3.3 Soils

Soils issues include the potential disturbance and alteration of native soil profiles and structure, increased soil erosion and compaction, and the loss of soil productivity.

3.3.1 Affected Environment

The study area for soils includes the permit area and the proposed road modifications that would occur outside of the permit area. The cumulative effects area is the same as the study area with the addition of surface disturbance associated with the interrelated actions (see Section 2.6). Regionally, soils are predominately sandy to sandy loam with interspersed areas of loamy and clayey soils. Site-specific soils in the study area are described in the following sections.

3.3.1.1 Native Soils

Baseline soils were identified for the permit area using NRCS (formerly the Soil Conservation Service [SCS]) published soils survey information for Lee and Bastrop Counties, Texas (SCS 1979, 1987; NRCS 1999; Alcoa 2000 [Volume 6]) and the NRCS Muir database (NRCS 2001). The soils within the permit area primarily occur on the Calvert Bluff Formation and consist of sandy and loamy surface layers overlaying compacted clay (i.e., claypans) and excessively sandy subsoils on gently rolling topography. Twenty individual soil series, one undifferentiated unit (i.e., clay pit), one soil complex, and one water unit were delineated within the permit area as identified in **Table 3.3-1** and shown in **Figure 3.3-1**.

The soils in the permit area are typically slightly acidic to very strongly acidic to a depth of 48 inches; however, some of the soils range from very acidic (pH <3.4) to moderately alkaline (pH 7.9 to 8.4). Thirty-nine percent of the soils within the permit area are classified by the NRCS (SCS 1979, 1987; NRCS 1999) as eroded, severely eroded, or gullied. **Table 3.3-2** provides a list of mapping units and specific soil characteristics including pH, erosion potential, permeability, runoff potential, percent slope, and designation of prime farmland. Approximately 82 percent of the soils within the permit area are classified as having a runoff potential ranging from moderately high to high. As a result, these soils tend to be highly susceptible to erosion and have low infiltration and permeability rates.

In addition to soil mapping, Alcoa has conducted an extensive soil sampling and laboratory analysis program for the native soils occurring in the permit area (Alcoa 2000 [Volume 6]). The soil profiles were sampled on the basis of their genetic horizons (layers formed during soil formation). Multiple profiles were sampled for each soils series, and numerous profiles were sampled and analyzed for the dominant soils occurring within the permit area. The results of the analyses are presented in **Table 3.3-3**.

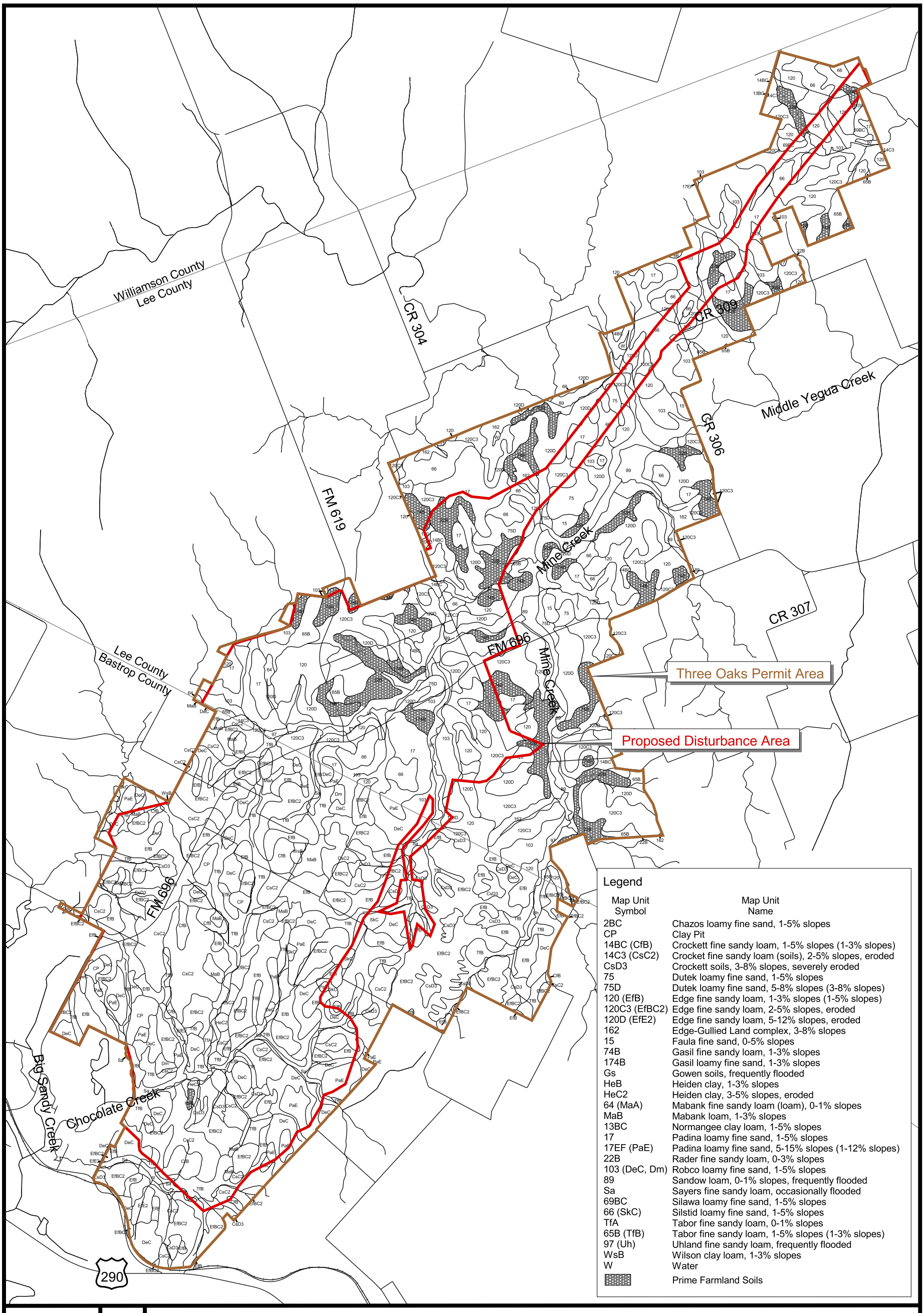
Within the mine area, the dominant soil is the Edge series (see **Table 3.3-2**). The Edge series was mapped by NRCS as the Axtell series in Bastrop County but was subsequently recorrelated. Additional codominant soils include the Crockett, Tabor, Robco, Padina, Sayers, and Uhland series. Sayers, Tabor, and Uhland soils primarily occur along toeslopes and alluvial drainages within the permit area. The others, most notably Edge and Crockett soils, occur more extensively in upland areas. In the northern part of the mine area, scattered delineations of Gasil, Mabank, Rader, and Silstid soils also occur.

Table 3.3-1
Soil Mapping Units in the Permit Area

Soil Mapping Units in Lee County (Bastrop County)[1]	Soil Mapping Unit Name and Characteristics	Acres in Permit Area	Percent of Permit Area
2BC	Chazos loamy fine sand	4	< 0.1
CP	Clay pit	96	0.6
14BC (CfB)	Crockett fine sandy loam	213	1.3
14C3 (CsC2)	Crockett fine sandy loam (sands)	863	5.4
CsD3	Crockett soils	361	2.2
75	Dutek loamy fine sand	108	0.7
75D	Dutek loamy fine sand	106	0.7
120C3 (EfBC2)	Edge fine sandy loam	3,384	21.1
120 (EfB)	Edge fine sandy loam	2,163	13.5
120D (EfE2)	Edge fine sandy loam	1,484	9.2
162	Edge-Gullied land complex	168	1.0
15	Faula fine sand	48	0.3
74B	Gasil fine sandy loam	335	2.1
174B	Gasil loamy fine sand	139	0.9
Gs	Gowen soils	11	0.1
HeB	Heiden clay	6	< 0.1
HeC2	Heiden clay	17	0.1
64 (MaA)	Mabank fine sandy loam (loam)	23	0.1
MaB	Mabank loam	99	0.6
13BC	Normangee clay loam	1	< 0.1
17	Padina loamy fine sand	782	4.9
17EF (PaE)	Padina loamy fine sand	266	1.7
22B	Rader fine sandy loam	577	3.6
103 (DeC, Dm)	Robco loamy fine sand	1,822	11.3
89	Sandow loam	643	4.0
Sa	Sayers fine sandy loam	206	1.3
69BC	Silawa loamy fine sand	30	0.2
66 (SkC)	Silstid loamy fine sand	632	3.9
TfA	Tabor fine sandy loam	8	< 0.1
65B (TfB)	Tabor fine sandy loam	1,180	7.3
97 (Uh)	Uhland fine sandy loam	254	1.6
WsB	Wilson clay loam	11	0.1
W	Water	22	0.1
Total		**16,062**	**100**

[1]Soil mapping unit symbols and numbers in parentheses represent Bastrop County soils (SCS 1987).

Sources: Alcoa 2000 (Volume 6); Jurena 2001a,b; NRCS 2001; SCS 1979, 1987.



Legend

Map Unit Symbol	Map Unit Name
2BC	Chazos loamy fine sand, 1-5% slopes
CP	Clay Pit
14BC (CfB)	Crockett fine sandy loam, 1-5% slopes (1-3% slopes)
14C3 (CsC2)	Crocket fine sandy loam (soils), 2-5% slopes, eroded
CsD3	Crockett soils, 3-8% slopes, severely eroded
75	Dutek loamy fine sand, 1-5% slopes
75D	Dutek loamy fine sand, 5-8% slopes (3-8% slopes)
120 (EfB)	Edge fine sandy loam, 1-3% slopes (1-5% slopes)
120C3 (EfBC2)	Edge fine sandy loam, 2-5% slopes, eroded
120D (EfE2)	Edge fine sandy loam, 5-12% slopes, eroded
162	Edge-Gullied Land complex, 3-8% slopes
15	Faula fine sand, 0-5% slopes
74B	Gasil fine sandy loam, 1-3% slopes
174B	Gasil loamy fine sand, 1-3% slopes
Gs	Gowen soils, frequently flooded
HeB	Heiden clay, 1-3% slopes
HeC2	Heiden clay, 3-5% slopes, eroded
64 (MaA)	Mabank fine sandy loam (loam), 0-1% slopes
MaB	Mabank loam, 1-3% slopes
13BC	Normangee clay loam, 1-5% slopes
17	Padina loamy fine sand, 1-5% slopes
17EF (PaE)	Padina loamy fine sand, 5-15% slopes (1-12% slopes)
22B	Rader fine sandy loam, 0-3% slopes
103 (DeC, Dm)	Robco loamy fine sand, 1-5% slopes
89	Sandow loam, 0-1% slopes, frequently flooded
Sa	Sayers fine sandy loam, occasionally flooded
69BC	Silawa loamy fine sand, 1-5% slopes
66 (SkC)	Silstid loamy fine sand, 1-5% slopes
TfA	Tabor fine sandy loam, 0-1% slopes
65B (TfB)	Tabor fine sandy loam, 1-5% slopes (1-3% slopes)
97 (Uh)	Uhland fine sandy loam, frequently flooded
WsB	Wilson clay loam, 1-3% slopes
W	Water
	Prime Farmland Soils

Three Oaks Mine

Figure 3.3-1

Soils and Prime Farmland Soils

Notes:

Map unit symbol and percent slope in parenthesis represent Bastrop County soils.

Many of the prime farmland soils shown do not meet the historic use criteria required for designation of prime farmland.

Source: Alcoa 2000 (Volume 6).

N

0 2000 4000 Feet

6/18/02

Table 3.3-2
Characteristics of Soils in the Permit Area

Soil Mapping Unit	Mapping Unit Name	pH Range (standard units)	Erosion Potential	Permeability	Runoff Potential	Range of Slope (%)	Prime Farmland
Lee County							
2BC	Chazos loamy fine sand	5.6-7.3	Moderate	Slow	Moderately high	1-5	Yes
14BC	Crockett fine sandy loam	5.6-7.8	Severe	Very slow	High	1-5	No
14C3	Crockett fine sandy loam (sands)	5.6-7.8	Severe	Very slow	High	2-5	No
75	Dutek loamy fine sand	5.6-7.3	Moderate	Moderate	Low	1-5	No
75D	Dutek loamy fine sand	5.6-7.3	Moderate	Moderate	Low	5-8	No
120C3	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	2-5	No
120	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	1-3	No
120D	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	5-12	No
162	Edge-Gullied land complex	4.5-7.3	Severe	Slow	High	3-8	No
15	Faula fine sand	5.1-7.3	Severe	Rapid	Low	0-5	No
74B	Gasil fine sandy loam	6.1-7.8	Moderate	Moderate	Moderately low	1-3	Yes
174B	Gasil loamy fine sand	6.1-7.8	Moderate	Moderate	Moderately low	1-3	Yes
64	Mabank fine sandy loam	5.6-7.3	Moderate	Very slow	High	1-3 (0-1)	No
13BC	Normangee clay loam	5.6-7.3	Severe	Very slow	High	1-5	No
17	Padina loamy fine sand	5.6-7.3	Moderate	Moderate	Moderately low	1-5 (1-8)	No
17EF	Padina loamy fine sand	5.6-7.3	Severe	Moderate	Moderately low	5-15 (8-20)	No
22B	Rader fine sandy loam	4.5-6.5	Moderate	Very slow	High	1-5	Yes
103	Robco loamy fine sand	5.1-6.5	Moderate	Slow	Moderately high	1-5	No
89	Sandow loam	0.0-1.0	None to slight erosion; frequently flooded	Moderately slow	Moderately high	0-1	No
69BC	Silawa loamy fine sand	4.5-6.5	Moderate	Moderate	Moderately low	1-5	No
66	Silstid loamy fine sand	5.6-7.3	Moderate	Moderate	Low	1-5	No
65B	Tabor fine sandy loam	5.1-6.5	Moderate	Very slow	High	1-5	No

Table 3.3-2 (Continued)

Soil Mapping Unit	Mapping Unit Name	pH Range (standard units)	Erosion Potential	Permeability	Runoff Potential	Range of Slope (%)	Prime Farmland
97	Uhland fine sandy loam	5.6-7.8	None to slight erosion; frequently flooded	Moderately slow	Moderately low		No
W	N/A	N/A	N/A	N/A	N/A	N/A	No
Bastrop County							
CfB	Crockett fine sandy loam	5.6-7.8	Moderate	Very slow	High	1-3	No
CsC2	Crockett soils	5.6-8.4	Eroded	Very slow	High	2-5	No
CsD3	Crockett soils	5.6-8.4	Severely eroded	Very slow	High	3-8	No
CP	Clay pit	N/A	N/A	N/A	N/A	N/A	No
EfB	Edge fine sandy loam	4.5-7.3	Eroded	Slow	High	1-5	No
EfBC2	Edge fine sandy loam	4.5-7.3	Eroded	Slow	High	2-5	No
EfE2	Edge fine sandy loam	4.5-7.3	Eroded	Slow	High	5-12	No
DeC	Robco loamy fine sand	5.6-7.8	Moderate	Slow	Moderately high	1-5	No
Dm	Robco loamy fine sand	5.6-7.8	Slight	Slow	Moderately high	1-5	No
Gs	Gowen soils	6.6-8.4	Slight, frequently flooded	Moderate	Moderately low		No
HeB	Heiden clay	7.9-8.4	Moderate	Very slow	High (rapid)	1-3	Yes
HeC2	Heiden clay	7.9-8.4	Eroded	Very slow	High (rapid)	3-5	No
MaA	Mabank loam	5.6-7.3	Slight	Very slow	High	0-1	No
MaB	Mabank loam	5.6-7.3	Moderate	Very slow	High	1-3	No
PaE	Padina loamy fine sand	5.6-7.3	Sever	Moderate	Moderately low	18-20	No
Sa	Sayers fine sandy loam	5.6-7.8	Slight, occasionally flooded	Rapid	Low		No
SkC	Silstid loamy fine sand	5.6-7.3	Moderate	Moderate	Low	1-5	No
TfA	Taber fine sandy loam	5.1-6.5	Moderate	Very slow	High	0-1	No
TfB	Tabor fine sandy loam	5.1-6.5	Moderate	Very slow	High	1-3	No
Uh	Uhland fine sandy loam	5.6-7.8	Slight, frequently flooded	Moderately slow	Moderately low	N/A	No
WsB	Wilson clay loam	5.6-7.3	Slight	Very slow	High	1-3	No
W	N/A	N/A	N/A	N/A	N/A	N/A	No

Sources: Alcoa 2000 (Volume 6); Jurena 2001a,b; NRCS 2001, 1999; SCS 1979, 1987.

Table 3.3-3
Characteristics of Native Soils

Suitability Parameter	Typical Native Topsoil (Edge Series)[1]	Typical Native Subsoil (Edge Series)[1]
pH (standard units)	4.8 to 7.0	4.4 to 7.8
ABA or NNP (tons/kiloton)	-2 to 9	-4 to 9
Sand (percent of fraction 0.05 to 2 mm diameter)	44 to 84	19 to 70
Clay (percent of fraction < 0.002 mm diameter)	7 to 29	20 to 55
Electrical conductivity (mmhos/cm)	0.0 to 1.0	0.0 to 3.0
Sodium adsorption ratio (SAR)	0.0 to 4.0	1.0 to 8.0
Boron (ppm)	0.0 to 1.0	0.0 to 1.0
Cadmium (ppm)	0.0 to 0.1	0.0 to 0.1
Molybdenum (ppm)	0.0 to 5.0	0.0 to 3.0
Selenium (ppm)	0.0 to 2.0	0.0 to 3.0

[1]Values reflect the most common characteristics used to delineate soil type for the most extensive soil series in the proposed disturbance areas.

Source: Alcoa 2001b (Volume 3).

Most of these soil series are classified according to soil taxonomy as having generally been in place on the land surface for a lengthy period relative to more typical settings. Weathering over a substantial length of time (hundreds or thousands of years) has left them strongly differentiated between the topsoil and subsoil layers. The Edge, Crockett, Tabor, and Mabank series are typical of this group of soils. These soils are characterized by relatively thick, sandy topsoils directly overlying heavy clay subsoils. The topsoil generally ranges from 3 to 24 inches thick or more, depending on the particular site and soil series, and usually has a sand content ranging from 60 to 80 percent and a clay content of 10 to 20 percent. For the Edge series, these layers are typically 4 to 10 inches thick (Alcoa 2000 [Volume 6]). This topsoil has generally been heavily weathered and leached of clays and organic matter, resulting in a highly erodible, sandy surface layer of limited fertility. The underlying subsoil is a dense, usually acidic, heavy clay. Clay contents usually range between 40 and 55 percent and are dominated by smectitic clays. A major characteristic of smectitic clays is that they have very high shrink-swell capacity between wetting and drying states, and often form dense, almost impermeable layers when dry. They are easily compacted during handling when moist, but remain blocky and hard when dry. Within the permit area, the subsoils and weathered substrata (which are typically acidic and clayey) extend to depths of 48 inches or more.

3.3.1.2 Prime Farmlands and Prime Farmland Soils

Prime farmland soil is defined by the NRCS as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and also is available for these uses (NRCS 2000). It has the soil quality that, in combination with the regional growing season and moisture supply, can produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. Prime farmland soils are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding. Approximately 1,100 acres (7 percent) of the proposed permit area is occupied by

prime farmland soil types, as identified by NRCS and supplemented by further data collection (Alcoa 2000 [Volume 6]). These soils are identified in **Table 3.3-4**.

Table 3.3-4
Prime Farmland Soils in the Permit Area

Soil Mapping Unit	Soil Mapping Unit Name	Acres in the Permit Area	Percent of Permit Area
2BC	Chazos loamy fine sand, 1-5 % slopes	4	0.0
74B	Gasil fine sandy loam, 1-3 % slopes	335	2.1
174B	Gasil loamy fine sand, 1-3 % slopes	139	0.9
HeB	Heiden clay, 1-3 % slopes	6	0.0
22B	Rader fine sandy loam, 1-5 % slopes	577	3.6
Total		**1,061**	**6.6**

Source: Alcoa 2000 (Volume 6).

The NRCS designation of a prime farmland soil indicates the characteristics of the soil type and its suitability for crop production. This designation often reflects successful historical cropland use somewhere within a wide region. However, a prime farmland soil designation by NRCS does not necessarily imply historical local cropland use.

RRC regulations promulgated in concert with the Surface Mining Control and Reclamation Act of 1977 administered by the OSM require that prime farmland investigations be conducted on a site-specific basis. These more specific studies include the assessment of historical land use and other soil management considerations to define the occurrence of prime farmland (lands having prime farmland soil characteristics plus a recent history of crop productions) within a specified permit area (TAC 2001c,d). In combination with the NRCS soil designations, site-specific prime farmlands were determined through review of local land use and management attributes within the proposed permit area. Cropland use, as defined in the RRC regulations, includes row crops, small grains, hay, orchards, and other specialty uses.

In accordance with the RRC regulations, Alcoa conducted a site-specific prime farmland investigation within the permit area. This investigation included the compilation of historical data and affidavits from all private land owners and lessees within the permit area (Alcoa 2000 [Volume 7]). Based on this investigation, approximately 122 acres of prime farmlands occur within the permit area, with approximately 56 acres in the proposed disturbance area (see **Figure 3.3-1**).

3.3.1.3 Soil Productivity

Vegetation production and reclamation success depend on the varying characteristics of the soils. The NRCS collectively describes soils that produce similar native vegetation species and amounts of vegetation as a range site, if the range is in similar condition. **Table 3.3-5** provides the estimated forage production in pounds per acre per year for each of the soil mapping units and associated range sites in the permit area (Alcoa 2000 [Volume 6]; SCS 1979).

