica	Edible Fig	FACU
Morus alba	White Mulberry	FACU
POACEAE – Grass Family		

Cynodon dactylon	Bermuda Grass	FAC
Hordeum murinum ssp. *leporinum*	Barnyard Barley	FACU
Leptochloa fusca ssp. *univerva*	Bearded Sprangletop	FACW
Sorghum halepense	Johnson Grass	FACU
Triticum aestivum	Wheat	UPL
Zea mays ssp. *mays*	Cultivated Corn	UPL
POLYGONACEAE – Smartweed Family		
Persicaria lapathifolium	Common Knotweed	FACW
Rumex crispus	Curly Dock	FAC
URTICACEAE – Nettle Family		
Urtica urens	Dwarf Nettle	UPL
ZYGOPHYLLACEAE – Puncture Vine Family		
Tribulus terrestris	Puncture Vine	UPL

APPENDIX B: TERRESTRIAL VERTEBRATE SPECIES THAT POTENTIALLY OCCUR ON THE PROJECT SITE

APPENDIX B: TERRESTRIAL VERTEBRATE SPECIES THAT POTENTIALLY OCCUR ON THE PROJECT SITE

The species listed below are those that may reasonably be expected to use the habitats of the project site routinely or from time to time. The list was not intended to include birds that are vagrants or occasional transients. Terrestrial vertebrate species observed in or adjacent to the project site during surveys conducted by Live Oak Associates, Inc. on December 9, 2014 and/or April 28, 2015 have been noted with an asterisk.

CLASS: REPTILIA (Reptiles)
ORDER: SQUAMATA (Lizards and Snakes)
SUBORDER: SAURIA (Lizards)
FAMILY: PHRYNOSOMATIDAE
Side-blotched Lizard (*Uta stansburiana*)
Western Fence Lizard (*Sceloporus occidentalis*)
SUBORDER: SERPENTES (Snakes)
FAMILY: COLUBRIDAE (Colubrids)
Pacific Gopher Snake (*Pituophis catenifer catenifer*)
Common Kingsnake (*Lampropeltis getulus*)

CLASS: AVES (Birds)
ORDER: ANSERIFORMES (Ducks, Geese, and Swans)
FAMILY: ANATIDAE (Ducks, Geese, and Swans)
Mallard (*Anas platyrhynchos*)
ORDER: CICONIIFORMES (Herons, Storcks, Ibises and Relatives)
FAMILY: ARDEIDAE (Herons and Bitterns)
Great Egret (*Ardea alba*)
Great Blue Heron (*Ardea herodias*)
ORDER: FALCONIFORMES (Vultures, Hawks, and Falcons)
FAMILY: CATHARTIDAE (American Vultures)
Turkey Vulture (*Cathartes aura*)
FAMILY: ACCIPITRIDAE (Hawks, Old World Vultures, and Harriers)
White-tailed Kite (*Elanus leucurus*)
Northern Harrier (*Circus cyaneus*)
Red-tailed Hawk (*Buteo jamaicensis*)
Sharp-Shinned Hawk (*Accipiter striatus*)
Cooper's Hawk (*Accipiter cooperii*)
Swainson's Hawk (*Buteo swainsoni*)
FAMILY: FALCONIDAE (Caracaras and Falcons)
American Kestrel (*Falco sparverius*)
ORDER: GRUIFORMES (Cranes and Rails)
ORDER: CHARADRIIFORMES (Shorebirds, Gulls, and relatives)
FAMILY: CHARADRIIDAE (Plovers and relatives)
*****Killdeer (*Charadrius vociferus*)
ORDER: COLUMBIFORMES (Pigeons and Doves)
FAMILY: COLUMBIDAE (Pigeons and Doves)

Rock Pigeon (*Columba livia*)
*Eurasian Collared Dove (*Streptopelia decaocto*)
*Mourning Dove (*Zenaida macroura*)

ORDER: APODIFORMES (Swifts and Hummingbirds)

FAMILY: TROCHILIDAE (Hummingbirds)

Anna's Hummingbird (*Calypte anna*)

ORDER: PICIFORMES (Woodpeckers and relatives)

FAMILY: PICIDAE (Woodpecker and Wrynecks)

Northern Flicker (*Colaptes chrysoides*)
Nuttall's Woodpecker (*Picoides nuttallii*)

ORDER: PASSERIFORMES (Perching Birds)

FAMILY: TYRANNIDAE (Tyrant Flycatchers)