Table 3.3-5
Forage Production Estimates for Soil Types and Range Sites in the Permit Area

Soil Mapping Units	Mapping Unit Name and Characteristics	Range Site	Forage Production		
			Favorable Year (lbs/ac/yr)[1]	Normal Year (lbs/ac/yr)[1]	Unfavorable Year (lbs/ac/yr)[1]
Lee County					
2BC	Chazos loamy fine sand	Sandy loam	5,500	4,500	3,000
14BC	Crockett fine sandy loam	Claypan prairie	6,000	5,000	3,000
14C3	Crockett fine sandy loam (sands)	Claypan prairie	6,000	5,000	3,000
75	Dutek loamy fine sand	Sandy	4,500	4,000	2,000
75D	Dutek loamy fine sand	Sandy	4,500	4,000	2,000
120C3	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500
120	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500
120D	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500
162	Edge-Gullied land complex	Claypan savannah	1,000	500	0
15	Faula fine sand	Deep sand	4,000	2,800	2,000
74B	Gasil fine sandy loam	Sandy loam	5,500	4,000	3,500
174B	Gasil loamy fine sand	Sandy loam	5,500	4,000	3,500
64	Mabank fine sandy loam (loam)	Claypan prairie	6,000	5,000	3,000
13BC	Normangee clay loam	Claypan prairie	5,500	4,000	3,000
17	Padina loamy fine sand	Deep sand	4,500	3,500	2,250
17EF	Padina loamy fine sand	Deep sand	4,500	3,500	2,250
22B	Rader fine sandy loam	Sandy loam	6,000	4,500	3,500
103	Robco loamy fine sand	Sandy	3,600	3,000	2,600
89	Sandow loam	Loamy bottomland	7,500	6,500	4,000
69BC	Silawa loamy fine sand	Sandy loam	5,500	4,500	2,500
66	Silstid loamy fine sand	Sandy	4,500	4,000	2,000
65B	Tabor fine sandy loam	Sandy loam	6,500	5,500	3,550
97	Uhland fine sandy loam	Loamy bottomland	7,500	6,500	4,000
W	Water	N/A	N/A	N/A	N/A
Bastrop County					
CfB	Crockett fine sandy loam	Claypan prairie	6,000	5,000	3,000
CsC2	Crockett soils (eroded)	Claypan prairie	6,000	5,000	3,000
CsD3	Crockett soils (severely eroded)	Claypan prairie	6,000	5,000	3,000
CP	Clay pit	N/A	N/A	N/A	N/A
EfB	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500
EfBC2	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500

Table 3.3-5 (Continued)

Soil Mapping Units	Mapping Unit Name and Characteristics	Range Site	Forage Production		
			Favorable Year (lbs/ac/yr)[1]	Normal Year (lbs/ac/yr)[1]	Unfavorable Year (lbs/ac/yr)[1]
EfE2	Edge fine sandy loam	Claypan savannah	5,000	3,500	2,500
DeC	Robco loamy fine sand	Sandy	5,000	4,000	2,500
Dm	Robco loamy fine sand (somewhat poorly drained)	Sandy	5,000	4,000	2,500
Gs	Gowen soils (frequently flooded)	Loamy bottomland	8,000	5,500	4,000
HeB	Heiden clay	Blackland	7,000	6,000	3,500
HeC2	Heiden clay	Blackland	7,000	6,000	3,500
MaA	Mabank loam	Claypan prairie	6,000	5,000	3,000
MaB	Mabank loam	Claypan prairie	6,000	5,000	3,000
PaE	Padina loamy fine sand	Deep sand	4,500	3,500	2,250
Sa	Sayers fine sandy loam	Sandy bottomland	5,000	4,000	2,000
SkC	Silstid loamy fine sand	Sandy	4,500	4,000	2,000
TfA	Tabor fine sandy loam	Sandy loam	6,500	5,500	3,550
TfB	Tabor fine sandy loam	Sandy loam	6,500	5,500	3,500
Uh	Uhland fine sandy loam (frequently flooded)	Loamy bottomland	7,500	6,500	4,000
WsB	Wilson clay loam	Claypan prairie	6,000	45,000	3,000
W	Water	N/A	N/A	N/A	N/A

[1]lbs/ac/yr = pounds per acre per year.

Sources: Alcoa 2000 (Volume 6); Jurena 2001a,b; SCS 1979.

There are no agricultural crops currently grown within the permit area. However, crops grown in Lee and Bastrop Counties include corn, oats, peanuts, grain sorghum, and wheat. **Table 3.3-6** provides estimates of potential crop productivity within the local area (Texas Agriculture Statistics Service [TASS] 2000). The crop values are not actual yields but estimates of maximum productivity under intensive management. Intensive management is described as the optimum integration of practices, such as fertilization, pest control, and mechanical practices with the average climatic conditions.

3.3.2 Environmental Consequences

3.3.2.1 Proposed Action

Surface Disturbance

Incremental surface disturbance as a result of mine construction and operation, including ancillary facilities, would total 8,654 acres of soil (see **Table 3.3-7**). Potential impacts to soils as a result of the Proposed Action would include an increase in soil erosion due to the removal of vegetation and an alteration of soil structure. However, the implementation and installation of erosion control measures and devices (e.g., sediment control ponds, diversion ditches, silt fences, straw bales, and revegetation measures), would limit the potential for soil erosion. Inspections and repairs to all sediment and erosion control facilities would be conducted periodically to ensure their proper operation. Reclamation activities described in Section 2.5.3.5, Revegetation, would minimize the effects of the loss of native soils and facilitate productive post-mining land uses, primarily pastureland and wildlife habitat.

Hay production for Sandow Mine pastureland on reclaimed land in the year 2000 was 2.6 tons per acre, 36 percent greater than the county average. The Milam County average was 1.9 tons per acre for that same year. Productivity success at the Sandow Mine is assumed to be due to the quality of the reconstructed topsoil. Native soils in the area are droughty, easily erodible, and have shallow clay pans which limit root growth. The post-mine soils are loamy, and root growth is not limited. Sandow's productivity success is not due to augmented fertilization rates. In accordance with RRC regulations, Alcoa must use the same fertilizer application rates as other responsible hay producers in Milam County (Hodges 2002). Given the success of the reclamation program at the existing Sandow Mine and the commitment to pursue additional revegetation evaluations during the life of the Three Oaks Mine, the adverse effect on native soil characteristics within the mine area is anticipated to be minor.

Short-term impacts (during the life of the mine and reclamation) to soils would include potential soil erosion of mined areas and stockpiled soils from prime farmland, until vegetation is reestablished, and the temporary loss of soil productivity in the mine areas, ancillary facilities, and along the transportation and utility corridor. The disturbed soils would be reclaimed following mining closure. Permanent adverse impacts would include the loss of native soils associated with the relocated public roads and end lakes; however, the relocated roads are expected to occupy relatively similar areas before and after mining and reclamation.

A total of 8,654 acres of soils would be disturbed as a result of the Proposed Action. Of this total, approximately 7,635 acres of the total disturbance would be revegetated and 895 acres would be reclaimed

Table 3.3-6
Estimated Crop Yields in Lee and Bastrop Counties

Crop (Yield Unit)	Acres Planted-All Purposes	Acres Harvested for Grain	Yield per Acre	Total Production
Lee County				
Corn (bushel)	1,700	1,600	86.3	138,000
Oats (bushel)	2,300	300	44.3	13,300
Peanuts (pounds)	1,500	700	1,160	813,000
Grain sorghum (pounds)	0	0	0	0
Wheat (bushel)	0	0	0	0
Bastrop County				
Corn (bushel)	2,400	2,400	89.6	215,000
Oats (bushel)	3,000	0	0	0
Peanuts (pounds)	0	0	0	0
Grain sorghum (pounds)	1,800	1,700	36,000	2,118
Wheat (bushel)	1,800	300	20.0	6,000

Sources: Alcoa 2000 (Volume 6); TASS 2000.

Table 3.3-7
Acreage and Proportionate Extent of Soil Disturbance under the Proposed Action

Mine Component	Acres of Disturbance	Percent of Disturbance
Transportation and utility corridor	359	4
Ancillary facilities	1,624	19
Mine area	6,466	75
Relocated roads and utilities	205	2
Total	**8,654**	**100**

as ponds and end lakes (a net increase of approximately 825 acres of water features), resulting in the net loss of approximately 825 acres of native soils.

Table 3.3-8 provides the disturbance acreage of prime farmlands that would occur as a result of project construction and operation. A total of approximately 122 acres of prime farmlands, as defined by RRC regulations, occur within the permit area. Of this total, approximately 56 acres occur within the proposed disturbance area; these soils would be salvaged to a depth of 4 feet and stockpiled. During reclamation, the stockpiled soils would be distributed over approximately 56 acres of land to be reclaimed as cropland.

Alcoa would comply with RRC regulations to restore prime farmland productivity after mining. The post-mining land use of previously existing prime farmlands would be cropland. Soil reconstruction, in accordance with RRC regulations, has been proposed for these areas on a 5-year permit term basis (Alcoa 2001b [Volume 4]). Native soils from prime farmland would be salvaged in separate layers (topsoil separate from subsoil) and reapplied to a depth of 4 feet on the final recontoured surface during reclamation.

Table 3.3-8
Prime Farmlands within the Anticipated Disturbance Area

Soil Mapping Unit	Soil Mapping Unit Name	Prime Farmlands within the Disturbance Area (acres)[1]	Percent of Disturbance Area
2BC	Chazos	0	0
74B	Gasil	5.2	0.06
174B	Gasil	30.0	0.35
HeB	Heiden	0	0
22B	Rader	21.0	0.24
Total		**56.2**	**0.65**

[1]These acres are defined by RRC regulations.

Sources: Alcoa 2001c (Volume 3).

Salvage, stockpiling (if necessary), and replacement would be conducted in accordance with RRC regulations (TAC 2001e). Soil amendments would be applied, if necessary, as determined by a testing program. As part of reclamation monitoring, crops would be monitored to compare the reclaimed soil productivity with nearby undisturbed prime farmland areas. Prime farmland restoration would be deemed successful when the productivity of the reclaimed areas is equal to or greater than that of non-mined prime farmland in adjacent areas (see Section 2.5.3.9, Monitoring of the Reclaimed Site).

Native soil characteristics (see **Table 3.3-3**) have been compared to RRC suitability guidelines and to the characteristics of other potential growth media sources (e.g., overburden). The suggested RRC guidelines for general use in Texas are presented in **Table 3.3-9**. The primary limitations to using the native topsoil materials in reclamation are their sandy texture, highly-erodible nature from the actions of both wind and water, and low fertility and moisture-holding capacity. The primary limitations to using the subsoil materials in reclamation are their heavy clay texture (with related structural, crusting and compaction, and permeability limitations) and frequent occurrence of strong acidity.

To promote site stabilization and revegetation success in the mine area, for areas other than prime farmlands, Alcoa proposes to select suitable growth media substitutes from overburden materials encountered during the mining process. These materials are proposed for use in place of native soil materials on the basis that they have better suitability for successful restoration of productive post-mining land uses. Intensive investigations of the native soil materials were carried out during baseline investigations, and they are deemed to be less suitable for reclamation purposes than other materials that can be obtained from the site (Alcoa 2000 [Volume 9]).

To determine the feasibility of the selective handling approach, 24 core samples were analyzed for suitability as growth media, generally using the parameters shown in **Table 3.3-9**. Samples were collected throughout the proposed disturbance area; however, they were more concentrated in the initial 5-year mine area (Alcoa 2001b [Volumes 2 and 5]). The borehole locations are shown in **Figure 3.3-2**. Additional review of the data was conducted during the course of this EIS assessment, adhering to the suitability parameters in **Table 3.3-9** for the purpose of consistent analysis of potential sources of material.

Table 3.3-9
General Suitability Criteria for Topsoil used in Reclamation

Suitability Parameter	RRC Recommended Criteria
pH (standard units)	≥ 5.0 to ≤ 8.4
ABA or NNP (tons/kiloton)	≥ 0
Sand (percent of fraction 0.05 to 2 mm diameter)	≤ 80
Clay (percent of fraction < 0.002 mm diameter)	≤ 40
Electrical conductivity (mmhos/cm)	≤ 4.0
Sodium adsorption ratio (SAR)	≤ 13
Boron (ppm)	≤ 5
Cadmium (ppm)	≤ 0.7
Molybdenum (ppm)	≤ 5
Selenium (ppm)	≤ 2

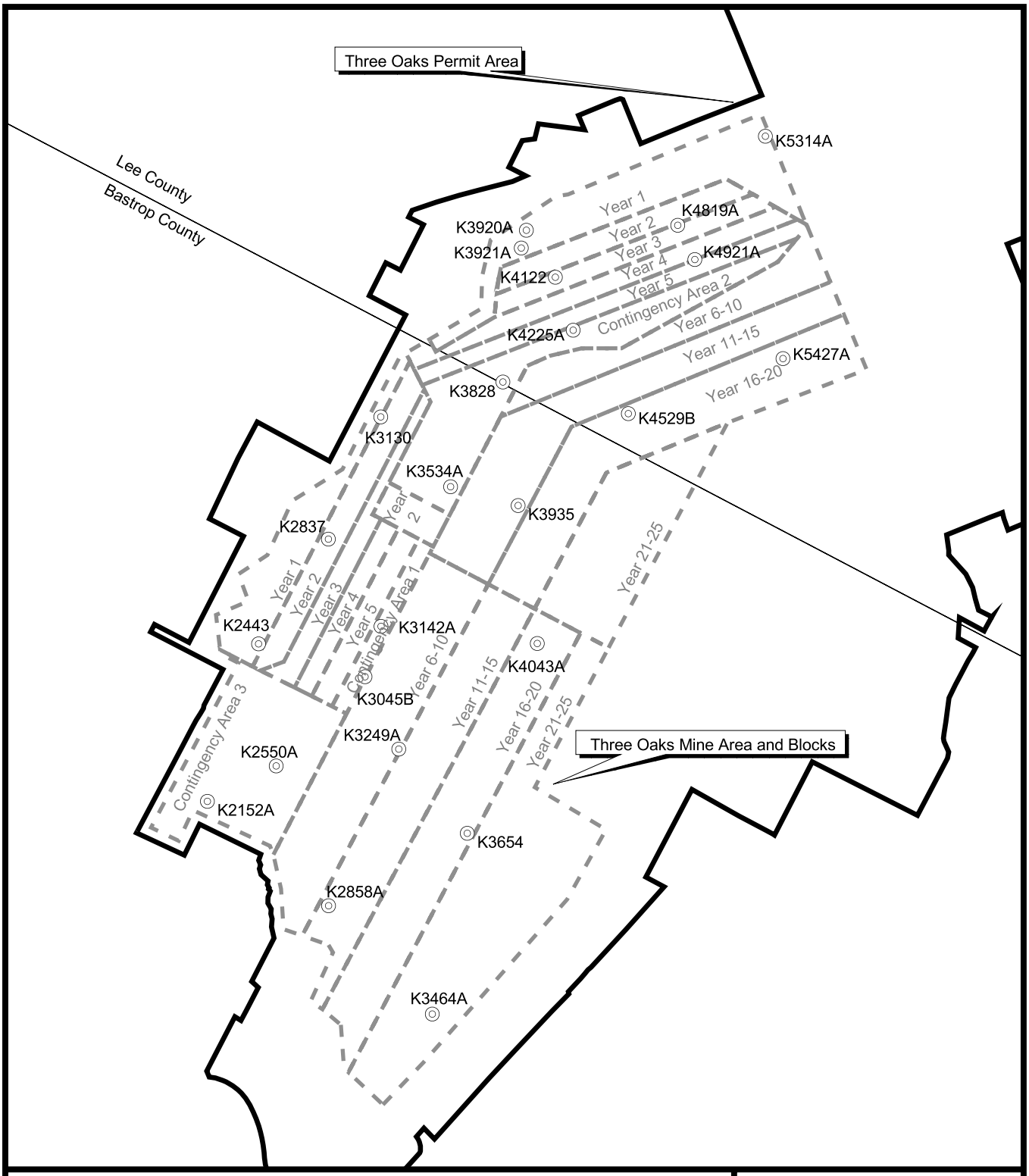
Note: mm = millimeter.
mmhos/cm = millimhos/centimeter.
ppm = parts per million.
ABA = acid base accounting.
NNP = net neutralization potential.

Sources: RRC 1988; Alcoa 2000 (Volume 9); Hodgkiss 2001.

The thickness of suitable growth media varies widely between borehole locations and with depth. In 4 of the 24 boreholes, the thickness of suitable material was 10 feet or less based on RRC criteria. Two of the boreholes have no suitable material if RRC criteria are rigorously applied. One borehole has approximately 16 feet of suitable material, 5 boreholes have suitable materials 20 to 40 feet thick, and the remaining 14 boreholes have suitable materials occurring in zones 40 to 80 feet thick or more. Similar to the native soil conditions, the limiting factors that would exclude other overburden and interburden materials from use in reclamation are dominantly related to texture (strongly sandy or clayey grain sizes). In some cases, trace metals (mostly selenium) and salt accumulations (as indicated by higher electrical conductivity and/or sodium adsorption ratio) restrict the suitability of materials. Acid-base conditions and net neutralization potential also are limiting in some zones.

Alcoa's investigation indicated that very large volumes of suitable alternative growth media from overburden and interburden sources exist within the proposed mine area. This was confirmed by further inspection during this impact assessment. The volume of suitable growth media is sufficient to replace a 4-foot depth of cover on the disturbed mine area. This assumes careful implementation of the selective handling program (see Section 2.5.2.6). The use of draglines and/or truck/shovel fleets during mining operations would promote the mixing of selected materials and allow for retrieval and inclusion of some less-suitable materials if they are encountered. Mixing of the selected growth media is anticipated to be more thoroughly accomplished under the proposed pit operations approach than it would be under a scraper/bulldozer operation, if the latter were used to salvage native topsoils.

The use of more suitable growth media from overburden and interburden sources, as opposed to the native topsoil materials, is not anticipated to limit the success of the reclamation program and possibly may enhance it. The reconstructed growth media is anticipated to have post-mine soil textures with an improved



Three Oaks Mine

Figure 3.3-2

Overburden Sampling Locations

balance of sand, silt, and clay, and is not expected to display the adverse physical characteristics of the native topsoil (i.e., excessive sand or clay). In addition, the pH and acid/base relationship in the alternative growth media is anticipated to be more advantageous to crop growth than the native topsoil characteristics. To ensure reclamation success, growth media testing would occur after the growth media is applied to the recontoured surface as part of the reclamation program described in Section 2.5.3, Closure and Reclamation. Based on reclamation procedures practiced at the existing Sandow Mine, it is anticipated that successful site stabilization and restoration of productive post-mining land uses would occur at the Three Oaks Mine as required by RRC regulations.

Water Discharge

Based on the planned implementation of erosion control measures (e.g., sediment control ponds, diversion ditches, silt fences, straw bales, and revegetation measures), the potential for soil erosion as a result of surface water discharge is anticipated to be low. No indirect impacts to soils on prime farmland would occur as a result of water discharge.

3.3.2.2 No Action Alternative

The mine-related disturbance of 8,654 acres of soils would not occur under the No Action Alternative. As a result, the direct and indirect impacts as described for the Proposed Action would not occur under this alternative.

3.3.3 Cumulative Impacts

Past, present, and reasonably foreseeable future projects within the cumulative effects area that have resulted and will result in the removal and disturbance of native soils include the Sandow Mine, Rockdale power generating station and aluminum smelter, clay mining and brick manufacturing near Butler and Elgin, Powell Bend Mine, and Lost Pine 1 and Sim Gideon power generating stations, and any future residential and commercial development.

Surface disturbance of soils at the Sandow Mine will total approximately 15,103 acres, all of which will be reclaimed. Approximately 772 acres of this total will be reclaimed as ponds and end lakes. Based on an estimated pre-mining waters of the U.S. acreage of approximately 118 acres, there will be a net increase of approximately 654 acres of water features. As a result, there will be a loss of 654 acres of native soils at Sandow. Reclamation practices at Sandow are the same as described in Section 2.5.3.5, Revegetation, for the Three Oaks Mine. Approximately 100 acres and 275 acres of native soils have been disturbed at the Rockdale power generating station and the aluminum smelter, respectively, since the 1950s. In addition, approximately 895 acres of native soils have been lost to development of Alcoa Lake in association with the Rockdale facilities.

Clay mining and brick manufacturing in the Butler and Elgin area include approximately 1,355 acres in ownership and have collectively disturbed approximately 1,000 acres for clay pits and ancillary facilities. Based on limited information received from inquiries to these operations, it appears that at least a portion of this area ultimately will be reclaimed (50 percent assumed for this analysis) for lake-side residential

development. Approximately 291 acres of native soils have been disturbed as a result of mine construction and operation at the Powell Bend Mine. This mine is being reclaimed under RRC regulations. In addition, approximately 900 acres of native soils have been permanently lost in association with the development of Lake Bastrop at the Lost Pines 1 and Sim Gideon power generating stations.

The continued growth of clay mining and manufacturing operations are reasonably foreseeable future actions that may occur within the cumulative effects area; however, surface disturbance for these actions cannot be determined at this time. Based on the quantifiable disturbances, including the soils loss associated with the Three Oaks Mine, a total of 27,218 acres of soils would be removed or disturbed within the cumulative effects area, of which a maximum of 23,132 acres have been or would be revegetated and the remainder reclaimed as water features. Based on a combined 188 acres of previously existing water features within these existing and proposed disturbance areas, there would be a cumulative loss of approximately 3,274 acres of native soils as a result of conversion of these lands to water features.

3.3.4 Monitoring and Mitigation Measures

Alcoa has committed to conducting soil sampling in the mine area to ensure that a suitable growth media is present for revegetation. Any areas that are deemed as unsuitable material would be covered with a suitable material to the appropriate depth (see Section 2.5.3.1, Rough and Final Grading). No additional monitoring or mitigation is being considered for soils.

3.3.5 Residual Adverse Effects

Residual adverse effects resulting from the Three Oaks Mine would include the permanent net loss of approximately 825 acres of native soils, resulting from the conversion of these lands to water features (i.e., ponds and end lakes) in conformance with the RRC approved post-mining land uses.

3.4 Vegetation

The principal issues associated with vegetation resources include: 1) disturbance and removal of native vegetation, particularly with respect to the long-term loss of Post Oak Savannah tree species; 2) loss of wetland/riparian vegetation due to direct disturbance and potential water level changes; 3) successful reclamation of disturbance areas to achieve post-mining land uses and to inhibit the establishment of invasive plant species; and 4) potential disturbance to the loblolly pines in the Lost Pines region as a result of groundwater drawdown.

3.4.1 Affected Environment

The study area for vegetation (including special status plant species) includes the permit area and road relocations; the projected mine-related 10-foot groundwater drawdown area within the Simsboro and Calvert Bluff aquifer outcrops; segments of Big Sandy and Middle Yegua Creeks extending approximately 6 miles downstream from the points of proposed mine water discharge; and the Lost Pines of Texas region. The boundary for the cumulative effects area includes the permit area and road relocations; the interrelated actions' projected 10-foot groundwater drawdown area within the Simsboro and Calvert Bluff aquifer outcrops; the interrelated actions' points of surface water discharge on Big Sandy, Middle Yegua, and East Yegua Creeks extending approximately 6 miles downstream; the Lost Pines of Texas region; and surface disturbance associated with the interrelated actions. Wetlands and other waters of the U.S. that support riparian, aquatic, and wetland vegetation and occur within the study and cumulative effects areas are described in Section 3.2.5, Waters of the U.S. Including Wetlands.

The Three Oaks Mine is located within the Prairie and Lakes ecoregion, which includes the Oaks Woods and Prairies and Blackland Prairies subregions of Texas (TPWD 2001a). The dominant native vegetation of the Three Oaks Mine study area is described as Post Oak Savannah (Alcoa 2000 [Volume 5]). This vegetation type extends more than 300 miles in a northeast-southwest strip from Oklahoma to Bexar and Atascosa Counties in southern Texas and ecompasses approximately 9.5 million acres (Bezanson 2000). Historical accounts describe the Post Oak Savannah as a mixture of open or closed woodlands and grasslands (Bezanson 2000). However, large areas have been converted to cultivated pastures and cropland over the last century. Topography of the region is characterized as gently rolling to hilly with elevations ranging from 300 to 800 feet NGVD (Gould 1975). The Post Oak Savannah is a transitional vegetation type, which consists of species that are representative of the oak-hickory forest and tall-grass prairie (Blair 1950).