*Black Phoebe (*Sayornis nigricans*)
Say's Phoebe (*Sayornis saya*)
Western Kingbird (*Tyrannus verticalis*)

FAMILY: LANIIDAE (Shrikes)

Loggerhead Shrike (*Lanius ludovicianus*)

FAMILY: CORVIDAE (Jays, Magpies, and Crows)

Western Scrub Jay (*Aphelocoma coerulescens*)
*American Crow (*Corvus brachyrhynchos*)
*Common Raven (*Corvus corax*)

FAMILY: ALAUDIDAE (Larks)

*****Horned Lark (*Eremophila alpestris*)

FAMILY: HIRUNDINIDAE (Swallows)

Cliff Swallow (*Hirundo pyrrhonota*)
Barn Swallow (*Hirundo rustica*)

FAMILY: AEGITHALIDAE (Bushtit)

Bushtit (*Psaltriparus minimus*)

FAMILY: TURDIDAE (Thrushes)

*American Robin (*Turdus migratorius*)
Mountain Bluebird (*Sialia currucoides*)

FAMILY: MIMIDAE (Mockingbirds and Thrashers)

Northern Mockingbird (*Mimus polyglottos*)

FAMILY: STURNIDAE (Starlings)

*European Starling (*Sturnus vulgaris*)

FAMILY: TROGLODYTIDAE (Wrens)

House Wren (*Troglodytes aedon*)

FAMILY: REGULIDAE (Kinglets)

*Ruby-Crowned Kinglet (*Regulus calendula*)

FAMILY: MOTACILLIDAE (Wagtails and Pipits)

*American Pipit (*Anthus rubescens*)

FAMILY: PARULIDAE (Wood Warblers and Relatives)

*Yellow-rumped Warbler (*Dendroica coronata*)

FAMILY: EMBERIZIDAE (Sparrows and Relatives)

*Savannah Sparrow (*Passerculus sandwichensis*)
*White-crowned Sparrow (*Zonotrichia leucophrys*)

FAMILY: ICTERIDAE (Blackbirds, Orioles and Allies)
*Red-winged Blackbird (*Agelaius phoeniceus*)
Tricolored Black Bird (*Agelaius tricolor*)
Bullock's Oriole (*Icterus bullockii*)
*Western Meadowlark (*Sturnella neglecta*)
Brewer's Blackbird (*Euphagus cyanocephalus*)
Brown-headed Cowbird (*Molothrus ater*)
FAMILY: FRINGILLIDAE (Finches and Allies)
*****House Finch (*Carpodacus mexicanus*)
Lesser Goldfinch (*Carduelis psaltria*)
*****American Goldfinch (*Spinus tristis*)
FAMILY: PASSERIDAE (Old World Sparrows)
*House Sparrow (*Passer domesticus*)

CLASS: MAMMALIA (Mammals)
ORDER: DIDELPHIMORPHIA (Marsupials)
FAMILY: DIDELPHIDAE (Opossums)
Virginia Opossum (*Didelphis virginiana*)
ORDER: CHIROPTERA (Bats)
FAMILY: PHYLLOSTOMIDAE (Leaf-nosed Bats)
Southern Long-nosed Bat (*Leptonycteris curasoae*)
FAMILY: VESPERTILIONIDAE (Evening Bats)
Yuma Myotis (*Myotis yumanensis*)
California Myotis (*Myotis californicus*)
Townsend's Western Big-eared Bat (*Corynorhinus townsendii townsendii*)
Western Pipistrelle (*Pipistrellus hesperus*)
Big Brown Bat (*Eptesicus fuscus*)
Western Red Bat (*Lasiurus borealis*)
Pallid Bat (*Antrozous pallidus*)
FAMILY: MOLOSSIDAE (Free-tailed Bat)
California Mastiff Bat (*Eumops perotis* ssp. *californicus*)
Brazilian Free-tailed Bat (*Tadarida brasiliensis*)
ORDER: LAGOMORPHA (Rabbits, Hares, and Pikas)
FAMILY: LEPORIDAE (Rabbits and Hares)
Audubon Cottontail Rabbit (*Sylvilagus audubonii*)
Black-tailed Jackrabbit (*Lepus californicus*)
ORDER: RODENTIA (Rodents)
FAMILY: SCIURIDAE (Squirrels, Chipmunks, and Marmots)
California Ground Squirrel (*Otospermophilus beecheyi*)
FAMILY: GEOMYIDAE (Pocket Gophers)
*Botta's Pocket Gopher (*Thomomys bottae*)
FAMILY: HETEROMYIDAE (Kangaroo Rats and Pocket Mice)
Heermann's Kangaroo Rat (*Dipodomys heermanni*)
FAMILY: MURIDAE (Old World Rats and Mice)
Western Harvest Mouse (*Reithrodontomys megalotis*)
Deer Mouse (*Peromyscus maniculatus*)