Vegetation nomenclature presented in this section follows the *Manual of the Vascular Plants of Texas* (Correll and Johnston 1979) and the *Checklist of the Vascular Plants of Texas* (Hatch et al. 2001). Grass species associated with the Post Oak Savannah include little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), purpletop (*Tridens flavus*), and inland sea oats (*Chasmanthium latifolium*). Post oak (*Quercus stellata*), blackjack oak (*Quercus marilandica*), and cedar elm (*Ulmus crassfolia*) are the dominant tree species of this region. Additional grass species within the Post Oak Savannah may include buffalograss (*Buchloe dactyloides*), common curly mesquite (*Hilaria berlangeri*), threeawn (*Aristida* spp.), red lovegrass (*Eragrostis oxylepis*), broomsedge bluestem (*Andropogon virginicus*), splitbeard bluestem (*Andropogon ternarius*), and smutgrass (*Sporobolus indicus*).

Common tree species of the bottomland woodlands within the Post Oak Savannah include black willow (*Salix nigra*), eastern cottonwood (*Populus deltoides*), green ash (*Fraxinus pensylvanica*), American elm (*Ulmus americana*), cedar elm, pecan (*Carya illinoinensis*), black walnut (*Juglans nigra*), and sugar hackberry (*Celtis laevigata*).

Post Oak Savannah vegetation present within the Three Oaks Mine permit area (see **Figure 3.4-1**), as well as the surrounding study and cumulative effects areas, can be categorized into distinct vegetation types, which include grassland, upland woodland, mesquite grassland, riparian woodland, and aquatic and wetland habitat. In the permit area, nine different range sites (as discussed in Section 3.3, Soils) are associated with these vegetation types. Forage production by range site is presented in **Table 3.3-5**.

3.4.1.1 Vegetation Types

Grassland

Grassland vegetation types comprise approximately 6,570 acres (41 percent) of the Three Oaks Mine permit area and are classified as managed, fallow, or natural grasslands. Managed grasslands are managed for moderate grazing in some areas and mowed for hay in others. Fallow grasslands are commonly heavily grazed and dominated by weedy species. Natural grasslands previously have not been managed for grazing or haying practices. Stands of trees and shrubs occur as isolated patches as a result of the encroachment of honey mesquite (*Prosopis glandulosa*) and baccharis (*Baccharis* spp.) in abandoned pasturelands.

Vegetation species commonly found in managed grasslands include bermudagrass (*Cynodon dactylon*), brownseed paspalum (*Paspalum plicatulum*), and bahiagrass (*Paspalum notatum*). Fallow grasslands are dominated by invasive, weedy species such as honey mesquite, croton (*Croton* spp.), common broomweed (*Amphiachyris dracunculoides*), geradia (*Agalinus* spp.), Drummond sesbania (*Sesbania drummondii*), western ragweed (*Ambrosia psilostachya*), and threeawns.

Natural grasslands support a mixture of native grasses and invasive grass species including witchgrass (*Panicum capillare*), panicum (*Panicum* spp.), thin paspalum (*Paspalum setaceum* var. *muhlenbergii*), dropseed (*Sporobolus* spp.), and little bluestem. Dominant forbs include brown-eyed susan (*Rudbeckia hirta* var. *pulcherrima*), wooly croton (*Croton capitatus*), southern dewberry (*Rubus trivialis*), senna (*Senna* spp.), geradia, plaintain (*Plantago* spp.), bitter sneezeweed (*Helenium amarium*), and gaillardia (*Gaillardia* spp.), along with various wildflowers.

Upland Woodland

Approximately, 6,484 acres (40 percent) of the permit area is classified as upland woodland. This vegetation type occurs in small, remnant patches in the Three Oaks Mine permit area. The dominant tree species include post oak, blackjack oak, cedar elm, water oak (*Quercus nigra*), eastern redcedar (*Juniperus virginiana*), and black hickory (*Carya texana*). Understory species may include coma (*Bumelia lanuginosa*), yaupon holly (*Ilex vomitoria*), American beautyberry (*Callicarpa americana*), coralberry (*Symphoricarpus orbiculatus*), tree sparkleberry (*Vaccinium arboreum*), common elderberry (*Sambucus canadensis*), and

Middle Yegua Creek
CR 307
CR 309
CR 306
Proposed Disturbance Area
Three Oaks Permit Area
Mine Creek
Mine Creek
FM 696
FM 696
CR 304
FM 619
Williamson County
Lee County
Lee County
Bastrop County
Chocolate Creek
Big Sandy Creek
290
McDade
N
0
2000
4000 Feet
Legend
Aquatic Habitat
Grassland
Mesquite Grassland
Riparian Woodland
Upland Woodland
Source: Alcoa 2000 (Volume 6).

Three Oaks Mine

Figure 3.4-1

Vegetation Types Present within the Permit Area

6/18/02

southern blackhaw (*Viburnum rufidulum*). Several vine species such as saw greenbriar (*Smilax bona-nox*), mustang grape (*Vitis mustangensis*), Alabama supplejack (*Berchemia scandens*), and poison ivy (*Toxicodenron radicans*) occur within the upland woodland type. Within the upland woodland openings, little bluestem, threeawns, lovegrasses (*Eragrostis* spp.), small-flowered creek oats (*Chasmanthium sessiliflorum*), white crownbeard (*Verbesina virginica*), yellow nutgrass (*Cyperus esculentes*), sedge (*Carex joorii*), and woodsorrel (*Oxalis* spp.) are the dominant species.

Mesquite Grassland

Approximately 2,173 acres (14 percent) of the permit area are classified as mesquite grassland. These areas are similar to natural grasslands, but have a higher density of mesquite, juniper, and other woody species. The mesquite grassland type is frequently heavily grazed and commonly supports weedy species. Common understory species include nightshade (*Solanum* spp.), broomweeds, wooly croton, western ragweed, and threeawns.

Riparian Woodland

The riparian woodland type covers approximately 676 acres (4 percent) of the permit area and is typically characterized by a dense overstory of hardwoods. The riparian woodland types that predominantly occur in the permit area are remnant corridors surrounded by previously cleared land, with the most extensive areas occurring along Big Sandy, Willow, and Middle Yegua Creeks and their larger, unnamed tributaries.

Overstory species include pecan, water oak, American elm, green ash, cedar elm, and sugar hackberry. Common understory species include possumhaw (*Ilex decidua*), American beautyberry, coralberry, and Alabama supplejack. Herbaceous species, such as sedges, white crownbeard, inland sea oats, Missouri violet (*Viola missourensis*), sanicle (*Sanicula canadensis*), Virgina creeper (*Parthenocissis quinquifolia*), common chickweed (*Stellaria media*), and whitegrass (*Leersia virginica*), provide sparse ground cover. Vine species, including greenbriar, poison ivy, and mustang grape, commonly use the trees for support, and their foliage often reaches the tree canopy.

Aquatic and Wetland

Aquatic vegetation within the Three Oaks Mine permit area predominantly occurs in association with water-covered lands, such as stock ponds and small wetlands located immediately adjacent to the ponds. This land cover type covers approximately 173 acres (1 percent) of the permit area. Aquatic vegetation is generally restricted to shallow pond margins and includes seedbox (*Ludwigia* spp.), Drummond sesbania, rushes (*Juncus* spp.), arrowhead (*Sagittaria* spp.), smartweed (*Polygonum* spp.), and the occasional black willow. Open water areas of ponds occasionally may be colonized by pondweed (*Potamogeton* spp.), muskgrass (*Chara* spp.), and water lilies (*Nymphae* spp., *Nuphar* spp., and *Nelumbo* spp.).

Wetland vegetation in hydric habitats located within depressions and seeps covers approximately 9 acres (less than 0.1 percent) of the Three Oaks Mine permit area. Representative wetland species may include various rushes, sedges, and cattails (*Typha latifolia, T. domingensis*). Various wetland types occur in the permit area, and disturbance of wetland areas that are waters of the U.S. is regulated under the CWA (see

Section 3.2.5, Waters of the U.S. Including Wetlands). No forested wetland areas occur within the Three Oaks Mine permit area.

3.4.1.2 Vegetation Attributes

Commercially Important Plant Species

Several commercially important plant species occur within the permit area. Hardwood species, such as elm, oaks, hickories, and pecan, are marketed for firewood in Lee and Bastrop Counties on a limited scale. Coastal bermudagrass is the most important forage species that is specifically planted in managed grasslands for cattle grazing. Other important forage species that are planted in cultivated fields include bahiagrass and dallisgrass (*Paspalum dilatatum*).

Important Plant Species for Wildlife

Several plant species that occur in the permit area provide valuable cover and forage for wildlife. These species include mustang grape, greenbriar, various oaks, yaupon, possumhaw, rough-leaf dogwood (*Cornus drummondii*), pecan, black hickory, black willow, winged elm, sugar hackberry, southern dewberry, common persimmon (*Diospyros virginiana*), trumpet-creeper (*Campsis radicans*), American beautyberry, and several grasses and sedges.

"Lost Pines of Texas" Region

With its rolling topography, sandy substrates, and permanent springs, the Lost Pines of Texas Region sustains the westernmost stand of loblolly pine (*Pinus taeda*) and bog-associated flowering plants, ferns, and bryophytes. This pine hardwood forest is thought to be a remnant of an Ice Age pine forest, most of which did not survive the shift to a warm, dry climate (Texas State Historical Association [TSHA] 2001). This region, also known as loblolly pine-post oak upland forest, occurs on water-retaining, gravelly clay soils of the Calvert Bluff, Carrizo, Reklaw, Queen City, and Weches Formations. Loblolly pines grow best in moist areas but can grow in drier areas and remain competitive with other plants. Rooting depth for taproots is generally 3 to 5 feet, although taproots may grow to 6.5 feet in depth in deep sandy or loamy soils. However, the tree generally favors an extensive shallow lateral-root system with the majority of the root weight occurring in the top 2 feet of soil (U.S. Forest Service [USFS] 1990). Located approximately 6 miles south of the proposed permit area and approximately 80 miles from the pine regions of East Texas, this narrow belt of loblolly pines stretches approximately 13 miles across east-central Bastrop County in the southern part of the Post Oak Savannah. The nearest isolated stand of loblolly pines is approximately 0.25 mile southeast of the permit area.

The Lost Pines area combines the characteristics of the typical grasslands and woodlands of central Texas, the oak-dominated temperate deciduous regions of eastern Texas, and relict elements of the pine forest that dominated the area 5,000 years ago. Plant species commonly associated with these forested areas include black hickory, blackjack oak, eastern redcedar, cedar elm, hackberry, greenbriar, yaupon, elbowbush (*Forestiera pubescens*), purpletop, sand lovegrass, broomsedge bluestem, little bluestem, brownseed paspalum, bushclover (*Lespedeza* spp.), tickclover (*Desmodium* spp.), gay feather (*Liatris* spp.), yellow

neptunia (*Neptunia lutea*), bitter sneezeweed, and velvet bundleflower (*Desmanthus velutinus*) (TPWD 1997).

3.4.1.3 Special Status Species and Species of Special Concern

Special status species are those that are listed as federally threatened or endangered, or have been proposed or are considered as candidates for listing by the USFWS, and those species that are state listed as threatened or endangered by the TPWD. Federally listed and proposed species and federally designated areas of critical habitat receive protection under the Endangered Species Act (ESA) (Federal Register 1973). State listed plant species are protected under Chapter 88 of the Texas Parks and Wildlife Code and Sections 69.01-69.14 of Title 31 of the TAC.

Under the ESA, the USACE, as lead federal agency for the proposed project, must determine if the proposed activities may affect a federally listed species or species proposed for federal listing. If such a determination is made, the USACE is required under Section 7 of the ESA to consult with the USFWS regarding the scope and magnitude of the effects. A Biological Assessment (BA) is required under 7(c) of the ESA, if a federally listed species or critical habitat may be present in the action area. The USACE is currently preparing a BA for the proposed project.

Species of special concern collectively refers to non-listed species that the USFWS and/or TPWD consider to be rare or vulnerable. The USFWS' designation for these species is "species of concern," and the TPWD's designation is "rare." Species of concern are defined by the USFWS as species for which there is some information showing evidence of vulnerability but not enough data to support listing at this time. These species are not specifically afforded the same protection under the ESA as threatened or endangered species; however, federal agencies are required to consider them in the agency's planning and decision-making processes. The TPWD "rare" designation is based on a species' global conservation status rank; these species do not have regulatory listing status.

The proposed permit area lies within Bastrop and Lee Counties and within approximately 200 feet of Williamson County. The study and cumulative effects areas also include a portion of Milam County. According to the USFWS, one federally endangered plant species (Navasota ladies'-tresses) has been identified as potentially occurring within the cumulative effects area (USFWS 2002). In addition, three state-designated rare species (branched gayfeather, Park's jointweed, and Sandhill woolly white) also have been identified by the TPWD as potentially occurring within the study and cumulative effects areas (TPWD 2002b) (Texas Biological and Conservation Data System [TBCDS] 2001). Occurrence potential within the study and cumulative effects areas for each species is presented below.

Navasota Ladies'-tresses (*Spiranthes parksii*)

This species is federally listed as endangered and state listed as endangered in Texas. Although originally identified by the TPWD as potentially occurring in Lee County, subsequent correspondence with the TPWD has confirmed the removal of the species from their Lee County list (TPWD 1998, 2002b). The species has been identified by the USFWS as potentially occurring in Milam County (USFWS 2002), a portion of which is in the study and cumulative effects areas. Habitat for the species comprises post oak (*Quercus stellata*)

savannah at the margin of minor tributaries within the Navasota River and Brazos River drainages (USFWS 1984a). Adapted for life in xeric, upland forests, typically above 250 feet NGVD, Navasota ladies'-tresses are rarely found in floodplain forests or open areas dominated by tall grasses. More typically, the species is found at the upper reaches of drainages along stream banks and adjacent open areas created by natural disturbances (Wilson 1999). This species has not been observed within Bastrop, Lee, or Williamson Counties. The nearest known occurrences of this species to the permit area are in Washington County, approximately 30 miles southeast of the permit area (Sugeno 2002), and in eastern Milam County, approximately 35 miles northeast of the permit area (TBCDS 2001). Based on the species' upland habitat requirements and known distribution, which is outside of the study and cumulative effects areas, the Navasota ladies'-tresses has been eliminated from further analysis.

Texabama Croton (*Croton alabamensis* var. *texensis*)

This species is listed as a rare species by TPWD, and is considered by TPWD as potentially occurring in Williamson County. Texabama croton's known distribution includes portions of western Williamson County (Regional Environmental Consultants [RECON] 1996), including parts of the Edwards Plateau. The species is found in association with deciduous or evergreen woodlands of xeric limestone canyons and ravines (TBCDS 2001). The geology and habitat within the proposed study and cumulative effects areas are atypical of that known to support the species. In addition, the known distribution of the species is well west of the study and cumulative effects areas. As a result, the Texabama croton has been eliminated from further analysis.

Branched Gayfeather (*Liatris cymosa*)

This species is listed as rare by the TPWD. The branched gayfeather occurs in somewhat barren grassland openings in post oak woodlands on tight clay, chalky, or gravelly soils, sometimes over the Catahoula Formation (TBCDS 2001). This species is known from Brazos, Brazoria, Burleson, Lee, Waller, and Washington Counties (TBCDS 2001; Texas A&M Bioinformatics Working Group 2002a). This species has not been observed within the permit area (TBCDS 2001). The nearest known occurrence in Lee County is in an opening alongside a road approximately 34.5 miles east of the permit area (TBCDS 2001), outside of the study and cumulative effects areas. The soil requirements for this species are generally lacking in the permit area. Based on the habitat requirements of this upland species, the branched gayfeather has been eliminated from further analysis.

Parks' Jointweed (*Polygonella parksii*)

This species is listed as rare by the TPWD. Parks' jointweed has been observed in eastern Milam County approximately 40 miles northeast of the permit area (TBCDS 2001). The species is an annual knotweed associated with successional grasslands and openings in post oak woodlands established on deep sandy soils of the Carrizo and similar formations (TPWD 2002a). The soils required by this species are generally lacking in the permit area. Base on the species' habitat requirements and known distribution, the Parks' jointweed has been eliminated from further analysis.

Sandhill Woollywhite (*Hymenopappus carrizoanus*)

This species is listed as rare by the TPWD. The sandhill woollywhite occurs in deep sands typically derived from the Carrizo and similar formations, in disturbed areas, open areas in grasslands, and oak or pine woodlands (Turner 1989; TXBCDS 2001). This species in known from ten Texas counties, including Bastrop County (Texas A&M Bioinformatics Working Group 2002b; TXBCDS 2002). In Bastrop County, this species has been observed south of the Colorado River approximately 24.6 miles south of the study and cumulative effects areas. The soil requirements for this species are generally lacking in the permit area. Based on the habitat requirements of this upland species, the sandhill woollywhite has been eliminated from further analysis.

3.4.1.4 Weeds and Invasive Species

Populations of invasive plant species may occur in the proposed permit area; field surveys have not been conducted to determine the locations and areal extent of any potentially existing populations. The State of Texas does not have a designated noxious weed or invasive plant species list (Alderson 2001). However, the Texas Department of Agriculture (TDA) has prohibitions and restrictions on noxious weed seeds. Information regarding prohibited (species not allowed in seed mix) and restricted (species inclusion in seed mix is limited) noxious weed seeds is provided in Sections 9.1 and 9.9 (i.e., Noxious Weed Seed) of the TAC, Title 4, Part 1, Chapter 9, Subchapter E, Rule 9.9 and the Texas Register: 22 Tex Reg 128 dated January 7, 1997 (TAC 1997). Prohibited and restricted noxious weed seeds are listed in **Table 3.4-1**.

3.4.2 Environmental Consequences

3.4.2.1 Proposed Action

General Vegetation

Surface Disturbance. Under the Proposed Action, a total of 8,654 acres of vegetation would be directly affected as a result of surface disturbance within the mine area, along the transportation and utility corridor, within the ancillary support facilities areas, and along the relocated road and utility corridors. As discussed in Section 2.5.2.3, Clearing and Grubbing, trees and other vegetation would be removed incrementally in advance of mine development over the 25-year life of the mine. **Table 3.4-2** identifies the acreages of specific vegetation types that would be disturbed or removed as a result of the proposed project. As shown, the majority (approximately 81 percent) of the disturbance would occur in grassland and upland woodland areas.

Short-term (limited to the life of the mine and reclamation) and long-term (extending beyond the life of the mine and reclamation) impacts to vegetation would occur as a result of project construction and operation. Short-term impacts would result from the removal of herbaceous and woody (i.e., trees and shrubs) species within the mine area, transportation and utility corridor, and ancillary facilities. Re-establishment of post oak trees within the disturbance area similar in stature to those currently present would take approximately 75 to 90 years, assuming an average growth rate of 0.5 centimeter in diameter breast height (dbh) per year

Table 3.4-1
Texas Prohibited and Restricted Noxious Weed Seeds[1]

Common Name	Scientific Name	Prohibited or Restricted	Limitation per Pound
Goatgrass	*Aegilops* spp.	Restricted	20
Corncockle	*Agrostemma githage*	Restricted	300
Wild onion/ wild garlic	*Allium* spp.	Restricted	100
Wild oat	*Avena fatua*	Restricted	300
Feral oat	*Avena* spp.	Restricted	300
Wild mustards	*Brassica* spp.	Restricted	300
Chessgrass	*Bromus commutatus*	Restricted	300
Cheatgrass	*Bromus secalinus*	Restricted	300
Hedge bindweed	*Calystegia sepium*	Prohibited	Prohibited
Balloonvine	*Cardiosperma halicacabum*	Prohibited	Prohibited
Russian knapweed	*Centaurea repens*	Restricted	100
Canada thistle	*Cirsium arvense*	Restricted	100
Blessed thistle	*Cnicus benedictus*	Restricted	100
Field bindweed	*Convolvulus arvensis*	Prohibited	Prohibited
Dodder	*Cuscuta* spp.	Restricted	100
Bermudagrass	*Cynodon dactylon*	Restricted	See footnote
Nutsedge	*Cyperus rotundus* and *Cyperus esculentus*	Prohibited	Prohibited
Nutsedge tubers	*Cyperus* spp.	Prohibited	Prohibited
Wild carrot	*Daucus carota*	Restricted	300
Quackgrass	*Elytriga repens*	Restricted	100
Blueweed	*Helianthus ciliaris*	Restricted	100
Morning glory	*Ipomoea* spp.	Restricted	See footnote
Persian ryegrass	*Lolium persicum*	Restricted	300
Darnel ryegrass	*Lolium temuleutum*	Restricted	300
Serrated tussock	*Nassella trichotoma*	Prohibited	Prohibited
Red rice	*Oryza sativa*	Restricted	1
Passion flower	*Passiflora incarnata*	Restricted	See footnote
Bracted plaintain	*Plantago aristata*	Restricted	300
Buckhorn plaintain	*Plantago lanceolata*	Restricted	300
Annual bluegrass	*Poa annua*	Restricted	See footnote
Wild radish	*Raphanus raphanistrum*	Restricted	100
Common giant mustard	*Rapistrum rugosum*	Restricted	300
Castor	*Ricinus communis*	Prohibited	Prohibited
Itchgrass	*Rottboellia cochinchinensis*	Prohibited	Prohibited
Dock and sorrel	*Rumex* spp.	Restricted	300
Giant foxtail	*Setaria faberi*	Restricted	100
Blessed milk thistle	*Silybum marianum*	Restricted	20
Wild turnips	*Sinapis* spp.	Restricted	300
Horsenettle	*Solanum carolinensis*	Restricted	300
Purple nightshade	*Solanum elaeagnifolium*	Restricted	300
Tropical soda apple	*Solanum viarum*	Prohibited	Prohibited
Johnsongrass	*Sorghum halpense*	Restricted	See footnote
Puncturevine	*Tribulus terristris*	Restricted	300
Cocklebur	*Xanthium* spp.	Prohibited	Prohibited

[1]Seeds are considered noxious weed seed only when present in lawn and turf seed such as perennial ryegrass, turf type tall fescue, chewings fescue, rough bluegrass, turf type annual ryegrass, or a mixture containing these grasses.

Source: Alderson 2001.

Table 3.4-2
Acreages of Affected Vegetation

Vegetation Type[1]	Disturbance Acreage[2]
Grassland	3,626
Upland woodland	3,349
Mesquite grassland	1,245
Riparian woodland	352
Aquatic	82
Total Area	**8,654**

[1]These categories include minor areas of existing disturbance such as residences and roadways and approximately 6 acres of mesquite grassland outside of the RRC permit area that would be affected by road improvements and widening of CR 89. These areas are not shown in Figure 3.4-1.
[2]Acreage within anticipated disturbance area as shown in Figure 3.4-1.

Source: Alcoa 2000 (Volume 5).

(USFS 2001). To minimize these impacts, disturbance areas would be reclaimed as discussed in Section 2.5.3.5, Revegetation. In addition, reclamation of the mine area would proceed concurrently with mining operations as pit areas are backfilled. Ancillary facility areas would be reclaimed following the completion of mining.

Indirect impacts to native vegetation that likely would occur as a result of the Proposed Action include: 1) increased potential for encroachment of invasive plant species and 2) economic impacts to commercially harvestable vegetation, including trees and herbaceous vegetation, which provide firewood and forage for livestock grazing. Disturbance areas would be prone to the establishment of invasive plants from adjacent, undisturbed areas. Successful reclamation would minimize the encroachment of invasive species into reclaimed areas. The encroachment of invasive species could be further minimized through implementation of a control program in coordination with the NRCS (see mitigation measure V-1 in Section 3.4.4, Monitoring and Mitigation). The loss of commercially harvestable herbaceous vegetation would be minimal since reclaimed areas would provide forage for livestock and wildlife several years after reclamation. The salvage of trees removed during construction is infeasible due to safety and liability concerns that would outweigh the benefits of utilizing this resource. This loss would be minimized through the planting of trees in the disturbance area; however, any commercial value would not be realized for a number of years.

The disturbance areas would be reclaimed to achieve the post-mine land uses as required by RRC and discussed in Section 2.5.3, Closure and Reclamation. Although the land use categories would not be directly comparable to the vegetation communities described in Section 3.4.1, it is evident that some comparisons are warranted. For example: 1) the area occupied by surface water is expected to increase more than tenfold from approximately 70 acres to approximately 895 acres; 2) the area occupied by riparian habitat would increase from approximately 350 acres to approximately 379 acres; 3) residential areas would decrease from several residences before mining to a single residence after mining; and 4) land uses, such as cropland and industrial/commercial (roadways and utility rights-of-way), are expected to occupy relatively similar areas before and after mining. In addition to the reclamation of the disturbance area, Alcoa has developed a draft Mitigation Plan (Appendix E), which would provide for the offsite enhancement of

approximately 44.2 acres of riparian vegetation in the Middle Yegua Mitigation Site (see **Figure 2-12** and **Table 2-14**).

Mine Area. Mine development and operation would remove a total of 6,466 acres of vegetation as indicated in **Table 2-5** and shown in **Figure 3.4-1**. The incremental loss of vegetation would occur by mine block over a 25-year period. Concurrent reclamation, including the installation of ponds, would occur after each mine block has been backfilled. The last pits to be mined would not be backfilled and revegetated but would be reclaimed as end lakes. In addition, smaller impoundments would be distributed throughout the reclaimed mine area. As a result, there would be a permanent net loss of approximately 825 acres of vegetation due to conversion to pond and end lake post-mining land uses.

Based on the spatial disturbance of existing versus proposed ponds, the increase in the number of ponds following reclamation, and the reclamation of at least some of the existing ponds in accordance with post-mining land uses, it is not possible to accurately quantify the permanent loss of vegetation by vegetation type in association with the net increase in pond surfaces. However, the creation of end lakes, which would comprise the majority of the net loss of vegetation, would result in the permanent loss of 722 acres of vegetation. Of this 722 total acres, the vegetation permanently lost would include approximately 322 acres of upland vegetation, 233 acres of grassland, 155 acres of mesquite vegetation, 6 acres of aquatic vegetation, and 6 acres of riparian vegetation.

Ancillary Facilities. A total of 1,624 acres of vegetation would be disturbed as a result of construction of the ancillary support facilities. Surface disturbance associated with ancillary facilities would occur during the first and second years of mine construction (see **Table 2-5**). Ancillary support facilities include office building, warehouses, shops, storage areas, parking, and access roads (see Section 2.5.1.7, Ancillary Support Facilities, and **Figure 2-3**). These areas would be reclaimed following the completion of mining.

Three Oaks-to-Sandow Transportation and Utility Corridor. Construction of the transportation and utility corridor would result in the disturbance of 359 acres of vegetation during the first and second years of mine construction. Reclamation of the transportation and utility corridor would occur following the completion of mining.

Road and Utility Relocation. Relocated road and utility corridors, as identified in Section 2.5, Proposed Action, would disturb a total of 205 acres of vegetation, primarily during the first and second years of mine construction. Although the relocated road segments would result in the permanent loss of vegetation, this impact would be offset in part by the reclamation of the abandoned road segments.

Water Level Change. It is anticipated that groundwater withdrawal from the Simsboro aquifer would not result in direct impacts to upland vegetation within the 10-foot drawdown contour of the Simsboro aquifer outcrop. Oak, pine, and other large tree species, as well as herbaceous plant species, have shallow root systems and predominantly rely on soil moisture from precipitation. Post oaks and loblolly pines have similar rooting depths of 3 to 5 feet, although taproots may grow to 6.5 feet in depth in sandy or loamy soils (USFS 1990). These taproots provide stability for the trees while surface roots are primarily responsible for nutrient and moisture uptake. Since these species are generally unable to access groundwater at depths

greater than 10 feet, it is unlikely that the vegetation would be affected. As discussed in Section 3.2.3.2, mine-related groundwater drawdown in the Calvert Bluff aquifer would be restricted to the lower portion of the aquifer. As a result, no vegetation-related impacts have been identified.

Potential impacts to riparian or wetland vegetation potentially could occur where gaining stream flow is sustained by groundwater sources within the 10-foot drawdown area of the Simsboro outcrop. As discussed in Section 3.2.4.2, a measurable decrease in groundwater baseflow of gaining reaches is not anticipated where the groundwater drawdown is projected to be 10 feet or less; therefore, impacts to the vegetation associated with these reaches are not anticipated. Within the estimated 10- to 20-foot drawdown area, flows associated with gaining stream segments fed by groundwater could potentially decrease, thereby reducing the amount of available water for wetland and riparian vegetation. This reduction in available water may result in the partial loss of herbaceous riparian and wetland vegetation. However, impacts to woody riparian species established along intermittent creeks are not anticipated since these species have more extensive root systems than herbaceous riparian species. In the 20-foot or greater drawdown area, a decrease in groundwater baseflow of gaining reaches fed by groundwater within the Simsboro outcrop area likely would occur, thereby resulting in the potential long-term loss of herbaceous riparian and wetland vegetation and a potential loss of woody riparian species established along the upstream reaches of Big Sandy, Middle Yegua, and Walleye Creeks and sections of Little Sandy and Big Sandy Creeks. These effects likely would be localized as observed along similar reaches of stream affected by the Sandow Mine. Impacts to Big Sandy and Middle Yegua Creeks, as a result of drawdown during the life of mine, would be partially offset by surface water discharge, which would minimize the potential loss of riparian vegetation along the creeks below the discharge point. Section 3.2.4.2, provides detailed information pertaining to the impacts of water level changes on surface waters. As discussed in that section, the Calvert Bluff aquifer does not provide baseflow to any of the streams in the study area.

Water level changes may potentially affect seeps and springs fed by groundwater associated with the Simsboro outcrop (see Section 3.2.4.2). Riparian and wetland vegetation associated with one known spring or seep that occurs within the 20-foot or greater drawdown area would likely be affected by drawdown. One spring or seep occurring in the 10- to 20-foot drawdown area may be affected by drawdown with a minimal loss of riparian or wetland vegetation. Impacts to riparian and wetland vegetation associated with five springs and seeps within the 10-foot or less drawdown area are not anticipated from drawdown activities. No impacts to seeps or springs as a result of Calvert Bluff dewatering drawdown have been identified (see Section 3.2.4.2); as a result, there would be no impacts to associated riparian or wetland vegetation.

Groundwater withdrawal from the Simsboro aquifer would not affect the small, sparse stands of loblolly pines in the Lost Pines area since the Simsboro Formation outcrop does not extend to that area.

Water Discharge. Water discharge into intermittent creeks would not affect upland vegetation. Riparian and wetland vegetation associated with Middle Yegua, Upper Big Sandy, and Chocolate Creeks below the discharge points would be directly affected by water discharge. Along Middle Yegua and Upper Big Sandy Creeks, water discharge would increase the extent of riparian and wetland vegetation for the duration of discharge (possibly for the life of the operation). Within several years following the discharge period, the extent of riparian and wetland vegetation would decrease. This impact would be compounded by mine-related groundwater drawdown in the Simsboro aquifer and the resulting impacts to gaining stream

reaches until the aquifer recovers (approximately 40 years for 90 percent recovery and approximately 100 years for 100 percent recovery). Effects to riparian and wetland vegetation from water discharge would be most prevalent along the stream segments within close proximity to the discharge points; riparian and wetland vegetation would progressively decrease as the distance from the discharge points increases. No impacts to riparian or wetland vegetation are anticipated to result from sedimentation, as the proposed discharge rates are not anticipated to contribute to channel erosion (see Effects of Discharges to Streams in Section 3.2.4.2. The establishment of riparian and wetland vegetation may occur along Chocolate Creek over a 2- to 3-year period as a result of discharge. This vegetation would likely exist for the duration of the discharge period. After the discharge period, riparian and wetland vegetation that had become established during the discharge period would be lost as the baseflow returned to pre-discharge conditions.

Indirect impacts, as a result of water discharge, would include an increased potential for invasive plant species establishment along the stream channels. Mine-related flows in Middle Yegua, Upper Big Sandy, and Chocolate Creeks would provide ample soil moisture during the discharge period that would create a more desirable environment for invasive plant species establishment.

Special Status Species and Species of Special Concern

As discussed in Section 3.4.1.3, the special status species and species of special concern that were identified for the project by the USFWS (2002) and TPWD (2002b) have been eliminated from further analysis based on their known distribution or habitat requirements, which place them outside of the project's area of effect.

3.4.2.2 No Action Alternative

The direct mine-related disturbance of 8,654 acres of vegetation would not occur under the No Action Alternative. In addition, the potential impacts to vegetation associated with mine-related water level changes and surface water discharge would not occur. As a result, the impacts to vegetation as described for the Proposed Action would not occur.

3.4.3 Cumulative Impacts

3.4.3.1 General Vegetation

Three Oaks without SAWS

Past, present, and reasonably foreseeable future projects within the cumulative effects area that have resulted and will result in the removal and disturbance of vegetation include the Sandow Mine, Rockdale power generating station and aluminum smelter, clay mining and brick manufacturing near Butler and Elgin, Powell Bend Mine, the Lost Pines 1 and Sim Gideon power generating stations, and any future residential and commercial development.

Approximately 15,103 acres of Post Oak Savannah vegetation will be removed at the Sandow Mine as a result of mine construction and operation. Of this total, approximately 14,331 acres will be revegetated and

approximately 772 acres will be reclaimed as post-mining ponds and end lakes. Based on an estimated pre-mining waters of the U.S. acreage of approximately 118 acres, there will be a net loss of approximately 654 acres of vegetation through conversion to water features. Approximately 100 acres and 275 acres of Post Oak Savannah vegetation have been removed at the Rockdale power generating station and aluminum smelter, respectively, since the 1950s. In addition, approximately 895 acres of vegetation have been converted to form Alcoa Lake in association with development of the Rockdale facilities.

Clay mining and brick manufacturing in the Butler and Elgin area include approximately 1,355 acres in ownership. Operations at these facilities have collectively resulted in the removal of approximately 1,000 acres of vegetation for clay pits and ancillary facilities. Based on limited information received from inquiries to these operations, at least a portion of this disturbance ultimately will be reclaimed (50 percent assumed for this analysis) (see Section 2.6.1.4). Approximately 291 acres of Post Oak Savannah vegetation have been removed as a result of mine construction and operation at the Powell Bend Mine. The Powell Bend Mine is currently being reclaimed in accordance with RRC regulations. In addition, approximately 900 acres of vegetation have been converted to form Lake Bastrop in association with operation of the Lost Pines 1 and Sim Gideon power generating stations.

The continued growth of clay mining and manufacturing operations and expansions by the various brick manufacturing companies are the only reasonably foreseeable future actions that may occur within the cumulative effects area. However, surface disturbance for these actions cannot be determined at this time.

Based on the quantifiable disturbances, including disturbances associated with the Three Oaks Mine, a total of 27,218 acres of vegetation would be removed or disturbed within the cumulative effects area of which a maximum of 23,132 acres would be revegetated, with the remainder reclaimed as water features. Based on a combined 188 acres of previously existing water features within these existing and proposed disturbance areas, there would be a cumulative loss of approximately 3,274 acres of vegetation as a result of the conversion of lands to water features.

As discussed in Section 3.4.2.1, the Proposed Action would not affect loblolly pines, including the Lost Pines Region of Texas, based on the location of loblolly pine stands in relation to the proposed mine and the species' shallow rooting system. As a result, the proposed Three Oaks Mine would not contribute to any cumulative impacts to this species.

As discussed in Section 3.2.4.2, cessation of Sandow Mine dewatering and depressurization discharges would end artificial flow in East Yegua and Walleye Creeks in approximately 2003, thus returning the creeks to their original ephemeral or intermittent regime. As a result, a progressive reduction in the extent of riparian vegetation along these channels may occur approximately 10 to 15 miles downstream of the discharge points. However, water discharge from the Three Oaks Mine would augment flows in Big Sandy, Middle Yegua, and Chocolate Creeks approximately 4 to 6 miles downstream of the discharge points. These augmented flows would result in the establishment of riparian vegetation due to increased available water, thereby temporarily (through approximately year 2030) offsetting the progressive loss of riparian vegetation resulting from the cessation of discharges from the Sandow Mine. Following year 2030, some loss of established vegetation along Big Sandy, Middle Yegua, and Chocolate Creeks also may occur.

As discussed in Section 3.2.4.3, prior to year 2030 water level changes in Big Sandy and Middle Yegua Creeks may be offset by water discharge from the Three Oaks Mine, thus not affecting riparian vegetation associated with these drainages downstream of the discharge points. With the cessation of discharge from the Three Oaks Mine after approximately year 2030, continued drawdown in the Simsboro aquifer from municipal pumping would result in the progressive reduction of riparian vegetation along the gaining segments of Big Sandy, Burlson, Little Sandy, Middle Yegua, Walleye, Grass, and Sandy Creeks and associated tributaries within the 20-foot or greater drawdown area. Riparian/wetland vegetation associated with three springs along the Big Sandy Creek system and three or possibly four springs along the Middle Yegua Creek system also may be affected by groundwater drawdown in the Simsboro aquifer by the year 2030.

Three Oaks with SAWS

Surface disturbance to vegetation within the cumulative effects area for the Three Oaks Mine with SAWS would be the same as discussed for the Three Oaks Mine without SAWS. Impacts to riparian vegetation as a result of water discharge would be similar to that described above through year 2013. As previously mentioned, prior to year 2013, riparian vegetation associated with Big Sandy and Middle Yegua Creeks would become enhanced as a result of Three Oaks Mine water discharge. However, following year 2013 with the implementation of SAWS, flow augmentation from the mine would cease and riparian vegetation associated with these drainage segments would progressively revert to pre-mining conditions. Although natural intermittent flows would occur in the creeks in response to storm events, they would not likely support riparian vegetation in the long-term. Based on the projected cumulative groundwater drawdown in the Simsboro aquifer (see Section 3.2.3.3), there would be a permanent loss of enhanced riparian vegetation along the gaining reaches associated with the Simsboro outcrop to the west of the Three Oaks and Sandow Mines.

SAWS without Three Oaks (No Action Alternative)

Surface disturbance to vegetation within the cumulative effects area for the No Action Alternative scenario would be the same as discussed in the Three Oaks without SAWS scenario, less the impacts from the proposed Three Oaks Mine. No Three Oaks Mine-related water discharge in the Big Sandy, Middle Yegua, or Chocolate Creeks would occur under the No Action Alternative. As a result, riparian vegetation currently present along these creeks would not temporarily benefit from additional available water provided by discharge from the Three Oaks Mine, and there would be no temporary offset in the reduction of enhanced riparian vegetation associated with the cessation of discharge from the Sandow Mine. Impacts to riparian vegetation associated with gaining stream channels, springs, and reaches as a result of SAWS and municipal pumpage drawdown would be similar to that described for the Three Oaks with SAWS scenario.

3.4.3.2 Special Status Species and Species of Special Concern

The proposed project would not impact any special status species or species of special concern (see Special Status Species and Species of Special Concern in Section 3.4.2.1). As a result, the proposed project would not contribute cumulatively to impacts for these species.

3.4.4 Monitoring and Mitigation Measures

Alcoa proposes concurrent revegetation, where possible, and testing of growth media for its suitability for revegetation. The USACE is considering the following additional mitigation measure for vegetation.

V-1: Invasive Plant Species. Alcoa would coordinate with the NRCS in regard to the potential treatment of invasive plant species that may become established within the permit area as a result of mine construction and operation.

3.4.5 Residual Adverse Effects

Based on the conversion of native vegetation to post-mining ponds and end lakes, a permanent net loss of approximately 825 acres of vegetation would occur. (Refer to Mine Area under Section 3.4.2.1 for a breakdown by vegetation type.)

3.5 Fish and Wildlife Resources

The primary issues related to wildlife and fisheries resources include the loss or alteration of wildlife habitat within the mine area and the ancillary support facility areas, decreased water availability and associated changes in wetland and riparian habitat as a result of water level changes within the projected mine-related groundwater drawdown area, and mine water discharge into local drainages.

3.5.1 Affected Environment

The study area for fish and wildlife species (including special status species) includes the permit area; the projected mine-related 10-foot groundwater drawdown area within the Simsboro and Calvert Bluff aquifer outcrops; and the areas downstream of the mine water discharge locations on Big Sandy Creek south to the confluence with the Colorado River and on Middle Yegua Creek south to Somerville Lake. The boundary for the cumulative effects area for these resources includes the mine permit area; surface disturbance associated with interrelated actions; the projected cumulative 10-foot groundwater drawdown area within the Simsboro and Calvert Bluff aquifer outcrops and the areas downstream of the surface water discharge on Big Sandy Creek south to the confluence with the Colorado River and on Middle and East Yegua Creeks south to Somerville Lake; and critical and known Houston Toad habitat within these potential impact areas. As discussed in Section 3.2, Water Resources, no impacts to the Carrizo aquifer and associated habitats at the outcrop areas are anticipated based on the project's projected groundwater drawdown .

Information regarding fish and wildlife resources and current habitat conditions within the permit area and the larger study area was obtained from existing published sources and site-specific field surveys conducted by Horizon Environmental Services, Inc. (Horizon) and Texas A&M University (TAMU) (Alcoa 2000 [Volume 6]). Surveys for both resident and migratory wildlife were conducted in and adjacent to the permit area in the spring and summer of 1999 and 2000, and winter 2000 (Alcoa 2000 [Volume 6]). Wildlife surveys also were conducted on reclaimed lands at Alcoa's Sandow Mine from May 22 through June 8, 2000. These studies examined the overall use of the area by terrestrial vertebrates and special status species. Representative wildlife species that may occur in the vicinity of the permit area are identified in Appendix F, **Table F-1**. Aquatic habitat, fish, and benthic macrovertebrate surveys were conducted by Horizon in May and June 1999 and March 2000. These studies focused on areas with water within or adjacent to the permit area (i.e., Big Sandy, Willow/Mine, and the Middle Yegua drainages). Survey specifics pertaining to sensitive aquatic and wildlife resources are discussed further in Section 3.5.1.5, Special Status Species.

3.5.1.1 Habitat

As discussed in Section 3.4, Vegetation, the study area occurs within the Post Oak Savannah Region. This region is a transitional vegetation type, which consists of species that are representative of the oak-hickory forest and tall-grass prairie (Blair 1950). The topography within this area is described as gently rolling to hilly at elevations ranging from 300 to 800 feet NGVD (Gould 1975).

Wildlife habitat within the study area consists primarily of upland woodland, mesquite grassland, and other grassland communities. Riparian woodlands within the study area occur primarily along the banks of ephemeral and intermittent creeks, tributaries, and drainages. The majority of wetlands within the study area

are limited to small depressional areas near ephemeral creeks or impoundments created by stock pond embankments or roadways (see Sections 3.2, Water Resources, and 3.4, Vegetation). Overall habitat value for wildlife resources within the study area ranges from low to high, transitioning from a mixture of improved and unimproved grassland and mesquite grassland communities to higher quality upland woodland and riparian woodland communities.

Aquatic habitat within or near the permit area is limited to ephemeral and intermittent creeks, stock ponds, and other impoundments. The primary drainages located within and near the permit area include Middle Yegua Creek and Big Sandy Creek and their tributaries (see **Figure 3.2-21**). Middle Yegua Creek drains the northern portion of the permit area, while Big Sandy Creek drains the southern portion (see Section 3.2, Water Resources). The mainstem portions of Big Sandy Creek are located outside of the permit area. The ephemeral streams exhibit seasonal flow solely as a result of rainfall events in the region, where as intermittent streams are supported by precipitation in addition to seasonal groundwater influence. Numerous ponds also are scattered throughout the general area. Aquatic sampling identified perennial flow at only three locations in the study area. All three locations (two locations in Little Sandy Creek and one location in Middle Yegua Creek) were downstream of the permit area (Alcoa 2001b [Volume 3]). The main channel in Big Sandy Creek (Station SC4) is approximately 8 to 20 feet wide with a mixture of pool and riffle habitats and depths ranging from less than 0.5 to 6 feet. The mainstem perennial portion of Middle Yegua Creek is approximately 15 to 25 feet wide and 3 to 6 feet deep. Pond habitat also is present (Station SC3) with a wetted width of approximately 50 to 75 feet and water depths of 6 to 8 feet.

The mainstem portions of East and Middle Yegua Creeks downstream to Somerville Lake within the Brazos River watershed and Big Sandy Creek downstream to the confluence with the Colorado River are within the study area. At full pool, Somerville Lake has 85 miles of shoreline. Fish cover is limited in the shoreline areas, except during high water periods when terrestrial vegetation is partially covered by high water levels. The maximum water depth is approximately 38 feet with water level fluctuations typically ranging from 1 to 6 feet (TPWD 2001b). Aquatic habitat in Big Sandy Creek in the Camp Swift area contains a mixture of pools, riffles, and runs with fish cover such as overhanging vegetation and instream woody debris and roots (Linam et al. 1996). Habitat in Middle and East Yegua Creeks also comprises a mixture of pools, riffles, and runs in perennial segments.

3.5.1.2 Terrestrial Game Species

White-tailed deer is the most important game species in the study area (Pleasant 2001). This species occurs primarily in post oak and blackjack oak forests that contain adequate shrub layers for both food and cover. However, higher quality habitat and increased densities of deer typically occur along the riparian corridors associated with creeks and rivers (Polasek 2001). In Bastrop and Lee Counties, deer occur at extremely low densities (approximately one deer per 70 to 100 acres and one deer per 50 to 75 acres, respectively) (Pleasant 2001; Polasek 2001). Low deer densities within the study area are attributed primarily to habitat alteration, resulting from agricultural practices and brush removal (Pleasant 2001). However, deer populations have risen slightly since 1996, due to private landowner awareness and wildlife habitat improvement programs (Pleasant 2001). White-tailed deer are occasionally observed in the permit area (Alcoa 2000 [Volume 6]).