California Vole (*Microtus californicus*)
House Mouse (*Mus musculus*)

ORDER: CARNIVORA (Carnivores)

FAMILY: CANIDAE (Foxes, Wolves, and relatives)
Coyote (*Canis latrans*)
Feral Dog (*Canis lupus familiaris*)
Red Fox (*Vulpes vulpes*)

FAMILY: PROCYONIDAE (Raccoons and relatives)
Raccoon (*Procyon lotor*)

FAMILY: MEPHITIDAE (Skunks)
Striped Skunk (*Mephitis mephitis*)

FAMILY: FELIDAE (Cats)
Feral Cat (*Felis domesticus*)

APPENDIX C: SELECTED SITE PHOTOGRAPHS

Photo 1: Wheat field covered the majority of the Cordeniz Basin site.

Photo 2: Disced Enterprise Basin.

Photo 3: Serpa Irrigation Ditch.

Photo 4: Ruderal land at proposed Serpa Ditch realignment site.

Photo 5: Residential land along Serpa Ditch.

Photo 6: The five well sites consisted entirely of ruderal habitats including levee roads and field margins. Shown is the Well No. 2 site, facing west.

APPENDIX D: U.S. FISH AND WILDLIFE SERVICE STANDARDIZED RECOMMENDATIONS FOR PROTECTION OF THE ENDANGERED SAN JOAQUIN KIT FOX PRIOR TO OR DURING GROUND DISTURBANCE

U.S. FISH AND WILDLIFE SERVICE STANDARDIZED RECOMMENDATIONS FOR PROTECTION OF THE ENDANGERED SAN JOAQUIN KIT FOX PRIOR TO OR DURING GROUND DISTURBANCE

Prepared by the Sacramento Fish and Wildlife Office
January 2011

INTRODUCTION

The following document includes many of the San Joaquin kit fox (*Vulpes macrotis mutica*) protection measures typically recommended by the U. S. Fish and Wildlife Service (Service), prior to and during ground disturbance activities. **However, incorporating relevant sections of these guidelines into the proposed project is not the only action required under the Endangered Species Act of 1973, as amended (Act) and does not preclude the need for section 7 consultation or a section 10 incidental take permit for the proposed project.** Project applicants should contact the Service in Sacramento to determine the full range of requirements that apply to your project; the address and telephone number are given at the end of this document. Implementation of the measures presented in this document may be necessary to avoid violating the provisions of the Act, including the prohibition against "take" (defined as killing, harming, or harassing a listed species, including actions that damage or destroy its habitat). These protection measures may also be required under the terms of a biological opinion pursuant to section 7 of the Act resulting in incidental take authorization (authorization), or an incidental take permit (permit) pursuant to section 10 of the Act. The specific measures implemented to protect kit fox for any given project shall be determined by the Service based upon the applicant's consultation with the Service.

The purpose of this document is to make information on kit fox protection strategies readily available and to help standardize the methods and definitions currently employed to achieve kit fox protection. The measures outlined in this document are subject to modification or revision at the discretion of the Service.

IS A PERMIT NECESSARY?

Certain acts need a permit from the Service which includes destruction of any known (occupied or unoccupied) or natal/pupping kit fox dens. Determination of the presence or absence of kit foxes and /or their dens should be made during the environmental review process. All surveys and monitoring described in this document must be conducted by a qualified biologist and these activities do not require a permit. A qualified biologist (biologist) means any person who has completed at least four years of university training in wildlife biology or a related science and/or has demonstrated field experience in the identification and life history of the San Joaquin kit fox. In addition, the biologist(s) must be able to identify coyote, red fox,

gray fox, and kit fox tracks, and to have seen a kit fox in the wild, at a zoo, or as a museum mount. Resumes of biologists should be submitted to the Service for review and approval prior to an6y survey or monitoring work occurring.