Upland game birds in the study area include mourning dove, white-winged dove, Rio Grande turkey, and northern bobwhite. Mourning dove is the most important game bird in Texas in terms of hunter recreation (George 1988). Both mourning dove and white-winged dove are abundant in native fields, agricultural areas, and pasture lands in the study area. Mourning dove were commonly observed in the permit area during the various field reconnaissances (Alcoa 2000 [Volume 6]). Wild turkey also is an important game bird in the study area. As with other game species, a diversity of cover is important for maintaining healthy turkey populations. Shrubs, weeds, vines, grasses, and agricultural crops provide adequate cover for this species. In the study area, turkeys are frequently associated with stream and river bottoms, and upland post oak forests (Polasek 2001). The most substantial numbers of turkeys in the vicinity of the study area occur around the Sandow Mine as a result of turkey reintroductions by Alcoa (Pleasant 2001). Turkey sign (i.e., feathers and tracks) also has been identified within the permit area (Alcoa 2000 [Volume 6]). Northern bobwhite has been identified within the permit area (Alcoa 2000 [Volume 6]). The majority of nesting northern bobwhite utilize high quality grass cover along roadsides, in pastures, and in hay fields, although brush and woodlands are sometimes used (Parmalle 1955). Within the study area, population levels have been substantially reduced by the conversion of native grassland communities to coastal bermudagrass (Polasek 2001). Consequently, very few bobwhite occur in Bastrop and Lee Counties (Polasek 2001). The highest densities of northern bobwhites within the vicinity of the study area occur within Alcoa's reclaimed sites at the Sandow Mine (Pleasant 2001).

Important small game mammals in the study area include fox squirrel, eastern gray squirrel, and eastern cottontail. The fox squirrel is found in upland woodlands and bottomland woodlands, while the eastern gray squirrel is restricted primarily to bottomland woodland habitat. Hardmast (e.g., acorns) provides the bulk of both species' diets. Only the fox squirrel was observed in the permit area during the surveys, although habitat for the eastern gray squirrel exists (Alcoa 2000 [Volume 6]). The eastern cottontail inhabits brush-dotted pastures, brushy edges of cultivated fields, and sides of well-drained streams. In many places it is common along country roads, especially where the sides are grown up to dense vegetation and adjoining areas are heavily grazed or farmed. The eastern cottontail was observed regularly within the permit area (Alcoa 2000 [Volume 6]).

Furbearers are of economic and recreational importance in Texas. On a statewide basis, the annual fur harvest for Texas in 1987 and 1988 was approximately $8 million (Sorola 1988). Within the Post Oak Savannah Region, the Virginia opossum, raccoon, and striped skunk were the most abundant furbearers that were observed during TPWD censuses in the Post Oak Savannah (Sorola 1988). These species also were observed within the permit area during wildlife surveys. Additional furbearers that occur within the study area include beaver, gray fox, nutria, and badger.

Other game species identified for the study area include a number of waterfowl that are present as migrant or winter residents (see Appendix F, **Table F-1**). In Central Texas, large concentrations of waterfowl migrate through the study area. Perennial and intermittent ponds within the study area could provide important habitat for many migrating and overwintering waterfowl. However, no large concentrations of waterfowl were observed during the wildlife surveys within the permit area (Alcoa 2000 [Volume 6]).

3.5.1.3 Terrestrial Nongame Species

A diversity of nongame wildlife species (e.g., small mammals, passerines, raptors, amphibians, and reptiles) is associated with the habitats within the study area. Regional nongame species that could occur within the study area are listed in Appendix F. General habitats found within the study area (i.e., upland woodland, riparian woodland, grassland, and wetland) support a variety of resident and seasonal nongame species. Passerines (songbirds) are numerous and use the entire range of native habitats (e.g., wooded uplands, riparian, mesquite grassland) and man-made features (e.g., pasture lands) within the study area. Mammal species also occur within habitats throughout the study area; however, certain habitats (e.g., riparian) support a greater density and diversity of species than other habitats. In general, small mammals tend to be more widely distributed than larger mammals, occupying a variety of habitat types.

Many nongame mammal species occur within the study area (see Appendix F, **Table F-1**). Nongame mammal species that were observed within the permit area during the wildlife surveys included nine-banded armadillo, black-tailed jackrabbit, plains pocket gopher, deer mouse, white-footed mouse, northern pygmy mouse, hispid cotton rat, eastern rat, and coyote (Alcoa 2000 [Volume 6]). Nongame mammals, particularly small mammal species, provide a substantial prey base for the region's mammalian predators and raptor species.

Nongame birds encompass a variety of passerine and raptor species. Regional birds are presented in Appendix F, **Table F-1**. Nongame birds include a diversity of neotropical migrants - birds that breed in North America and winter in the neotropical region of South America. These bird species are considered integral to natural communities and act as environmental indicators based on their sensitivity to environmental changes caused by human activities. A total of 66 avian species were observed and recorded during the wildlife surveys. The most common bird species observed during the bird surveys included northern cardinal, American crow, mourning dove, and cattle egret. Other species that were commonly observed during the surveys included turkey vulture, red-tailed hawk, Carolina chickadee, tufted titmouse, northern mockingbird, and eastern meadowlark (Alcoa 2000 [Volume 6]). Due to the higher level of plant diversity and structure, more abundant potential nest sites, and greater food base, upland and riparian woodlands support a greater number of birds than the surrounding grassland communities within the study area.

Several raptor species have been observed within the study area including Cooper's hawk, red-shouldered hawk, red-tailed hawk, and crested caracara. The red-tailed hawk was one of the commonly observed raptor species during wildlife surveys and reconnaissance efforts within the permit area (Alcoa 2000 [Volume 6]). Consequently, it is possible that established breeding territories could occur within the permit area. A number of other raptors also may use the permit area and surrounding habitats for foraging and nesting. **Table F-1** in Appendix F lists the raptor species that could occur within the study area.

Other nongame species in the study area would include amphibian and reptile species. Common amphibian species that were observed within the permit area during wildlife surveys included Blanchard's cricket frog, Gulf Coast toad, Woodhouse's toad, green treefrog, gray treefrog, bullfrog, and southern leopard frog. Common reptile species that were observed within the permit area included red-eared slider, northern fence lizard, ground skink, and diamondback water snake. A number of these nongame species depend on the

limited riparian and wetland habitat associated with area creeks and ponds, which are particularly important to the presence of certain species within the study area.

3.5.1.4 Aquatic Species

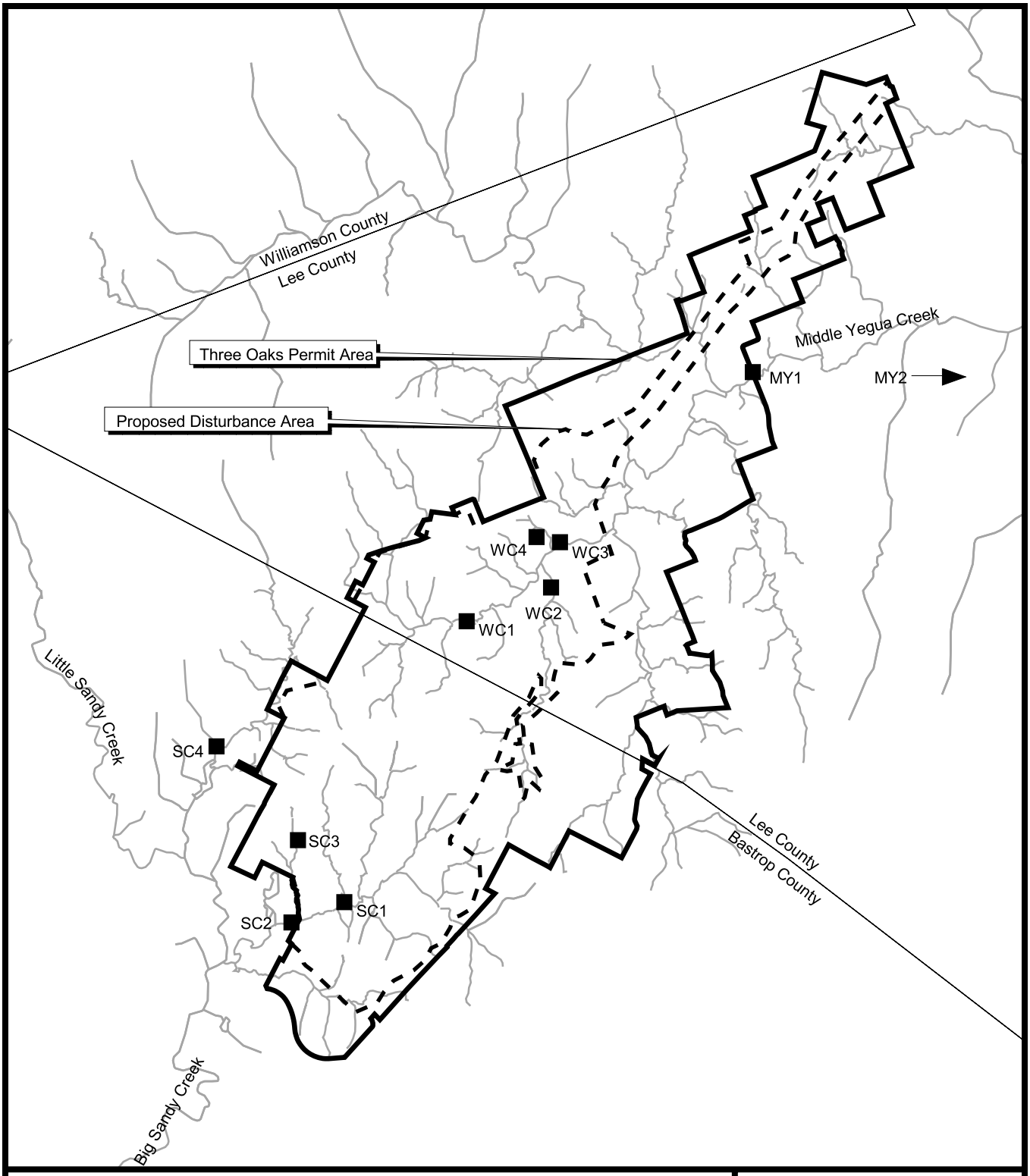
Dip net, seine net, and electrofishing surveys were conducted to describe fish composition in water bodies located within and immediately adjacent to the mine area (Alcoa 2001b [Volume 3]). Eight sampling sites (**Figure 3.5-1**) located in the Big Sandy, Willow/Mine, and Middle Yegua drainages supported a total of 18 warmwater fish species; these species are identified in **Table F-2** in Appendix F. The highest numbers of fish taxa were collected in a tributary to Big Sandy Creek (pond habitat designated as sample location SC3) and in Big Sandy Creek itself (sample location SC4) with 10 and 12 fish taxa, respectively.

The Middle Yegua sampling site contained 11 fish taxa. One to three taxa were collected at the unnamed tributary to Big Sandy Creek (sample location SC2) and Willow/Mine sampling sites, which reflect marginal habitat associated with intermittent stream reaches. The most abundant species included sunfishes and western mosquitofish. Game fish, represented by largemouth bass, white crappie, and sunfish species, were collected in the Big Sandy and Middle Yegua drainages. However, recreational fishing in the area is limited due to the limited extent of perennial stream reaches in the study area, limited access, and the relatively low numbers of bass and crappie populations.

Fish communities in water bodies located downstream of the permit area are present in perennial reaches in Big Sandy and Middle Yegua Creeks and Somerville Lake. Fish composition in Big Sandy Creek and Middle and East Yegua Creeks is similar to that within or near the permit area. Previous sampling in Big Sandy Creek in the Camp Swift area resulted in 19 fish species, while 14 species were collected in Middle Yegua Creek below State Highway 21 (Linam et al. 1996; TPWD 2000b; Mosier 2001). Game fish species consist of sunfishes, catfishes, and largemouth bass. The lower portion of Big Sandy Creek at the confluence with the Colorado River also may support species from the Colorado River, particularly during high flow periods. Somerville Lake contains game fish species such as largemouth bass, white crappie, black crappie, sunfishes, white bass, hybrid striped bass, channel catfish, blue catfish, and flathead catfish (TPWD 2001b). Hybrid striped bass move into Yegua Creek during the spring spawning period.

The spawning periods of the game fish species present within or downstream of the permit area occur primarily in the spring or early summer. No unique or critical spawning habitat is present in streams within the permit area.

Macroinvertebrate communities collected at nine sampling sites in the Big Sandy, Willow/Mine, and Middle Yegua drainages are widespread in distribution, fairly tolerant of water quality conditions, and indicative of slow-moving stream or pond habitat (Alcoa 2001b [Volume 3]). The total number of taxa collected at each sampling site ranged from 1 to 14 taxa. The most abundant taxa consisted of chironomid midges, adult bugs, and crayfish. The abundance of the other macroinvertebrate taxa represented by oligochaete worms, snails, mayflies, dragonflies/damselflies, and beetles was low.



Source: Alcoa 2001b (Volume 2).

Three Oaks Mine

Figure 3.5-1

Aquatic
Sampling Sites

6/14/02

No information is available on aquatic communities in the off-channel and on-channel stock ponds. Although no surveys have been conducted in the stock ponds, nongame and possibly game fish species could be present in the on-channel ponds due to dispersal during high-flow conditions. Macroinvertebrate communities would be similar to the taxa collected in pond habitats (Alcoa 2001b [Volume 3]). Macroinvertebrate production is expected to be higher in the on-channel ponds due to the presence of more aquatic vegetation and less turbid water compared to the off-channel ponds.

3.5.1.5 Special Status Species and Species of Special Concern

Special status species are those that are listed as federally threatened or endangered, or have been proposed or are considered as candidates for such listing by the USFWS, and those species that are state-listed as threatened or endangered by the TPWD. Federally listed and proposed species and federally designated critical habitat receive protection under the ESA. State-listed animal species are protected by laws and regulations contained in Chapters 67 and 68 of the Texas Parks and Wildlife Code and in Sections 65.171-65.184 of Title 31 of the TAC.

The USFWS and TPWD also have designated categories for non-listed species that are believed by those agencies to be rare or vulnerable. USFWS designates such species as “species of concern” while TPWD designates them as “rare.” Species of concern are defined by the USFWS as species for which there is some information showing evidence of vulnerability, but there are not enough data to support listing at this time. These species are not specifically afforded the same protection under the ESA as threatened or endangered species; however, federal agencies are required to consider them in the agency’s planning and decision-making processes. The TPWD “rare” designation is based on a species’ global conservation status; these species do not have regulatory listing status. For this EIS, USFWS species of concern and Texas rare species are referred to as species of special concern.

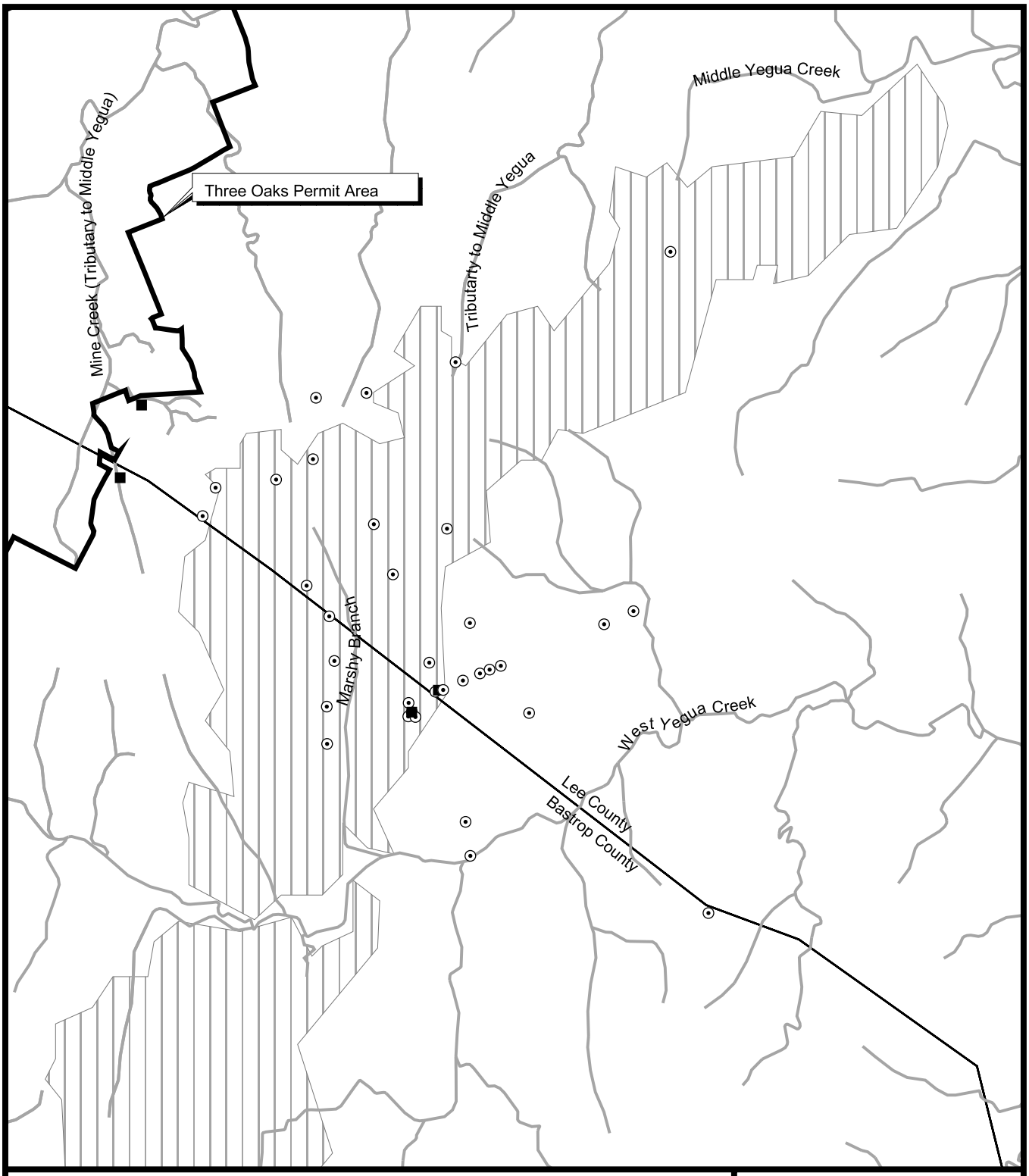
A total of 33 animal species (18 special status species and 15 species of special concern) were identified as potentially occurring within the study area and cumulative effects area (TBCDS 2001; USFWS 2002). These species, their associated habitats, and their potential for occurrence within the study and cumulative effects areas are summarized in **Tables F-3** and **F-4** in Appendix F. Occurrence potential in the study area and cumulative effects area was evaluated for each species based on their habitat requirements and/or known distribution. Based on these evaluations, 14 special status species or species of concern were eliminated from detailed analysis, as their known range is outside of the study area, and the study area does not include vegetation communities that comprise their habitat (see **Tables F-3** and **F-4** in Appendix F). Of the remaining 19 species that are analyzed in detail, 9 are listed as endangered or threatened by USFWS or TPWD (blue sucker, Houston toad, timber/canebrake rattlesnake, Texas horned lizard, American peregrine falcon, arctic peregrine falcon, bald eagle, whooping crane, and wood stork) and 10 are listed as species of concern or rare by these agencies (Leonora’s dancer, Guadalupe bass, Texas garter snake, Henslow’s sparrow, loggerhead shrike, reddish egret, white-faced ibis, Elliot’s short-tailed shrew, cave myotis, and plains spotted skunk). Brief discussions of the relationships of these species to the study area and cumulative effects area are provided below.

Special Status Species

Blue Sucker (*Cycleptus elongatus*). This fish species is listed as threatened by the TPWD and is a USFWS species of concern. The blue sucker typically inhabits deep river channels, chutes, and flowing pools of medium to large rivers (Page and Burr 1991; Bradsby et al. No date). This species is a spring spawner and has been observed spawning in the Colorado River of Texas over cobble/boulder substrate in approximately 1 foot of water (Koster 1957; Mosier and Ray 1992). No suitable habitat for this species has been identified within the permit area. The blue sucker has been observed in the Colorado River near its confluence with Big Sandy Creek in Bastrop County (Mosier and Ray 1992). Although, the blue sucker is unlikely to occur in the permit area, it potentially could occur within the study and cumulative effects areas of the proposed project.

Houston Toad (*Bufo houstonensis*). This toad species is listed as endangered by the USFWS and TPWD. Houston toads typically inhabit pine and/or oak woodlands or savannas with deep, friable sands associated with the Carrizo, Queen City, Sparta, Reclaw, or Weches Formations (USFWS 1984b; Horizon 2001). Calling may occur from December through June with most breeding activity taking place in February and March; breeding cues include warm temperatures (approximately 57 degrees Fahrenheit [°F] or greater) and high humidity (USFWS 1984b; Horizon 2001). Breeding sites include still or slow-flowing water bodies including ephemeral habitats (e.g., rain pools, flooded fields, ephemeral streams) and more permanent water bodies (e.g., seeps, creeks, ponds) (USFWS 1984b; Horizon 2001). The entire permit area is underlain by the Calvert Bluff and Simsboro Formations, which are not associated with suitable Houston toad habitat. However, based on the proximity of the permit area to outcrops of the Carrizo Formation, Horizon (2001) assessed the potential for occurrence of the Houston toad within or near the permit area. Although some water bodies and isolated patches of potentially suitable vegetation with deeper sandy soils (deeper than 20 inches) occur within and adjacent to the permit area, these areas are considered marginal habitat for the toad, based on their relatively small size and fragmented, isolated characteristics (Horizon 2001). The locations of Houston toad observations in the project vicinity are shown in **Figure 3.5-2**.

Presence/absence vocalization surveys for calling male Houston toads were conducted within potentially suitable habitat by Horizon during the 1999, 2000, 2001, and 2002 breeding seasons for this species (Horizon 2001, 2002). No Houston toads were identified within the permit area during these surveys. However, Houston toads were recorded calling in Lee and Bastrop Counties approximately 1 mile east of the permit area. These calls were recorded at the boundary between the Calvert Bluff Formation to the west and the Carrizo Formation to the east. In addition, variations of Houston toad and Woodhouse's toad (*B. woodhousei*) vocalization calls were recorded within approximately 200 feet of the permit area along the boundary between the Carrizo and Calvert Bluff Formations. It is possible that these calls could be attributed to Woodhouse's/Houston toad hybrids occurring along the interface of Houston toad habitat of the Carrizo Formation to the east and habitat of the Calvert Bluff Formation to the west that supports Woodhouse's and Gulf coast (*B. valliceps*) toads.



Known Houston Toad Locations (2001)
- Houston Toad Present
- Possible Woodhouse's/Houston Toad Hybrid
- Drainages
- Carrizo Outcrop

N

0 1 Miles

Source: Alcoa 2001c (Volume 3).