SMALL PROJECTS

Small projects are considered to be those projects with small foot prints, of approximately one acre or less, such as an individual in-fill oil well, communication tower, or bridge repairs. These projects must stand alone and not be part of, or in any way connected to larger projects (i.e., bridge repair or improvement to serve a future urban development). The Service recommends that on these small projects, the biologist survey the proposed project boundary and a 200-foot area outside of the project footprint to identify habitat features and utilize this information as guidance to situate the project to minimize or avoid impacts. If habitat features cannot be completely avoided, then surveys should be conducted and the Service should be contacted for technical assistance to determine the extent of possible take.

Preconstruction/preactivity surveys shall be conducted no less than 14 days and no more than 30 days prior to the beginning of ground disturbance and/or construction activities or any project activity likely to impact the San Joaquin kit fox. Kit foxes change dens four or five times during the summer months, and change natal dens one or two times per month (Morrell 1972). Surveys should identify kit fox habitat features on the project site and evaluate use by kit fox and, if possible, assess the potential impacts to the kit fox by the proposed activity. The status of all dens should be determined and mapped (see Survey Protocol). Written results of preconstruction/preactivity surveys must be received by the Service within five days after survey completion and prior to the start of ground disturbance and/or construction activities.

If a natal/pupping den is discovered within the project area or within 200-feet of the project boundary, the Service shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If the preconstruction/preactivity survey reveals an active natal pupping or new information, the project applicant should contact the Service immediately to obtain the necessary take authorization/permit.

If the take authorization/permit has already been issued, then the biologist may proceed with den destruction within the project boundary, except natal/pupping den which may not be destroyed while occupied. A take authorization/permit is required to destroy these dens even after they are vacated. Protective exclusion zones can be placed around all known and potential dens which occur outside the project footprint (conversely, the project boundary can be demarcated, see den destruction section).

OTHER PROJECTS

It is likely that all other projects occurring within kit fox habitat will require a take authorization/permit from the Service. This determination would be made by the Service during the early evaluation process (see Survey Protocol). These other projects would include, but are not limited to: Linear projects; projects with large footprints such as urban development; and projects which in themselves may be small but have far reaching impacts (i.e., water storage or conveyance facilities that promote urban growth or agriculture, etc.).

The take authorization/permit issued by the Service may incorporate some or all of the protection measures presented in this document. The take authorization/permit may include measures specific to the needs of the project and those requirements supersede any requirements found in this document.

EXCLUSION ZONES

In order to avoid impacts, construction activities must avoid their dens. The configuration of exclusion zones around the kit fox dens should have a radius measured outward from the entrance or cluster of entrances due to the length of dens underground. The following distances are **minimums**, and if they cannot be followed the Service must be contacted. Adult and pup kit foxes are known to sometimes rest and play near the den entrance in the afternoon, but most above-ground activities begin near sunset and continue sporadically throughout the night. Den definitions are attached as Exhibit A.

Potential den**	50 feet
Atypical den**	50 feet
Known den*	100 feet
Natal/pupping den (occupied and unoccupied)	Service must be contacted

*Known den: To ensure protection, the exclusion zone should be demarcated by fencing that encircles each den at the appropriate distance and does not prevent access to the den by kit foxes. Acceptable fencing includes untreated wood particle-board, silt fencing, orange construction fencing or other fencing as approved by the Service as long as it has openings for kit fox ingress/egress and keeps humans and equipment out. Exclusion zone fencing should be maintained until all construction related or operational disturbances have been terminated. At that time, all fencing shall be removed to avoid attracting subsequent attention to the dens.

**Potential and Atypical dens: Placement of 4-5 flagged stakes 50 feet from the den entrance(s) will suffice to identify the den location; fencing will not be required, but the exclusion zone must be observed.

Only essential vehicle operation on existing roads and foot traffic should be permitted. Otherwise, all construction, vehicle operation, material storage, or any other type of surface-disturbing activity should be prohibited or greatly restricted within the exclusion zones.

DESTRUCTION OF DENS

Limited destruction of kit fox dens may be allowed, if avoidance is not a reasonable alternative, provided the following procedures are observed. The value to kit foxes of potential, known, and natal/pupping dens differ and therefore, each den type needs a different level of protection. **Destruction of any known or natal/pupping kit fox den requires take authorization/permit from the Service**.

Destruction of the den should be accomplished by careful excavation until it is certain that no kit foxes are inside. The den should be fully excavated, filled with dirt and compacted to ensure that kit foxes cannot reenter or use the den during the construction period. If at any point during excavation, a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den as described above should be resumed. Destruction of the den may be completed when in the judgment of the biologist, the animal has escaped, without further disturbance, from the partially destroyed den.

Natal/pupping dens: Natal or pupping dens which are occupied will not be destroyed until the pups and adults have vacated and then only after consultation with the Service. Therefore, project activities at some den sites may have to be postponed.

Known Dens: Known dens occurring within the footprint of the activity must be monitored for three days with tracking medium or an infra-red beam camera to determine the current use. If no kit fox activity is observed during this period, the den should be destroyed immediately to preclude subsequent use.

If kit fox activity is observed at the den during this period, the den should be monitored for at least five consecutive days from the time of the observation to allow any resident animal to move to another den during its normal activity. Use of the den can be discouraged during this period by partially plugging its entrances(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied may the den be excavated under the direction of the biologist. If the animal is still present after five or more consecutive days of plugging and monitoring, the den may have to be excavated when, in the judgment of a biologist, it is temporarily vacant, for example during the animal's normal foraging activities.

The Service encourages hand excavation, but realizes that soil conditions may necessitate the use of excavating equipment. However, extreme caution must be exercised.

Potential Dens: If a take authorization/permit has been obtained from the Service, den destruction may proceed without monitoring, unless other restrictions were issued with the take authorization/permit. If no take authorization/permit has been issued, then potential dens should be monitored as if they were known dens. If any den was considered to be a potential den, but is later determined during monitoring or destruction to be currently, or previously used by kit fox (e.g., if kit fox sign is found inside), then all construction activities shall cease and the Service shall be notified immediately.

CONSTRUCTION AND ON-GOING OPERATIONAL REQUIREMENTS

Habitat subject to permanent and temporary construction disturbances and other types of ongoing project-related disturbance activities should be minimized by adhering to the following activities. Project designs should limit or cluster permanent project features to the smallest area possible while still permitting achievement of project goals. To minimize temporary disturbances, all project-related vehicle traffic should be restricted to established roads, construction areas, and other designated areas. These areas should also be included in preconstruction surveys and, to the extent possible, should be established in locations disturbed by previous activities to prevent further impacts.

1. Project-related vehicles should observe a daytime speed limit of 20-mph throughout the site in all project areas, except on county roads and State and Federal highways; this is particularly important at night when kit foxes are most active. Night-time construction should be minimized to the extent possible. However if it does occur, then the speed limit should be reduced to 10-mph. Off-road traffic outside of designated project areas should be prohibited.

2. To prevent inadvertent entrapment of kit foxes or other animals during the construction phase of a project, all excavated, steep-walled holes or trenches more than 2-feet deep should be covered at the close of each working day by plywood or similar materials. If the trenches cannot be closed, one or more escape ramps constructed of earthen-fill or wooden planks shall be installed. Before such holes or trenches are filled, they should be thoroughly inspected for trapped animals. If at any time a trapped or injured kit fox is discovered, the Service and the California Department of Fish and Game (CDFG) shall be contacted as noted under measure 13 referenced below.

3. Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4-inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is

discovered inside a pipe, that section of pipe should not be moved until the Service has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.

4. All food-related trash items such as wrappers, cans, bottles, and food scraps should be disposed of in securely closed containers and removed at least once a week from a construction or project site.

5. No firearms shall be allowed on the project site.

6. No pets, such as dogs or cats, should be permitted on the project site to prevent harassment, mortality of kit foxes, or destruction of dens.

7. Use of rodenticides and herbicides in project areas should be restricted. This is necessary to prevent primary or secondary poisoning of kit foxes and the depletion of prey populations on which they depend. All uses of such compounds should observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other State and Federal legislation, as well as additional project-related restrictions deemed necessary by the Service. If rodent control must be conducted, zinc phosphide should be used because of a proven lower risk to kit fox.

8. A representative shall be appointed by the project proponent who will be the contact source for any employee or contractor who might inadvertently kill or injure a kit fox or who finds a dead, injured or entrapped kit fox. The representative will be identified during the employee education program and their name and telephone number shall be provided to the Service.

9. An employee education program should be conducted for any project that has anticipated impacts to kit fox or other endangered species. The program should consist of a brief presentation by persons knowledgeable in kit fox biology and legislative protection to explain endangered species concerns to contractors, their employees, and military and/or agency personnel involved in the project. The program should include the following: A description of the San Joaquin kit fox and its habitat needs; a report of the occurrence of kit fox in the project area; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of measures being taken to reduce impacts to the species during project construction and implementation. A fact sheet conveying this information should be prepared for distribution to the previously referenced people and anyone else who may enter the project site.