Three Oaks Mine

Figure 3.5-2

Known Houston Toad Locations

6/19/02

In addition to field surveys, *Bufo* spp. tadpoles were collected from potential Houston toad breeding sites within the permit area and from known Houston toad sites outside of the permit area during the 2000, 2001, and 2002 breeding seasons. Genetic analyses were performed on these tadpoles in an attempt to identify the presence of Houston toad genetic material. Forstner and Dixon (2001) concluded that, based on the year 2000 samples, it is unlikely that Houston toads occur within the permit area. The 2001 and 2002 analyses suggest that all tadpoles collected within the permit area were Gulf coast toads and Woodhouse toads; no genetic material from Houston toads was detected among the tadpoles collected within the permit area in 2001 or 2002 (Forstner and Dixon 2001; Forstner 2002). Based on the results of the habitat evaluations and vocalization surveys conducted by Horizon (2001) and genetic analyses preformed by Forstner and Dixon (2001) and Forstner (2002), it is unlikely that Houston toads would occur within the proposed permit area. However, it is possible that this species potentially could occur in suitable habitat in the Carrizo outcrop area within the larger cumulative effects area.

Timber/Canebrake Rattlesnake (*Crotalus horridus)*. This rattlesnake is listed as threatened by the TPWD. The species primarily inhabits lowland forests and hilly woodlands near water; however, it also occurs in palmetto-covered lowlands, cane thickets, abandoned fields, and woodland clearings (Werler and Dixon 2000). Based on a study in South Carolina, young are typically born in August and September, and females may reproduce only once every 2 to 3 years (Werler and Dixon 2000). This species has been documented in Bastrop and Lee Counties and at the Sandow Mine in Lee and Milam Counties. However, no timber/canebrake rattlesnakes were observed within the Three Oaks Mine permit area during the 1999 and 2000 field surveys (Alcoa 2000 [Volume 6], 2001c [Volume 3]). Based on the known distribution and habitat association of this species, the timber/canebrake rattlesnake potentially could occur in suitable habitat within the study area (including the permit area) and in the larger cumulative effects area.

Texas Horned Lizard *(Phrynosoma cornutum)*. This lizard species is listed as threatened by the TPWD and is a USFWS species of concern. This species is widely distributed in Texas and typically occurs in dry, open areas with sparse vegetation including grass, cactus, scattered brush or scrubby trees (TBCDS 2001). Texas horned lizards lay their eggs in moist sandy areas in April and July; young hatch in approximately 45 to 55 days (Animal Diversity Web 2002). This species has not been observed within the permit area; however, it has been documented in Lee County and could potentially occur in Williamson County (TBCDS 2001; Alcoa 2000 [Volume 6]). Based on the distribution and habitat association of this species, the Texas horned lizard potentially could occur in suitable habitat within the study area (including the permit area) and in the larger cumulative effects area.

American Peregrine Falcon (*Falco peregrinus anatum)*. This falcon, formerly listed as federally endangered, was delisted on August 25, 1999. The American peregrine falcon is currently listed as endangered by the TPWD. In Texas, the American peregrine falcon occurs statewide as a migrant, where it could be expected to occur in any type of habitat that is not heavily wooded; it winters on the Texas coast and occasionally inland, often near water. Based on the known distribution and habitat association of this species, this falcon potentially could forage within suitable habitat in the study area and the larger cumulative effects area for the proposed project during migration periods. Peregrine falcons have been observed in Lee County approximately 1 to 2 miles east of the permit area, and in Milam County approximately 10 miles northeast of the permit area (Brown 2001; Texas On-line Clearinghouse 2002). The latter observation occurred in 2001 near Alcoa Lake, which is adjacent to the Sandow Mine permit area.

However, incidence of foraging peregrine falcons within the study area and in the larger cumulative effects area would be expected to be infrequent and transitory in nature during migration.

Arctic Peregrine Falcon (*Falco peregrinus tundrius)*. At the time the American peregrine falcon was delisted, as discussed above, the Final Rule also removed the "endangered due to similarity of appearance" provision of the ESA for free-flying peregrines (including this arctic subspecies) in the conterminous United States. The arctic peregrine falcon is currently listed as threatened by the TPWD. This subspecies breeds in the arctic and only occurs in Texas as a migrant. The potential for occurrence of the arctic peregrine falcon in the study area and cumulative effects area would be the same as that discussed above for the American subspecies.

Bald Eagle (*Haliaeetus leucocephalus)*. The bald eagle was federally downlisted to threatened on July 12, 1995, and the USFWS has proposed to delist the bald eagle in the lower 48 states (64 FR 36453). This species also is listed as threatened by the TPWD. The bald eagle also is protected under the Bald Eagle Protection Act and the Migratory Bird Treaty Act. No designated critical habitat for this species occurs in the vicinity of the proposed project. Widely distributed in the United States, bald eagles occur in Texas as migrants, breeders, and winter residents. Bald eagle nests are typically found in mature, heterogeneous stands of multi-storied trees that have sturdy branches at sufficient height for nest support and protection. Optimum nest sites in Texas are typically found within 1 mile of wetlands or open water that provide an adequate food source (Campbell 1995). A confirmed nest site occurs in the immediate vicinity of the confluence of the Colorado River and Wilbarger Creek in Bastrop County, approximately 10 miles south of the permit area. This pair typically arrives at its breeding territory in October and departs by late May (Ortega 2001). Additional Bastrop County sightings include locations approximately 13 miles southwest of the permit area, approximately 15 miles to the southwest (at McKinney Roughs), and approximately 16 miles to the south (near the Lost Pines Golf Course) (Texas On-line Clearinghouse 2002). In Milam County, bald eagles recently have been observed at Alcoa Lake adjacent to the Sandow Mine permit area, approximately 11 miles northeast of the Three Oaks Mine permit area (Thering 2002). At least one of the observations took place in the Sandow Mine area.

Although a few small wetlands have been identified within the permit area, no large water bodies occur in the immediate vicinity of the permit area. In addition, no historic nest sites have been identified in the vicinity of the permit area. As a result, it is extremely unlikely that eagles would nest within or immediately adjacent to the permit area. However, based on the known bald eagle nest site at the Colorado River, it is possible that nesting eagles could occur within the study and cumulative effects areas for the proposed project.

Wintering eagles may roost individually or they may gather in large aggregations and share communal roosts and diurnal perches that may be used for successive years (USFWS 1982). Roost sites are often located near water; however, eagles also may roost on windbreaks and in secluded canyons well away from water. Roosts typically consist of large trees that have large horizontal limbs and open branches that allow for an unobstructed view of the surrounding area and provide an open flight path to and from the site. Food availability is probably the single most important factor influencing winter eagle distribution and abundance. In Texas, the primary food items include waterfowl, fish, and carrion. Mammals (e.g., jackrabbits) also are utilized in upland habitat types (Campbell 1995). Although wintering populations of bald eagles may occur statewide, they are generally found near large lakes and reservoirs. No established bald eagle winter

concentration areas or communal roost sites have been identified within the study or cumulative effects areas. However, one adult and one juvenile bald eagle were sighted at the Sandow Mine immediately adjacent to Alcoa Lake in January 2002 (Thering 2002). Although it is assumed that occurrence of this species within the permit area would be limited to migrating or transient individuals based on the lack of optimal winter habitat in the permit area, eagles potentially could winter along the Colorado River and at Somerville Lake that are associated with the study and cumulative effects areas.

Whooping Crane (*Grus americana)*. The whooping crane is federally listed as endangered and is state-listed as endangered in Texas. This species occurs in Texas as a winter resident on the Gulf coast, primarily on the Aransas National Wildlife Refuge. The whooping crane is most closely associated with river bottoms, marshes, potholes, prairie grasslands, and croplands. They generally feed on small grains (including a number of cultivated crops), aquatic plants, insects, crustaceans, and small vertebrates (Campbell 1995). Optimal roosting habitat occurs along braided submerged sandbars in wide unobstructed channels with an understory and overstory component along the stream margins (Campbell 1995). Whooping cranes have been observed in Bastrop County approximately 11 miles southwest of the permit area and in Lee County approximately 1 to 2 miles to the east (Brown 2001; Texas On-line Clearinghouse 2002); it is believed that these were observations of fly-over cranes during migration. Additional reported sightings of whooping cranes have occurred in Falls and Milam Counties in 1981 and 1983 near the towns of Rosebud and Thorndale, respectively (Alcoa 2000 [Volume 6]). As a result, it is possible that migrating individuals temporarily could utilize potential roosting or foraging habitat within the study area and in the larger cumulative effects area.

Wood Stork (*Mycteria americana)*. This stork species is listed as threatened by TPWD and is federally listed as endangered in portions of its range (other than Texas) by USFWS. This species typically occupies coastal habitats including wet meadows, swamps, ponds, and coastal shallows (National Geographic Society [NGS] 1987). Dispersal following breeding results in some individuals moving inland away from coastal areas (NGS 1987). Wood storks are colonial breeders typically nesting in cypress trees or other tall trees that are associated with marshes, swamps, and streams (Ehrlich et al. 1988). Typical breeding habitat for this species is not present within the study or cumulative effects areas, and the species is not known to breed anywhere in Texas (Texas Ornithological Society [TOS] 1995). Wood storks have been observed in Bastrop County at Shipp Lake approximately 23 miles southeast of the permit area, and in the vicinity of Utley approximately 12 miles to the southwest (Texas On-line Clearinghouse 2002). One of the Shipp Lake observations included approximately 300 wood storks, and one of the Utley observations was of a fly-over flock of 54 wood storks. Also, wood storks in groups of 3 to 41 individuals have been observed in Milam County at Alcoa Lake, which is adjacent to the Sandow Mine permit area (Texas On-line Clearinghouse 2002). Although no record for the observation of wood storks within the Three Oaks Mine permit area has been located, it is possible that transitory individuals could occur in the study area and in the larger cumulative effects areas in appropriate foraging habitat during post-breeding dispersal in late summer and early fall.

Species of Special Concern

Leonora's Dancer (*Argia leonorae)*. This damselfly is a USFWS species of concern. Little is known about the habitat of this species; however, the species has been observed along small streams and seeps such as

muddy-banked rivulets and in areas that contain scattered sedge-ridden swales (Odonata Central, no date). Although the distribution of this species is poorly understood, the damselfly appears to have a relatively wide distribution in south-central and western Texas (Odonata Central, no date). Breeding habits of this species are unknown, and the presumably aquatic larvae have not been identified. Adults are believed to emerge from mid-July to mid-September (Odonata Central, no date). No records for this species have been documented for the permit area. Relative to the cumulative effects area, this species has been documented at Mustang Creek in Williamson County, approximately 11 miles north of the permit area. This species also has been documented south of the permit area within the Brazos River drainage. Based on the known distribution and habitat association of this species, the Leonora's dancer potentially could occur within suitable habitat in the study area and cumulative effects area.

Guadalupe Bass (*Micropterus treculi)*. This fish species is a USFWS species of concern and is identified as a TPWD rare species. This bass typically inhabits riffles, runs, and pools with gravel and cobble substrates in small to medium rivers (Page and Burr 1991). Guadalupe bass spawn in the spring and early summer. Males build spawning nests, typically in shallow waters with gravel substrate, and guard the nests after eggs are laid. Multiple spawns may occur during a season. No suitable habitat for this species has been identified within the permit area. However, the Guadalupe bass is known to occur in the Colorado River, including the vicinity of the Big Sandy Creek confluence (Mosier and Ray 1992). As a result, the bass potentially could occur in the study area and cumulative effects area.

Texas Garter Snake (*Thamnophis sartalis annectens)*. This subspecies is a USFWS species of concern and is identified as a TPWD rare species. This species occurs in portions of central and northern Texas in grasslands and shrub/scrub habitats that are typically associated with wet or moist microhabitats near water (Conant 1975; TBCDS 2001). Werler and Dixon (2000) report that the only documented account of reproduction for this subspecies is the birth of 11 young in late July in Dallas County, Texas. The Texas garter snake has not been observed in the permit area; however, this subspecies has been identified as possibly occurring in Bastrop and Williamson Counties (TBCDS 2001). Based on the distribution and habitat association of this species, the Texas garter snake potentially could occur within suitable habitat within the study area (including the permit area) and the cumulative effects area.

Henslow's Sparrow (*Ammodramus henslowii)*. This sparrow is identified as a TPWD rare species. In Texas, this species is a rare to uncommon migrant and winter resident, typically occurring east of the Balcones Escarpment. Winter habitat for this species in Texas consists of grasslands and savannas or open woodlands (especially pine) with a grassy understory. This species has been identified as potentially occurring in Bastrop and Williamson Counties (TBCDS 2001). Although this species has not been documented within the study area or cumulative effects area, Henslow's sparrow potentially could occur during migration or winter in areas of suitable habitats within the study area and in the larger cumulative effects area.

Loggerhead Shrike (*Lanius ludovicianus)*. This bird species is a USFWS species of concern. A permanent resident in Texas, this species typically occurs in open areas dominated by grasses or forbs, interspersed with shrubs or trees and bare ground. Loggerhead shrikes are often found breeding along linear strips of habitat along roadsides, because these areas frequently provide foraging areas, man-made perches (e.g., overhead wires, utility poles, fences), and nesting substrate. In south Texas, park-like settings

with scattered trees and short grass (city parks, university campuses, and cemeteries) appear to be favored by nesting shrikes (USFWS 2000). Although no shrikes have been observed in the permit area, it is highly likely that breeding, transient, and wintering birds occur within the study area (including the permit area) and the cumulative effects area.

Reddish Egret (*Egretta rufescens)*. The reddish egret is a USFWS species of concern. This species occurs in Texas along the Gulf coast and occasionally inland. In Texas, typical habitat for this species includes saltwater beaches and bays. Breeding habitat consists of brackish marshes and shallow coastal habitats (Ehrlich et al. 1988). A reddish egret has been observed in Bastrop County at Shipp Lake, approximately 23 miles southeast of the permit area (Texas On-line Clearinghouse 2002). Although no egrets have been observed in the permit area, it is possible that individuals could occur in shallow water habitat within the study area (including the permit area) and the cumulative effects area.

White-faced Ibis (*Plegadis chihi)*. The white-faced ibis is a USFWS species of concern. This species is common along the Texas coast, and breeding records exist from northern, central, and eastern parts of the state. White-faced ibises also may occur as post-breeding migrants throughout Texas, often associated with freshwater marshes, wet meadows, and rice fields. Typical breeding habitat includes marshes, swamps, ponds, and rivers. Nest sites are in aquatic vegetation, shrubs, and low trees occasionally over water but usually on land (Ehrlich et al. 1988). This species has been observed in Bastrop County, but not within the permit area; however, it is possible that individuals could occur within suitable habitat within the study area (including the permit area) and the cumulative effects area.

Elliot's Short-tailed Shrew (*Blarina hylophaga hylophaga*). This shrew is listed as rare by the TPWD. This sub-species has been collected in small groups of live oak on sandy soils and grassy areas with loblolly pine overstory or near post oak stands (TBCDS 2001). Elliot's short-tailed shrew burrows extensively under leaf litter, logs, and into soil (Davis and Schmidly 1994). Burrows are limited to areas with soft, damp soils and do not require groundcover. This sub-species only is known from Montague and Bastrop Counties in Texas (TBCDS 2001; Davis and Schmidly 1994; Baumgardner et al. 1992). Elliot's short-tailed shrew has not been observed within the permit area; however, it has been observed in Bastrop State Park approximately 13 miles south of the permit area (Dronen and Simmons 1990; TBCDS 2001). Baumgardner et al. (1992) considered this shrew to be extremely rare in Bastrop County. Habitats within the permit area generally are not typical of those habitats that support this sub-species; however, it is possible that individuals could occur within suitable habitat within Bastrop County in the cumulative effects area.

Cave Myotis (*Myotis velifer)*. This bat species is a USFWS species of concern and is identified as a TPWD rare species. Occurring throughout much of Texas as a permanent resident, this colonial species typically roosts in caves; however, it may occupy man-made structures including mines, old buildings, carports, bridges, and also may roost in abandoned cliff swallow nests (Davis and Schmidly 1994). An evening forager, the cave myotis is an opportunistic insectivore consuming a wide range of prey including moths, weevils, ant-lions, and small beetles. Foraging typically is close to vegetation (Schmidly 1991). Although this species has been documented in Bastrop County, roosting habitat for the cave myotis is not abundant within the permit area. However, one known mine shaft (Borum Mine Shaft) occurs within the proposed disturbance area. This shaft is approximately 12 feet wide and 15 feet deep (Alcoa 2000 [Volume 1]). In addition, a number of old buildings within the mine area also could support suitable roost

sites for this species. As a result, it is possible that individuals could utilize suitable roost sites (e.g., man-made structures) and foraging habitat within the study area and cumulative effects area.

Plains Spotted Skunk (*Spilogale putorius interrupta*). This skunk is a USFWS species of concern and a TPWD rare species. Distributed throughout much of eastern and northern Texas, this species typically occupies wooded areas and tall-grass prairies with rock outcrops but may occupy short-grass prairies to a lesser extent (Davis and Schmidly 1994). This species has been documented as occurring in Bastrop County (Davis and Schmidly 1994). As a result, it is possible that individuals could utilize potentially suitable habitat within the study area (including the permit area) and the cumulative effects area.

3.5.2 Environmental Consequences

3.5.2.1 Proposed Action

Terrestrial Wildlife

The potential impacts of the proposed Three Oaks Mine on terrestrial wildlife can be classified as short-term and long-term. Short-term impacts arise from habitat removal and disturbance as well as from activities associated with the mine operation; these impacts would cease upon mine closure and completion of successful reclamation. Long-term impacts consist of permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. Direct impacts to wildlife populations would include limited direct mortalities from mine development, habitat loss or alteration, incremental habitat fragmentation, and animal displacement. Indirect impacts would include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

Surface Disturbance. The greatest impact to wildlife from surface disturbance would be the temporary and permanent loss or alteration of habitat. Temporary and permanent loss or alteration of habitats would be caused by construction and operation of the mine and its associated facilities. Habitat loss or alteration would result in direct losses of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. Displacement also could result in some local reductions in wildlife populations if adjacent habitats are at carrying capacity.

As discussed in Section 3.4, Vegetation, the Proposed Action would result in the direct loss of approximately 8,654 acres of vegetation and aquatic resources (see **Table 3.4-2**). In the mine area, a related direct loss of habitat would occur incrementally over the 25-year life of the mine, with approximately 640 acres of mine disturbance at any given time. The disturbance area would be reclaimed to achieve specified post-mining land uses, including fish and wildlife habitat, as required by RRC and discussed in Section 2.5.3, Closure and Reclamation. Of the total disturbance, approximately 4,520 acres would be reclaimed to wildlife habitat; 895 acres of aquatic habitat (a net increase of approximately 825 acres) would be provided by development of water features (i.e., ponds and end lakes); and 4,010 acres would be reclaimed to other post-mining land uses (i.e., pastureland, cropland, developed water sources, and undeveloped lands) that also would provide habitat for specific wildlife species. In addition, approximately 379 acres of riparian habitat would be developed along some of the restored channels counted within the above categories. As a result, there would be a net gain of approximately 30 acres of riparian habitat following mining and reclamation in

addition to the offsite enhancement of approximately 20.6 acres of riparian habitat in the Middle Yegua Mitigation Site (see **Figure 2-12** and **Table 2-14**). The direct loss of habitat would be a short-term impact in much of the mine area because vegetation would become re-established following project reclamation, which would be conducted concurrently with mining. Facilities that would be in place throughout the life of the project (e.g., offices, mine maintenance, crusher/stockpile facility, transportation and utility corridor) would result in a long-term impact to habitats until closure and final reclamation have been completed. Approximately 123 acres would be reclaimed for industrial/commercial (e.g., roads) and residential purposes. The area occupied by these uses would be relatively similar before and after mining. However, some long-term adverse (and beneficial) impacts would result where the habitat is different than it was before mining. Acreages of disturbance by mine-year and mine component are presented in **Table 2-5**.

Game Species. Potential direct impacts to big game species (i.e., white-tailed deer) would include the incremental short-term reduction of potential forage and the incremental increase of habitat fragmentation from construction and development activities (i.e., vegetation removal for mine area development, ancillary facilities, transportation and utility corridor, and road and utility relocations). This anticipated loss of habitat would result in a small, incremental reduction in the amount of available habitat and is expected to have little impact on the existing low deer population densities that occur in the study area (see Section 3.5.1.2). No important big game corridors or key seasonal habitats have been identified within the study area. Therefore, impacts to deer populations are expected to be low.

Direct impacts to small game species from surface disturbance would include the incremental short-term loss of potentially suitable breeding, nesting, and foraging habitat in upland and riparian areas; in most instances, suitable habitat adjacent to the project areas would be available for use by these species. However, as discussed above, displacement would increase competition and could result in some local reductions in wildlife populations if adjacent habitats are at carrying capacity. This displacement would be temporary and short-term until vegetation is re-established following project reclamation. Potential direct adverse impacts also could include nest or burrow abandonment or loss of eggs or young. These losses would reduce productivity for that breeding season.

Nongame Species. As indicated in Section 3.5.1.3, a variety of resident and migratory bird species (e.g., raptors, songbirds, waterfowl) have been identified as potentially occurring in the study area. Although no nest sites were identified during the wildlife surveys within the permit area, it is possible that nesting birds could be present within or adjacent to construction or development areas associated with the Proposed Action. Potential direct adverse impacts to bird species would include the incremental short-term loss of potentially suitable breeding, roosting, and foraging habitat. However, this incremental loss is expected to have little effect on local bird populations based on the amount of potentially suitable breeding and foraging habitat in the surrounding area. If construction were to occur during the breeding season (approximately March to September, depending on the species), direct impacts to breeding birds could include the possible direct loss of nests or indirect effects (e.g., abandonment) from increased noise and human presence within close proximity to an active nest site. Loss of an active nest site, incubating adults, eggs, or young would be in violation of the Migratory Bird Treaty Act. In order to minimize potential impacts to breeding birds, Alcoa has committed to clearing vegetation (in advance of construction and mine block development) outside of the breeding season (February 28 through July 31). Alternately, prior to construction during the breeding season, a qualified biologist would survey potentially suitable habitat for nest activity and other evidence of

nesting (e.g., mated pairs, territorial defense, birds carrying nest material, transporting of food). If active nests are located, or other evidence of nesting is observed, appropriate protection measures, including establishment of buffer areas and constraint periods, would be implemented until the young have fledged and have dispersed from the nest area. With implementation of these protection measures, residual impacts to nesting birds within the project area would be limited to incremental habitat loss associated with mine development. This loss, however, is anticipated to have little effect given the extent of native habitats in the surrounding region and the lack of unique habitats or documented rare bird species in the permit area.