10. Upon completion of the project, all areas subject to temporary ground disturbances, including storage and staging areas, temporary roads, pipeline corridors, etc. should be

re-contoured if necessary, and revegetated to promote restoration of the area to pre-project conditions. An area subject to "temporary" disturbance means any area that is disturbed during the project, but after project completion will not be subject to further disturbance and has the potential to be revegetated. Appropriate methods and plant species used to revegetate such areas should be determined on a site-specific basis in consultation with the Service, California Department of Fish and Game (CDFG), and revegetation experts.

11. In the case of trapped animals, escape ramps or structures should be installed immediately to allow the animal(s) to escape, or the Service should be contacted for guidance.

12. Any contractor, employee, or military or agency personnel who are responsible for inadvertently killing or injuring a San Joaquin kit fox shall immediately report the incident to their representative. This representative shall contact the CDFG immediately in the case of a dead, injured or entrapped kit fox. The CDFG contact for immediate assistance is State Dispatch at (916)445-0045. They will contact the local warden or Mr. Paul Hoffman, the wildlife biologist, at (530)934-9309. The Service should be contacted at the numbers below.

13. The Sacramento Fish and Wildlife Office and CDFG shall be notified in writing within three working days of the accidental death or injury to a San Joaquin kit fox during project related activities. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information. The Service contact is the Chief of the Division of Endangered Species, at the addresses and telephone numbers below. The CDFG contact is Mr. Paul Hoffman at 1701 Nimbus Road, Suite A, Rancho Cordova, California 95670, (530) 934-9309.

14. New sightings of kit fox shall be reported to the California Natural Diversity Database (CNDDB). A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed should also be provided to the Service at the address below.

Any project-related information required by the Service or questions concerning the above conditions or their implementation may be directed in writing to the U.S. Fish and Wildlife Service at:

Endangered Species Division
2800 Cottage Way, Suite W2605
Sacramento, California 95825-1846
(916) 414-6620 or (916) 414-6600

EXHIBIT "A" - DEFINITIONS

"Take" - Section 9 of the Endangered Species Act of 1973, as amended (Act) prohibits the "take" of any federally listed endangered species by any person (an individual, corporation, partnership, trust, association, etc.) subject to the jurisdiction of the United States. As defined in the Act, take means " . . . to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct". Thus, not only is a listed animal protected from activities such as hunting, but also from actions that damage or destroy its habitat.

"Dens" - San Joaquin kit fox dens may be located in areas of low, moderate, or steep topography. Den characteristics are listed below, however, the specific characteristics of individual dens may vary and occupied dens may lack some or all of these features. Therefore, caution must be exercised in determining the status of any den. Typical dens may include the following: (1) one or more entrances that are approximately 5 to 8 inches in diameter; (2) dirt berms adjacent to the entrances; (3) kit fox tracks, scat, or prey remains in the vicinity of the den; (4) matted vegetation adjacent to the den entrances; and (5) manmade features such as culverts, pipes, and canal banks.

"Known den" - Any existing natural den or manmade structure that is used or has been used at any time in the past by a San Joaquin kit fox. Evidence of use may include historical records, past or current radiotelemetry or spotlighting data, kit fox sign such as tracks, scat, and/or prey remains, or other reasonable proof that a given den is being or has been used by a kit fox. The Service discourages use of the terms "active" and "inactive" when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens often, with the result that the status of a given den may change frequently and abruptly.

"Potential Den" - Any subterranean hole within the species' range that has entrances of appropriate dimensions for which available evidence is insufficient to conclude that it is being used or has been used by a kit fox. Potential dens shall include the following: (1) any suitable subterranean hole; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use.

"Natal or Pupping Den" - Any den used by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two, therefore, for purposes of this definition either term applies.

"Atypical Den" - Any manmade structure which has been or is being occupied by a San Joaquin kit fox. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.

APPENDIX E: TULARE COUNTY GENERAL PLAN POLICIES

the assurance of rail transport for commodities such as grain, row crops, and fruit, a number of farming colonies soon appeared throughout the region.