The new power line segments and associated substation incrementally would increase the collision potential for migrating and foraging bird species (e.g., raptors and waterfowl) (Avian Power Line Inaction Committee [APLIC] 1994). However, collision potential typically is dependent on variables such as the location in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design. The USACE is evaluating a mitigation measure that may minimize the collision potential for migrating and foraging raptor and waterfowl species (see potential mitigation measure FW-1 in Section 3.5.4, Monitoring and Mitigation Measures). In addition, the relocated 14.4-kV power line and new 25-kV power distribution lines could pose an electrocution hazard for raptor species attempting to perch on the structures. To minimize this impact, the USACE is evaluating a mitigation measure that would include standard raptor-proofing designs (see potential mitigation measure FW-2 in Section 3.5.4, Monitoring and Mitigation Measures). The configuration of power lines greater than 69-kV typically does not present an electrocution potential, based on conductor placement and orientation (APLIC 1996).

Human Presence and Noise. The most common wildlife responses to noise and human presence are avoidance or accommodation. Avoidance would result in displacement of animals from an area larger than the actual disturbance area. The total extent of habitat lost as a result of wildlife avoidance response is impossible to predict since the degree of this response varies from species to species and can even vary between different individuals of the same species. Also, after initial avoidance of human activity and noise producing areas, certain wildlife species may acclimate to the activity and begin to reoccupy areas formerly avoided. For example, during the initial development phases, it is likely that deer would be displaced from a larger area than the actual disturbance sites due to the avoidance response. However, deer have demonstrated the ability to acclimate to a variety of mining activities as long as human harassment levels do not increase substantially. It is possible, therefore, that the extent of deer displacement would approximate the actual disturbance area after the first few years of mine operation.

In addition to avoidance response, increased human presence intensifies the potential for wildlife/human interactions ranging from harassment of wildlife to poaching and legal harvest. Increased human presence and related increases in traffic levels on project access roads also increases the potential for wildlife/vehicle collisions. The greatest increases in traffic levels on access roads to the project area would occur during the peak of construction. Once construction is completed, traffic levels would decrease correspondingly to the loss of construction workers. The posting of appropriate speed limits along the access roads would further minimize the potential of wildlife/vehicle collisions.

Field surveys conducted by Alcoa at the existing Sandow Mine and the proposed Three Oaks Mine in May and June 2000, support the conclusions that: 1) most wildlife species rapidly reinvade the reclaimed areas,

and 2) human activities in and around the mine have little effect on the numbers and diversity of wildlife using these reclaimed areas (Silvy 2000). These field surveys compared morning, evening, and nighttime counts of wildlife observed at the two areas in a combination of road transects and spot counts. In general, the numbers and diversity of wildlife observed in the reclaimed areas at the Sandow Mine were comparable to or greater than the numbers and diversity observed at the Three Oaks site.

Water Level Change. This section focuses on the potential long-term, indirect impacts to wildlife species due to a potential reduction in surface water availability and potential decrease in associated riparian and wetland communities as a result of water level change in the Simsboro aquifer outcrop area. Mine-related water level changes are not expected to affect surface water sources associated with the Calvert Bluff aquifer (see Section 3.2.4.2).

As discussed in Section 3.2.4.2, a change in water level from depressurization pumping in the Simsboro aquifer potentially would reduce the surface water availability in certain intermittent gaining reaches of area streams and associated perennial pools as well as naturally occurring springs and seeps that occur within the 10-foot drawdown area of the Simsboro aquifer outcrop. Riparian/wetland habitats that are associated with affected spring, seeps, and/or gaining stream reaches could be affected by water level change (see Section 3.2.4.2). Based on groundwater modeling, the maximum extent of these potential effects to surface water availability and the associated riparian/wetland communities could continue for approximately 40 years (anticipated 90 percent groundwater recovery) to 100 years (anticipated 100 percent recovery) following the completion of mining (see Section 3.2.3.2).

The potential loss or reduction in available surface water as a result of water level change could result in long-term changes in wildlife habitats where the water sources are hydraulically connected to the Simsboro aquifer outcrop. The habitats associated with naturally occurring springs, seeps, and intermittent stream reaches and associated perennial pools encompass riparian vegetation (both woody and herbaceous plant species), wetland areas, and mesic habitats (moist areas or wet meadows). Reduction or loss of approximately 352 acres of riparian and wetland habitats associated with these water sources would impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure, as discussed below. However, based on Alcoa's proposed reclamation procedures, long-term impacts to riparian habitats and surface water sources would be minimized by the development of approximately 895 acres of surface water features and an associated 379 acres of riparian habitat within the mine area (see Section 2.5.3, Closure and Reclamation) net increase of approximately 30 acres of riparian and wetland habitat and approximately 825 acres of surface water sources. Some of these restored habitats would be similar to pre-mining conditions and others would be different.

Naturally occurring seeps, springs, and intermittent gaining reaches provide important wildlife habitat in the study area. Riparian habitat and its associated plant communities contribute to a greater wildlife species diversity, compared to the adjacent upland areas. Since surface water and the associated riparian habitat are limiting factors for wildlife in study area, the loss of these habitat features would alter the available habitat for species that depend on these riparian areas, resulting in: 1) a reduction of available water for consumption; 2) a reduction in riparian vegetation for breeding, foraging, and cover; 3) reduction in the regional carrying capacity; 4) displacement and loss of animals; 5) a reduction in the overall biological

diversity; 6) a potential long-term impact to the population numbers of some species; and 7) reduction in prey availability. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use; species' sensitivity (i.e., level of dependency on riparian areas); and the extent of the anticipated water and riparian habitat reductions.

Due to the limited amount of riparian communities within the study area, it is assumed that species dependent upon these areas are currently at carrying capacity. Consequently, some species that are displaced due to the reduction of surface water or riparian vegetation may be able to move into adjacent areas; however, it is assumed that these adjacent riparian habitats are already at their full carrying capacity and would not support additional animals. Therefore, some individuals would be lost from the population, concentrating the remaining animals within smaller habitat areas. However, it is assumed that wildlife would reoccupy the mine area following the development of surface water features and riparian habitats within the mine area as identified in Alcoa's reclamation procedures (see Section 2.5.3, Closure and Reclamation), although species competition and population numbers may not represent what was present prior to project construction. It is assumed that reestablishment of a given wildlife species in the reclaimed area would be dependent on successful reclamation and the species ability to move to adjacent habitats, especially for the smaller, less mobile species.

Species likely affected by reductions in perennial water sources and associated habitats would include big game, upland game birds and mammals, waterfowl, nongame birds (e.g., raptors and passerines), mammals (e.g., bats), reptiles, amphibians, and fish. The extent of these indirect effects from the mine's dewatering activities would depend on the species' use and relative sensitivity, as discussed for each group below.

Game Species. Big game (i.e., white-tailed deer) require water during the summer and fall periods, as well as during the winter period, as needed, to satisfy physiological requirements. The reduction or loss of existing water sources could impact white-tailed deer use and movements. Due to reduced habitat availability resulting from earlier habitat alteration in the area, as discussed above, low populations of deer currently occupy the study area, which lacks important big game corridors and key seasonal habitats. As a result, it is assumed that some individuals would be displaced due to the reduction of surface water and riparian vegetation and may move into adjacent areas that are already at their carrying capacity. These displaced individuals could be lost from the population; however, this loss cannot be quantified. Impacts to regional deer populations from the reduction of surface water and riparian vegetation would be expected to be low.

A reduction in the riparian community would affect the amount of nesting, brooding, and foraging habitat for upland game birds (e.g., mourning dove and wild turkey), and denning and foraging habitat for small game mammals (e.g., fox squirrel and eastern cottontail), and furbearers (e.g., Virginia opossum and raccoon). A decline in surface water availability would impact the extent of open water and riparian vegetation along portions of the streams, springs, and seeps. Since riparian communities are limited within the study area, it cannot be assumed that displaced individuals would successfully relocate into adequate breeding or foraging habitat in adjacent areas, as it is assumed that these habitats already would be at carrying capacity. As a result, some animals could be lost from the population. However, area wildlife would reoccupy the mine area depending on the success of project reclamation.

Short- and long-term effects to waterfowl species that may be present within the study area would vary, depending on the vegetative structure and habitat types associated with springs that may support migrating and wintering birds. The impacts to waterfowl species that commonly occur within the cumulative effects area may include the reduction of perennial pools and springs and seeps within the 10-foot drawdown contour of the Simsboro aquifer outcrop that support adequate riparian habitat and pools for foraging and cover. The reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas currently used by waterfowl would result in the displacement of these birds to adjacent habitats.

Isolated birds and breeding pairs may be impacted by the reduction or loss of surface water and riparian or emergent habitat types, possibly affecting the viability of certain species within the study area until project reclamation is completed and riparian vegetation and surface water habitats have become re-established; however, the extent of this impact cannot be quantified. The ultimate reduction in bird numbers would not result in population-level impacts.

Nongame Species. As discussed in Section 3.5.1.3, a variety of bird species may breed, forage, or roost in or near the study area. Potential long-term impacts to bird species could include loss of nesting, roosting, and foraging habitat along the gaining reaches of intermittent drainages and at the seeps and springs identified in Section 3.2.4.2 that occur within the 10-foot drawdown area of the Simsboro outcrop area (see **Figure 3.2-11**). These losses would result from an incremental reduction in available habitat for both resident and migratory bird species. In addition, the regional carrying capacity would be reduced by the incremental loss of available nest and roost sites. Some bird species are closely associated with riparian habitats large enough to support trees and increased shrub density while other species may use these trees for roosting only. Therefore, the reduced availability of potential nest and roost sites in riparian habitats within the mine's drawdown area would result in a long-term direct adverse impact to some bird species until project reclamation is completed and riparian vegetation has become re-established.

Potential impacts to amphibian and reptile species that are associated with the perennial water sources that may be affected by mine-related groundwater drawdown activities would parallel those discussed for other terrestrial wildlife species. The loss or reduction in surface water availability and associated riparian vegetation would result in an incremental loss of suitable breeding, foraging, and cover habitats for these species until project reclamation is completed and riparian and surface water habitats have become re-established. However, as discussed above, the reestablishment of the mine area by amphibian and reptile species would be based on the success of project reclamation and the species' ability to move to adjacent habitats, especially smaller less mobile species.

Water Discharge. Increased flows in Big Sandy and Middle Yegua Creeks from the mine's proposed water discharge would result in an increase in available water, foraging and breeding habitat, and cover for terrestrial wildlife, including white-tailed deer, upland small game species, waterfowl, songbirds, raptors, and other terrestrial species within the study area. Increased flows may better support existing plant communities of riparian woodlands and emergent vegetation immediately adjacent to these intermittent creeks (see Section 3.4.2.1). Increased riparian vegetation would be site-specific, depending on the existing condition or health of the plant species present, channel geometry and stability, potential livestock grazing

intensity and season of use, and timing of increased flows. During the life of the mine, the temporary increased availability of water and riparian vegetation downstream of the discharge points would help to offset the loss of riparian and wetland habitat in the upper reaches of these creeks as a result of groundwater drawdown. As discussed in Section 3.4, Vegetation, the cessation of mine-related discharge, in combination with watershed modifications, would result in the incremental long-term reduction of riparian and wetland habitats for area wildlife. However, the extent of these indirect effects on wildlife would depend on the species' use of the affected area and their relative sensitivity, as well as the availability of similar habitat types in the area.

Aquatic Species

Surface Disturbance. The potential effects of the Three Oaks Mine on aquatic resources are closely related to impacts on groundwater and surface water resources, which are discussed in Sections 3.2.3.2 and 3.2.4.2, respectively. Mine construction and operation would remove aquatic habitat consisting of ephemeral and intermittent streams and stock ponds. Approximately 38 miles of intermittent/ephemeral streams and 150 stock ponds would be incrementally removed during the life of the mine. In addition, approximately 31 acres of off-channel ponds would be physically removed. Typically, these off-channel ponds are turbid, relatively shallow, and normally dry up. Due to the lack of water on a consistent basis, existing aquatic communities are mainly limited to macroinvertebrates and attached algae (periphyton) that can persist in intermittent and ephemeral streams. The removal of the stock ponds would eliminate habitat for macroinvertebrates and possibly nongame fish species. Although game fish may be present in some of the on-channel ponds, no records are known. Mine reclamation would replace pond habitat, primarily after mining is completed. In total, an estimated 895 acres of pond habitat (including the end lakes) would exist after reclamation is completed, resulting in a net increase of approximately 825 acres of pond habitat. In general, these end lakes would be larger and deeper compared to the present ponds. The duration of impact (i.e., habitat loss) in each phased-disturbance area would be approximately 20 to 22 months, based on proposed concurrent reclamation plans.

Short-term, local increases in suspended sediment could occur during mining and construction of road and bridge crossings. These short-term increases in sediment could result in localized effects on macroinvertebrate communities and bottom substrate composition. Fish species, if seasonally present in intermittent streams or stock ponds, would be able to tolerate short-term increases in sediment. Sedimentation resulting from mining activity would be confined to the collection channels and sedimentation ponds. After water is detained in the ponds, suspended sediment levels would be similar to background conditions. Suspended sediment concentrations would stabilize and return to typical background concentrations after the road and bridge construction activities are completed. By implementing proper drainage design including detention ponds and erosion control measures during and after construction, the impact of potential increased sediment levels on aquatic species and their habitat would be low. Any localized increases in sediment would not affect downstream areas in Big Sandy Creek or Middle Yegua Creek that contain game fish species such as sunfishes and largemouth bass. The USACE is considering mitigation measures that would further reduce sedimentation impacts (see mitigation measures SW-2 and SW-3 in Section 3.2.4.4, Monitoring and Mitigation Measures).

Water Level Change. Depressurization of the Simsboro aquifer would result in flow reductions in the gaining reaches of the Big Sandy Creek drainage as discussed in Section 3.2.4.2. For those areas located upstream of the proposed discharge points or in separate drainages (e.g., Little Sandy Creek), there would be a reduction in aquatic habitat. These areas include Little Sandy Creek, Burlson Creek, and tributaries to Big Sandy Creek. Since habitat in these areas is currently intermittent, the affected aquatic species mainly would consist of macroinvertebrates. In areas located downstream of the proposed discharge points, any slight reduction in baseflow as a result of groundwater withdrawal would be small compared to the flow increases from mine discharge. The net change in flow in areas located below the discharge points would be an increase, which means that additional aquatic habitat would be available during the period of mine discharge. When mining is completed, a net decrease in flow would occur until the aquifer recovers, which would result in reduced habitat in portions of the Big Sandy drainage.

Water Discharge. Discharge of mine water would result in increased flows in Big Sandy and Middle Yegua Creeks below the proposed discharge locations (**Figure 3.2-24**). The increased flow in the receiving streams would range from approximately 3.3 to 9.7 cfs in Big Sandy Creek and 13 to 18.5 cfs in Middle Yegua Creek (average flow conditions). Flow increases in these ranges would represent a substantial increase compared to base flow conditions (2- to >5-fold change). However, some of the surface water discharge may seep into the channel bed or be taken up by evapotranspiration within a few miles of the outfall, which would reduce the level of increased flow in Big Sandy and Middle Yegua Creeks. A net increase in the amount of available habitat for aquatic species would occur in stream sections located below the outfalls. The relative increase in habitat likely would result in increased numbers of fish and macroinvertebrates, particularly in those sections of the streams that presently exhibit intermittent flow. Flow increases likely would change the relative composition of riffle, run, and pool habitats. Sufficient information is not available in the affected reaches to predict the predominant types of habitat that would exist after mine discharge is initiated.

During the post-mining phase of the project, flows and the amount of aquatic habitat would decrease mainly due to watershed modifications made as part of reclamation. In addition, groundwater discharges to Big Sandy and Middle Yegua Creeks would cease at the end of mining. Although groundwater would recharge and contribute water to streams located near the Simsboro aquifer in approximately 40 years, the overall effect on flows and habitat would be a reduction due to the watershed modifications. The effect of reduced habitat on aquatic biota would be possible reductions in numbers. To determine if fish and macroinvertebrate populations are affected by drawdown and/or discharge volumes, the USACE is considering monitoring for lower Big Sandy Creek (see mitigation measure FW-3 in Section 3.5.4, Monitoring and Mitigation Measures).

The effects of discharges on water quality in Big Sandy and Middle Yegua Creeks are expected to be minor. Overall, sediment levels resulting from increased flows are expected to be within ranges exhibited during high-flow periods. No changes in aquatic communities or their habitat is expected over most of the areas receiving discharges. No changes in metals concentrations are anticipated, since discharge water would be treated by flocculation or other chemicals to meet TPDES permit requirements. The effect of discharge water on stream temperature is expected to be minor. Prior to discharge, groundwater withdrawals may be held in retention ponds, which would result in water temperatures similar to those in the receiving streams. All discharge water would need to meet TPDES permit requirements for temperature.

Special Status Species

The impact analysis for sensitive wildlife resources (i.e., special status species and species of special concern) focused on those species or sub-species that were identified in Section 3.5.1.5, Special Status Species and Species of Special Concern, as potentially occurring within the study area and cumulative effects area of the proposed project. Consequently, project-related impact assessments for 19 sensitive species or sub-species are discussed below.

Blue Sucker. No impacts to the blue sucker would be anticipated as a result of surface disturbance, water level changes, or water discharge from mine-related activities. This assessment is based on the unlikely potential that this species would occur within the permit area, within portions of streams that may be affected by groundwater drawdown of the Simsboro aquifer, or within the segment of Middle Yegua Creek that would receive water discharge from the permit area. Changes in the flow regime of Big Sandy Creek as a result of water discharge potentially could result in a benefit to fishes that occur in the Colorado River including this species, which is known to occur at the confluence of the Colorado River and Big Sandy Creek. Following the cessation of mine-related water discharge, potential changes in the flow regime of Big Sandy Creek are anticipated to have a negligible effect on the Colorado River. Consequently, no impacts from water discharge into Big Sandy Creek would be anticipated for the blue sucker.

Houston Toad. No direct or indirect impacts to the Houston toad would be anticipated from surface disturbance within the permit area. This assessment is based on the results of Houston toad presence/absence vocalization surveys, tadpole genetic analyses, absence of geologic formations typical for the species within the permit area, and the general lack of deep sandy soils in the permit area. In addition, critical habitat would not be impacted by the Proposed Action as it does not occur within the permit area.

No indirect impacts to the Houston toad would be anticipated from water level change in the Simsboro aquifer outcrops or associated stream segments that may receive groundwater contributions from the Simsboro aquifer as a result of project-related activities. This assessment is based on the known distribution and habitat characteristics of this species, which are primarily associated with the Carrizo, Queen City, Sparta, Reclaw, and Weches Formations. The Simsboro Formation is located below the Calvert Bluff Formation, from which it is hydraulically separated by approximately 60 feet of low permeability clay; thus, depressurization of the Simsboro Formation is not anticipated to impact groundwater levels in the Calvert Bluff or Carrizo Formations. As a result, water level changes associated with Three Oaks Mine dewatering and depressurization activities would not impact water levels in Houston toad habitat or Houston toad critical habitat associated with the Carrizo, Queen City, Sparta, Reclaw, or Weches Formations.

Depressurization of the Simsboro Formation, alterations in surface water flow related to discharge of dewatering and depressurization water, and the modification of surface water features, potentially could impact portions of Big Sandy Creek and Middle Yegua Creek downstream of the permit area. However, these creeks do not flow through Houston toad critical habitat and would not impact critical habitat for this species. Big Sandy Creek drains the southern portion of the permit area and flows across outcrops of the Hooper, Simsboro, and Calvert Bluff Formations (BEG 1995). These formations are not typical of Houston

toad habitat. Big Sandy Creek occurs approximately 4 miles from the Carrizo outcrop. Consequently, Big Sandy Creek is very unlikely to provide habitat for Houston toads, and potential changes in the flow regime of the creek are not expected to indirectly impact the species.

Middle Yegua Creek, which drains the northern portion of the permit area, does not intersect the Carrizo Formation; Middle Yegua Creek occurs within an alluvial floodplain that bisects the Carrizo Formation approximately 5 miles downstream of the project's water discharge points. It is unlikely that Houston toads or potential breeding habitat for this species would be impacted as a result of surface water discharge over the 25-year life of the mine. This assessment is based on the expected distance of flow alteration (4 to 6 miles downstream from the discharge points, as discussed in Section 3.2.4.2) relative to where the alluvial floodplain bisects the Carrizo outcrop, and the limited amount of potentially suitable Houston toad habitat within the alluvial floodplain. The alluvium within this floodplain does not contain appreciable amounts of deep sandy soils that is typical habitat for this species, and much of the woodland habitat within the floodplain area previously has been modified for pasture use. However, in the event that flow alterations were to reach the Carrizo outcrop, and suitable breeding habitat conditions for the Houston toad (i.e., still or slow-flowing water bodies) were present, alterations in the flow regime potentially could impact individuals and breeding/nursery sites within or adjacent to the main-stem of Middle Yegua Creek that may experience elevated base flows, reduced peak flows, and more sustained flows. Although Houston toads have not been documented to occur within the Middle Yegua Creek alluvial floodplain and are not known to utilize flowing main-stem creek channels for breeding or egg laying purposes, this species may utilize adjacent off-channel still or slow-flowing wetlands or other hydric areas (e.g., tributaries, ponds, rain pools, flooded fields) that may provide more suitable breeding habitat for Houston toads within close proximity to the Carrizo outcrop. Consequently, if flow alterations were to reach the alluvial floodplain of Middle Yegua Creek and suitable Houston toad habitat and individuals were present, potential impacts could include the loss of egg masses and young. However, based on the lack of appreciable amounts of suitable Houston toad habitat within the alluvial floodplain and the potential for flow alteration at the Carrizo outcrop, potential impacts to the Houston toad, if present, would be anticipated to be low.

Timber/Canebrake Rattlesnake. Direct impacts to the timber/canebrake rattlesnake from surface disturbance would result in the temporary loss of potentially suitable habitat, including approximately 352 acres of riparian habitat, which would have the highest likelihood of supporting this species in the permit area. However, it is anticipated that most of the riparian woodlands that would be impacted would be affected incrementally over the 25-year life of the mine. These impacts would be minimized, based on the proposed reclamation procedures that would include the establishment of fish and wildlife habitat, 3,451 acres of which potentially would be suitable for this species. Included in this acreage would be 379 acres of riparian corridor (see Section 2.5.3). In addition, approximately 20.6 acres of riparian habitat would be enhanced at the Middle Yegua Mitigation Site. However, it is not clear what portion of reclaimed lands may provide potential habitat for rattlesnakes or whether rattlesnakes would successfully occupy these areas. Direct impacts to the timber/canebrake rattlesnake from surface disturbance also may result in the loss of individuals, if present. In order to minimize potential impacts to individual rattlesnakes, Alcoa has committed to implementation of their current protection plan for the timber/canebrake rattlesnake at the Sandow Mine for the proposed Three Oaks Mine. These protection measures would include employee awareness and education, and the relocation of individual rattlesnakes found in the disturbance area to

nearby suitable habitat outside the mine area. Based on the committed protection measure, these actions are unlikely to cause more than minimal adverse impacts to this species.