The colonies grew to become cities such as Tulare, Visalia, Porterville, and Hanford. Visalia, the County seat, became the service, processing, and distribution center for the growing number of farms, dairies, and cattle ranches. By 1900, Tulare County boasted a population of about 18,000. New transportation links such as SR 99 (completed during the 1950s), affordable housing, light industry, and agricultural commerce brought steady growth to the valley. The U.S. Census Bureau estimated the 2003 Tulare County population to be 390,791.

8.1 Biological Resources

ERM-1	To preserve and protect sensitive significant habitats, enhance biodiversity, and promote healthy ecosystems throughout the County. [*New Goal]*

ERM-1.1 Protection of Rare and Endangered Species

The County shall ensure the protection of environmentally sensitive wildlife and plant life, including those species designated as rare, threatened, and/or endangered by State and/or federal government, through compatible land use development. [*New Policy based on ERME IV-C; Biological Resources; Issue 12, and ERME; Pg 32*]

ERM-1.2 Development in Environmentally Sensitive Areas

The County shall limit or modify proposed development within areas that contain sensitive habitat for special status species and direct development into less significant habitat areas. Development in natural habitats shall be controlled so as to minimize erosion and maximize beneficial vegetative growth. [*New Policy based on EMRE; Water; Issue 3; Recommendation 3, ERME; Pg 28]*

ERM-1.3 Encourage Cluster Development

When reviewing development proposals, the County shall encourage cluster development in areas with moderate to high potential for sensitive habitat. [*New Policy*]

ERM-1.4 Protect Riparian Areas

The County shall protect riparian areas through habitat preservation, designation as open space or recreational land uses, bank stabilization, and development controls. [*New Policy*]

ERM-1.5 Riparian Management Plans and Mining Reclamation Plans

The County shall require mining reclamation plans and other management plans include measures to protect, maintain and restore riparian resources and habitats. [*New Policy*]

ERM-1.6 Management of Wetlands

The County shall support the preservation and management of wetland and riparian plant communities for passive recreation, groundwater recharge, and wildlife habitats. [*New Policy*]

ERM-1.7 Planting of Native Vegetation

The County shall encourage the planting of native trees, shrubs, and grasslands in order to preserve the visual integrity of the landscape, provide habitat conditions suitable for native vegetation and wildlife, and ensure that a maximum number and variety of well-adapted plants are maintained. [*New Policy*]

ERM-1.8 Open Space Buffers

The County shall require buffer areas between development projects and significant watercourses, riparian vegetation, wetlands, and other sensitive habitats and natural communities. These buffers should be sufficient to assure the continued existence of the waterways and riparian habitat in their natural state. [*New Policy based on EMRE policies*]

ERM-1.9 Coordination of Management on Adjacent Lands

The County shall work with other government land management agencies (such as the Bureau of Land Management, US Forest Service, National Park Service) to preserve and protect biological resources while maintaining the ability to utilize and enjoy the natural resources in the County. [*New Policy*]

ERM-1.10 Appropriate Access for Recreation
The County shall encourage appropriate access to resource-managed lands. [*New Policy*]

ERM-1.11 Hunting and Fishing
The County shall provide opportunities for hunting and fishing activities within the County pursuant to appropriate regulations of the California Fish & Game Code. [*New Policy*]

ERM-1.12 Management of Oak Woodland Communities
The County shall support the conservation and management of oak woodland communities and their habitats. [*New Policy*]

ERM-1.13 Pesticides
The Tulare County Agricultural Commissioner/Sealer will cooperate with State and federal agencies in evaluating the side effects of new materials and techniques in pesticide controls to limit effects on natural resources. *[ERME IV-C; Pesticides; Recommandation 1] [ERME; Pg 131, Modified*]

ERM-1.14, Mitigation and Conservation Banking Program
The County shall support the establishment and administration of a mitigation banking program, including working cooperatively with TCAG, federal, State, not-for-profit and other agencies and groups to evaluate and identify appropriate lands for protection and recovery of threatened and endangered species impacted during the land development process. [*New Policy*]

8.2 Mineral Resources - Surface Mining

ERM-2	To conserve protect and encourage the development of areas containing mineral deposits while considering values relating to water resources, air quality, agriculture, traffic, biotic, recreation, aesthetic enjoyment, and . [*New Goal based on MRPAC June 28, 2006*]

ERM-2.1 Conserve Mineral Deposits
Emphasize the conservation of identified and/or potential mineral deposits, recognizing the need for identifying, permitting, and maintaining a 50 year supply of locally available PCC grade aggregate. [*MRPAC June 28, 2006*]

ERM-2.2 Recognize Mineral Deposits
Recognize as a part of the General Plan those areas which have identified and/or potential mineral deposits. [*MRPAC June 28, 2006*]

ERM-2.3 Future Resource Development
Provide for the conservation of identified and/or potential mineral deposits within Tulare County as areas for future resource development. Recognize that mineral deposits are significantly limited within Tulare County and that they play an important role in support of the economy of the County. [*MRPAC June 28, 2006*]

ERM-2.4 Identify New Resources
Encourage exploration, evaluation, identification, and development of previously unrecognized but potentially significant hard rock resources for production of crushed stone aggregate. [*MRPAC June 28, 2006*]

ERM-2.5 Resources Development
The County will promote the responsible development of identified and/or potential mineral deposits. [*MRPAC June 28, 2006*]

ERM-2.6 Streamline Process
Create a streamlined and timely permitting process for the mining industry, which will help encourage long-range planning and the reasonable amortization of investments. [*MRPAC June 28, 2006*]

ERM-2.8 Minimize Adverse Impacts
Minimize the adverse effects on environmental features such as water quality and quantity, air quality, flood plains, geophysical characteristics, biotic, archaeological and aesthetic factors. [*MRPAC June 28, 2006*]

ERM-2.9 Minimize Hazards and Nuisances
Minimize the hazards and nuisances to persons and properties in the area during extraction, processing and reclamation operations. [*MRPAC June 28, 2006*]

ERM-2.10 Compatibility
Develop mineral deposits in a manner compatible with surrounding land uses. [*MRPAC June 28, 2006*]

ERM-2.11 Incompatible Development
Proposed incompatible land uses shall not be on lands containing, or adjacent to identified mineral deposits, or along key access roads, unless adequate mitigation measures are adopted or a statement of overriding considerations stating public benefits and overriding reasons for permitting the proposed use are adopted. [*MRPAC June 28, 2006*]

ERM-2.12 Conditions of Approval
Procedures shall be established to ensure compliance with conditions of approval on all active and idle mines. [*MRPAC June 28, 2006*]

ERM-2.13 Approved Limits
Procedures shall be established to ensure that vested interest mining operations remain within their approved area and/or production limits. [*MRPAC June 28, 2006*]

ERM-2.14 SMARA Requirements
All surface mines, unless otherwise exempted, shall be subject to reclamation plans that meet SMARA requirements. Reclamation procedures shall restore the site for future beneficial use of the land. Mine reclamation costs shall be borne by the mine operator, and guaranteed by financial assurances set aside for restoration procedures. [*MRPAC June 28, 2006*]

8.3 Mineral Resources

ERM-3	To protect the current and future extraction of mineral resources that are important to the County's economy while minimizing impacts of this use on the public and the environment. [*ERME IV-B; Land; Issue 8*] [ERME; Pg 30, *Modified*]

ERM-3.1 Environmental Contamination
All mining operations shall be required to take precautions to avoid contamination from wastes or incidents related to the storage and disposal of hazardous materials, or general operating activity at the site. [*New Policy*]

ERM-3.2 Limited In-City Mining
Within UDBs, new commercial mining operations should be limited due to environmental and compatibility concerns. [*New Policy*]

ERM-3.3 Small-Scale Oil and Gas Extraction
The County shall permit by special use permit small-scale oil and gas extraction activities and facilities that can be demonstrated to not have a significant adverse effect on surrounding or adjacent land and are within an established oil and gas field outside of a UDB. [*New Policy*]

ERM-3.4 Oil and Gas Extraction
Facilities related to oil and gas extraction and processing may be allowed in identified oil and gas fields subject to a special use permit. The extraction shall demonstrate that it will be compatible with surrounding land uses and land use designations. [*New Policy*]

ERM-3.5 Reclamation of Oil and Gas Sites
The County shall require the timely reclamation of oil and gas development sites upon termination of such activities to facilitate the conversion of the land to its primary land use as designated by the General Plan. Reclamation costs shall be born by the mine operator, and guaranteed by financial assurances set aside for restoration procedures. [*New Policy, MRPAC Goals, Policies, Implementation Measures, and Development Standards, Goal F and associated policies*]

8.4 Energy Resources

ERM-4	To encourage energy conservation in new and existing developments throughout the County. [*New Goal*]

ERM-4.1 Energy Conservation and Efficiency Measures
The County shall encourage the use of solar energy, solar hot water panels, and other energy conservation and efficiency features in new