Potential indirect impacts to the timber/canebrake rattlesnake as a result of groundwater drawdown would include the incremental long-term reduction of riparian habitat along gaining stream reaches within the 10-foot or greater drawdown area of the Simsboro outcrop, although these areas are less likely to support this species than the riparian habitat that is associated with the permit area. Consequently, effects to this species as a result of water level changes in the Simsboro outcrop are expected to be low.

No potential impacts to the timber/canebrake rattlesnake as a result of surface water discharge to Big Sandy Creek or Middle Yegua Creek would be anticipated during the 25-year life of the mine. In fact, increased flows may enhance riparian habitat over the life of the mine. Indirect impacts during the post-mining phase of the project would result from the incremental reduction of enhanced riparian habitat along these creeks for a distance of 4 to 6 miles as a result of watershed modifications and water level changes in the Simsboro aquifer (see Section 3.4.2.1 under Vegetation). Although potential impacts to this species as a result of watershed modifications and water level changes could result in a reduction of riparian habitat along 4 to 6 miles of these creek segments, potential impacts partially may be offset by the development of approximately 379 acres of riparian habitat near developed surface water features in the permit area and the enhancement of approximately 20.6 acres of riparian habitat at the Middle Yegua Mitigation Site. Consequently, potential impacts to this species during the post-mining phase of the project are expected to be low.

Texas Horned Lizard. Potential direct impacts to the Texas horned lizard from surface disturbance within the permit area could occur, particularly where sandy soils and grassland and/or mesquite grassland occur. Direct impacts to this species also could result in the direct loss of individuals from mine development, if present. This species has not been identified in the permit area to date; however, Alcoa has committed to developing and implementing protection measures, in coordination with the jurisdictional agencies, that would reduce potential impacts to the Texas horned lizard, if the species is observed in the disturbance area. Based on Alcoa's committed protection measure and the wide distribution of this species within the state, it is expected that the Proposed Action unlikely would result in more than minimal impacts to the Texas horned lizard.

No impacts to the Texas horned lizard as a result of water level changes or surface water discharge would be anticipated based on the dry grassland and mesquite grassland habitats that this species occupies.

American Peregrine Falcon, Arctic Peregrine Falcon, and Bald Eagle. Both sub-species of peregrine falcon and the bald eagle potentially could occur in the permit area as migrants or occasionally as foraging individuals.

Many of the ponds in the proposed disturbance area likely contain a small number of ducks during most times of the year and could provide hunting opportunities for migrating peregrine falcons and eagles. However, since similar ponds are abundant throughout the project region, the loss of these features would occur incrementally, and peregrine falcons and eagles are expected to occur in the permit area only infrequently, the loss of these ponds is expected to have a negligible effect on the ability of peregrine falcons

and bald eagles to find food during migration. Therefore, potential impacts to these species as a result of surface disturbance is considered to be low.

Final reclamation of the mine area would result in the presence of two end lakes with a combined surface area of approximately 722 acres (Section 3.2.4.2 under Surface Water). Waterbodies of this size ultimately could support waterfowl, shorebirds, and fish in sufficient concentrations to attract and support migrating, and possibly even wintering, peregrine falcons and bald eagles. The total number of falcons or eagles utilizing the end lakes in any given year would be expected to be low. As a result, the benefit to these species as populations likely would be negligible; however, the lakes could provide a slight positive benefit to individual falcons or eagles.

The effects of mine water discharge and water level changes are not expected to result in habitat changes that would change the availability of food resources for falcons or eagles within this area. Therefore, potential impacts to these species as a result of water level change and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek would be low.

Whooping Crane. No direct impacts to nesting whooping cranes would occur from the construction and operation of the Proposed Action. Although it is possible that migrating whooping cranes occasionally could utilize grasslands within the permit area during migration, the grasslands that occur within the permit area generally are distributed within a mosaic of brushy and woody vegetation that does not provide typical habitat for whooping cranes (see **Figure 3.4-1**). However, the loss of potentially suitable stop-over habitat within the permit area would be offset through Alcoa's proposed reclamation plan to create 3,031 acres of pastureland, 70 acres of cropland, and mitigate for wetlands at a ratio of 2:1. Therefore, the reclaimed lands likely would be as suitable or more suitable for migrating cranes than habitat that currently exists in the permit area. Consequently, the temporary loss of grasslands from the permit area is not likely to adversely impact the species.

Potential surface water discharge and water level effects within the permit area also are not expected to adversely impact the whooping crane. Surface water discharge and water level changes within the permit area may result in some localized changes in vegetation composition along some stream channels; however, they are not expected to result in substantial landscape changes. Therefore, no change in the present level of potentially suitable stopover habitat available to whooping cranes in the study area is expected.

Wood Stork. Surface disturbance would result in the loss of approximately 150 stock ponds that provide potentially suitable habitat for this species during post-breeding dispersal. Based on the proposed reclamation procedures that would be implemented concurrently with mining, there would be a net increase of approximately 825 acres of potentially suitable habitat (e.g., ponds and end lakes) following the completion of mining and reclamation. Based on the availability of potential habitat at other stock ponds and lakes in the region and the net increase in potentially suitable habitat in the permit area, the potential for adverse impacts to this species would be low.

Indirect adverse impacts to the wood stork could result in the incremental long-term reduction of riparian and wetland habitats along gaining stream reaches as a result of water level changes within the 10-foot or

greater drawdown area of the Simsboro outcrop. However, these incremental habitat changes would be offset by the development of approximately 379 acres of riparian habitat and approximately 895 acres of surface water habitat in the permit area. Consequently, potential impacts from water level changes are expected to be low.

No potential impacts to the wood stork as a result of surface water discharge to Big Sandy Creek or Middle Yegua Creek would be anticipated during the 25-year life of the mine. As discussed above for the timber/canebrake rattlesnake, increased flows may improve riparian habitat over the life of the mine. Indirect impacts during the post-mining phase of the project would result in an incremental reduction of enhanced riparian and wetland habitats along these creeks for a distance of 4 to 6 miles as a result of watershed modifications and water level changes in the Simsboro aquifer (see Section 3.4.2.1 under Vegetation). Although potential impacts to this species could result from watershed modifications and water level changes, potential impacts would be overshadowed by the development of riparian and surface water habitats in the permit area and enhancement of riparian habitat at the Middle Yegua Mitigation Site. Consequently, potential impacts to this species during the post-mining phase of the project are expected to be low.

Species of Special Concern

Leonora's Dancer. Potential direct impacts to the Leonora's dancer from surface disturbance would include the incremental short-term loss of approximately 23.6 acres of ephemeral and intermittent stream channels, 69.9 acres of ponds, and 5.3 acres of wetlands that may support suitable habitat for this species. The loss of these water features would occur incrementally over the life of the mine and concurrently with project reclamation. As a result, the potential long-term loss of habitat would be offset by the development of 895 acres of aquatic habitat and 379 acres of riparian habitat in the mine area following reclamation. In addition, approximately 20.6 acres of riparian habitat would be enhanced at the Middle Yegua Mitigation Site. It is possible that some of these water features could provide potential habitat for Leonora's dancer should this species occur in the permit area. If construction were to occur during the breeding season (see **Table F-4** in Appendix F), direct impacts could include the possible loss of breeding adults, eggs, and larvae, if present. However, because the likelihood of this species occurring within the permit area is low, potential impacts to the Leonora's dancer from surface disturbance also would be low.

Indirect adverse impacts to the Leonora's dancer, if present, could occur as a result of groundwater drawdown in the Simsboro aquifer. The water level changes in the 10-foot drawdown area of the outcrop would result in the incremental long-term loss of 11.5 acres of ephermeral and intermittent stream habitat and 5.2 acres of wetland habitat, if present. However, the potential long-term loss of habitat would be offset through the development of aquatic and riparian habitat during reclamation, as discussed above. Potential increases in the flow of Big Sandy Creek and Middle Yegua Creek from surface water discharge potentially could impact the Leonora's dancer by affecting aquatic habitat availability in segments of these creeks, if present. However, these flows also may benefit this species in the short-term by creating more aquatic habitat in these streams during mining. Although post-mining water levels within the creeks may result in the loss of some aquatic and wetland habitats compared to conditions during mining, these losses are not expected to substantially change the suitability of these creeks for the Leonora's dancer relative to baseline conditions along these stream channels. Consequently, potential impacts to the Leonora's dancer as a

result of water level changes and surface water discharge are unlikely to adversely impact Leonora's dancer. The stream segments that potentially would be impacted are intermittent. Most damselfly nymphs are associated with permanent waters, though some are adapted to temporary or even semi-aquatic environments (Merritt and Cummings 1984). As it is uncertain if Leonora's dancers occur in this area, and these intermittent streams are not typical habitat for most damselfly nymphs, it is unlikely that water level changes in the Simsboro aquifer would adversely impact the species.

Guadalupe Bass. The impact assessment for this species would be similar to the blue sucker. No impacts to the Guadalupe bass would be anticipated as a result of surface disturbance, water level changes, or water discharge from mine-related activities. This assessment is based on the unlikely potential that this species would occur within the permit area, within portions of streams that may be impacted by water level changes in the Simsboro aquifer, or within the segment of Middle Yegua Creek that would receive water discharge from the permit area. Changes in the flow regime of Big Sandy Creek as a result if water discharge could potentially result in a benefit to fishes that occur in the Colorado River including this species. Following the cessation of mine-related water discharge, potential changes in the flow regime of Big Sandy Creek are anticipated to have a negligible effect on the Colorado River. Consequently, no impacts from water discharge into Big Sandy Creek would be anticipated for the Guadalupe bass.

Texas Garter Snake. Potential impacts to the Texas garter snake from surface disturbance, water level changes, and mine water discharge are expected to be low based on the location of the study area outside of the known range of the snake, the general lack of typical aquatic and riparian habitats within the permit area, and the uncommon occurrence of this snake within its known range. Therefore, while it cannot be ruled out that surface disturbances, water level changes in the Simsboro aquifer, and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek may result in impacts to a few individuals, these actions are unlikely to cause more than minimal adverse impacts to this species.

Henslow's Sparrow. Because of the irregularity of expected occurrence and the general scarcity of this species in the permit area, mine-related surface disturbance is not expected to cause adverse impacts to this species.

Surface water and groundwater effects are not expected to result in substantial changes to potential Henslow's sparrow wintering habitat, as such habitat typically occurs away from drainage channels. Therefore, Simsboro aquifer water level changes and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek are not likely to adversely impact the species.

Reclamation of mined areas would result in the creation of 4,520 acres of wildlife habitat and 3,031 acres of pastureland, portions of which may provide potentially suitable habitat for this species. However, due to the rarity of Henslow's sparrow in the region and the distance of the permit area from primary wintering areas, development of potentially suitable habitat is expected to have negligible benefit to the species.

Loggerhead Shrike. Potential impacts to the loggerhead shrike as a result of surface disturbance in the permit area are expected to result from the incremental short-term loss of habitat for this species. Of the vegetation types present in the permit area, those described as grassland, mesquite grassland, and upland woodland could provide habitat for loggerhead shrikes. These vegetation communities make up

approximately 95 percent of the permit area (see Section 3.4.1 under Vegetation). Loggerhead shrikes are unlikely to occur in all areas supporting these communities, either because some areas are likely too open or too heavily wooded. However, in a conservative scenario, assuming that these habitat types are equally distributed throughout the permit area, 8,209 acres of the approximately 8,654 acres proposed to be disturbed could provide habitat for loggerhead shrikes. Depending on the time of year, land-clearing activities could result in the loss of nests, eggs, or young. However, direct impacts to active nests would be minimized by Alcoa's committed protection measures to clear vegetation outside of the breeding season or conduct breeding bird surveys within potentially suitable habitat prior to construction from February 28 through July 31, as discussed above for nongame bird species. Disturbed areas would be reclaimed concurrently with mining, and these areas are expected to provide suitable habitat for loggerhead shrikes. Because shrikes prefer relatively open habitats, reclaimed areas could begin supporting shrikes shortly after reclamation. Consequently, potential impacts to this species as a result of disturbance are expected to be low.

Potential surface water and groundwater effects are not expected to result in substantial landscape changes and, therefore, are not expected to change the quality of habitats in the area with regard to suitability for the species. Therefore, water level changes in the Simsboro aquifer and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek are not expected to adversely impact the species.

Reddish Egret. No potential impacts to the reddish egret as a result of surface disturbance, water level changes, or mine water discharge from the project are anticipated, because the reddish egret does not breed or occur regularly in the permit area.

White-faced Ibis. Surface disturbance in the permit area would result in the temporary, incremental loss of approximately 150 stock ponds (Section 3.2.4.2 under Surface Water). Many of these ponds likely provide small amounts of appropriate habitat for white-faced ibis. However, similar ponds are abundant throughout the region, and, as the loss of these features would occur incrementally, the loss of these ponds is expected to have a negligible effect on availability of resources for migrating or wandering white-faced ibises. Therefore, surface disturbances would not adversely impact this species.

The effects of mine water discharge and water level changes are not expected to affect the white-faced ibis. These activities may result in some localized changes in vegetation composition along some stream channels but would not effect the ponds in the areas where ibises could potentially occur.

Mine reclamation would result in a net increase of approximately 825 acres of aquatic habitats. These waterbodies would likely develop marshy edges in some areas that could provide potentially suitable habitat for migrating or wandering white-faced ibises.

Elliot’s Short-tailed Shrew. The potential for impacts to Elliot’s short-tailed shrew resulting from surface disturbance and water level changes within the permit area is low based on the unlikelihood that this sub-species occurs within the permit area. Potential surface water and groundwater effects, including Simsboro aquifer drawdown and potential changes to the flow regimes of Big Sandy and Middle Yegua Creeks, are not expected to result in landscape changes, and therefore, are not expected to change the quality of potential shrew habitats within the study area.

Cave Myotis. Potential direct impacts to the cave myotis as a result of surface disturbance would include the incremental short-term loss of potentially suitable foraging habitat. Potential impacts also could result in the direct loss of adults and young from the disturbance of potentially suitable roost sites (e.g., old buildings and bridges) within the disturbance area. However, based on the wide distribution of this species in the state, surface disturbance is unlikely to result in more than minimal adverse impacts to the species.

The effect of mine water discharge and water level changes are not expected to affect the cave myotis. Surface water and groundwater changes may result in some localized changes in vegetation composition along some stream channels; however, they are not expected to result in the loss of cave myotis roosting sites or foraging areas. Therefore, no change in the present level of potentially suitable cave myotis habitat in the study area is expected as a result of discharge or water level changes.

Plains Spotted Skunk. Potential direct impacts as a result of surface disturbance within the permit area would include the temporary, incremental, short-term loss of potentially suitable habitat for the plains spotted skunk. Surface disturbance impacts from mine development also could result in the loss of individual skunks, if present. However, due to the skunk's relatively wide distribution, such impacts are not likely to adversely impact the species as a population.

Potential surface water and water level change effects are not expected to affect plains spotted skunks. Localized changes in vegetation composition along some stream channels are not expected to impact these habitats such that they are rendered unsuitable for the species. Therefore, no change in the present level of potentially suitable plains spotted skunk habitat in the permit area is expected. Water level changes in the Simsboro aquifer and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek are not likely to adversely impact the species.

3.5.2.2 No Action Alternative

Terrestrial Species

Under the No Action Alternative, the Three Oaks Mine-related impacts to approximately 8,654 acres of vegetation and aquatic habitat, as described for the Proposed Action, would not occur. As a result, the related animal displacement and habitat fragmentation would not occur, and the current habitat mosaic would be retained. No animal mortalities from mine-related construction or operation would occur. No impacts to nesting birds, including raptors and songbirds, would occur. No mine-related effects to riparian or wetland habitat due to water level changes or mine water discharge, or net increases in these habitats as a result of Three Oaks Mine reclamation, would occur.

Aquatic Species

Under the No Action Alternative, no mine-related flow alterations and associated changes in aquatic habitat would occur in Middle Yegua Creek, Big Sandy Creek, or Little Sandy Creek and its tributaries. No loss of intermittent or ephemeral streams or stock ponds as a result of mine-related surface disturbance, or net increase in aquatic habitats as a result of mine reclamation, would occur under this alternative.

Special Status Species and Species of Special Concern

No mine-related impacts associated with surface disturbance, water level changes, or surface water discharge would occur to special status species or species of special concern under this alternative.

3.5.3 Cumulative Impacts

3.5.3.1 Three Oaks without SAWS

Terrestrial Species

Surface Disturbance. The cumulative effects area for surface disturbance examined for wildlife resources included the Three Oaks Mine, Sandow Mine, Powell Bend Mine, the Rockdale power generating station and Rockdale aluminum smelter, and clay mining and brick manufacturing facilities near Butler and Elgin in Bastrop County.

As discussed in Section 3.4.3 under Vegetation, an area of approximately 8,654 acres would be disturbed over the projected life of the Three Oaks Mine. In accordance with RRC guidelines, approximately 7,635 acres would be revegetated including 4,520 acres of fish and wildlife habitat. In addition, 895 acres would be reclaimed as ponds and end lakes (a net increase of approximately 825 acres). The Sandow Mine will disturb approximately 15,103 acres, of which 14,331 acres would be revegetated, and the remaining 772 acres would be reclaimed as ponds and end lakes (a net increase of approximately 654 acres of aquatic habitat). The Powell Bend Mine has disturbed approximately 291 acres and is currently being reclaimed in accordance with RRC criteria. Other surface disturbance activities within the cumulative effects area include the previous removal of approximately 100 acres and 275 acres at the Rockdale power generating station and the Rockdale aluminum smelter, respectively. Also, approximately 895 acres of terrestrial habitat has been lost due to development of Alcoa Lake in association with the Rockdale facilities, and approximately 900 acres of terrestrial habitat has been converted to form Lake Bastrop for the Lost Pines Power Park. In addition, of the 1,355 acres that is privately owned by the clay mining and brick manufacturing facilities near Butler and Elgin, 1,000 acres have previously been disturbed. For purposes of this analysis, it is assumed that 50 percent (500 acres) of this disturbance will be reclaimed.

Overall, cumulative impacts for the interrelated projects would parallel those discussed for the proposed project. Consequently, the cumulative effects to wildlife resources would be directly related to habitat loss or alternation, fragmentation, and animal displacement that have primarily resulted from the interrelated projects as well as the alteration of native habitats into pastureland and cropland in the project area. Habitat loss or alteration would result in direct losses of smaller, less mobile wildlife species (e.g., small mammals and reptiles), and the displacement of more mobile species into adjacent habitats that may currently be at or near carrying capacity. The proximity of the proposed project to historic and current operations has affected wildlife habitat value and habitat availability in the project vicinity.

Surface disturbance associated with the Three Oaks Mine and the interrelated actions would result in a combined loss of approximately 27,218 acres of wildlife habitat. The majority of this acreage (approximately

23,132 acres) eventually would be revegetated, with much of the remaining acreage reclaimed to surface water features (i.e., ponds and end lakes). Based on a combined 188 acres of previously existing surface water features, there would be a cumulative increase in aquatic habitat of approximately 3,274 acres. Although wildlife populations that occur in the cumulative effects area would continue to occupy their respective habitats and breed successfully, species composition population numbers may change relative to the amount of cumulative habitat loss and disturbance from the incremental development. Although subsequent reclamation would restore habitats to specified post-mining land-uses, it is expected that all reclaimed areas would be capable of supporting wildlife; however, species' composition and densities would be expected to change. Revegetated areas would be planted with species appropriate to the proposed post-mining land uses, but natural processes of species competition and survival will modify these communities over time (see Section 2.5.3, Closure and Reclamation). Thus, it is expected that vegetation communities on reclaimed areas will gradually evolve to more closely resemble the surrounding undisturbed communities, leading to similar gradual changes in the wildlife populations using these areas.

Water Level Change. The projected water level change from mining activities and municipal pumping would result in a reduction in the amount and extent of available surface water (e.g., streams, seeps, and springs) and associated riparian, wetland, and mesic habitats for area wildlife. In the cumulative effects area, municipal pumping would reduce flows in the Big Sandy and Middle Yegua drainages; however, the greatest impacts would occur along Big Sandy Creek, based on its location in relation to the Simsboro aquifer outcrop. Flow reductions in Big Sandy and Middle Yegua Creeks would result in the long-term loss of perennial pools and mesic habitats that occur in the affected reaches of these drainages. Reduced flows in the Big Sandy and Middle Yegua drainages, in combination with the effects of water level change on seeps and springs, would result in the incremental long-term reduction of riparian and wetland habitats, available surface water for area wildlife. Potential loss or reduction of available water or possible long-term effects to the riparian and wetland communities could result in the loss of cover, breeding and foraging habitats, reduction in available water for consumption, increased animal displacement and loss, reduction in the overall biological diversity, a reduction in the area's carrying capacity for terrestrial wildlife, and possible population declines, depending on the level of effects and the relative species' sensitivity.

Loss or reduction of perennial pools and riparian and wetland habitats would reduce the regional carrying capacity for terrestrial wildlife (i.e., the region located within the cumulative drawdown area would support a lower diversity and reduced number of riparian- and wetland-dependent wildlife species). Animals that use perennial water sources would be displaced as the available water and riparian and wetland vegetation declines. Assuming that these limited communities are currently at their respective carrying capacities, individuals that are displaced into adjacent communities may be lost from the population, concentrating the remaining animals within smaller habitat areas.

Species likely impacted by the reductions of perennial pools and riparian and wetland habitats would include big game, upland game birds, waterfowl, raptors, songbirds, nongame mammals, and area amphibians and reptiles. The extent of these indirect effects from water level change would depend on the species' use and relative species' sensitivity.

Although some recovery of the Simsboro aquifer is expected to occur following the termination of mine-related groundwater drawdown in the vicinity of the Three Oaks Mine, drawdown from continued

municipal pumping would adversely affect surface water availability and riparian and wetland habitats associated with the 20-foot drawdown area of the Simsboro outcrop in the cumulative effects area. However, these effects would be offset by the development of approximately 1,667 acres of ponds and end lakes in the reclaimed areas of the Three Oaks and Sandow Mines. In addition, the perimeter of these ponded water features would be revegetated with riparian vegetation. These ponded water features in addition to the reclamation of riparian habitats and enhancement of riparian habitat in the Middle Yegua Mitigation Site (see Section 2.5.3.6 and **Figure 2-12**) would offset the amount of surface water and riparian habitats that would be impacted from water level change.

Water Discharge. Mine water discharge from the Sandow Mine has provided temporary increased flows in East Yegua and Walleye Creeks up to an estimated 10 to 15 miles downstream of the discharge points. These increased flows have resulted in a net increase in available surface water for terrestrial wildlife, including deer, upland game birds, waterfowl, songbirds, raptors, and other terrestrial species that are closely associated with these creek drainages. In addition, it appears that these increased flows have added to the establishment and/or health of riparian vegetation for area wildlife. The cessation of discharges from the Sandow Mine would result in the termination of artificial flow augmentation and the return of these stream segments to their natural intermittent/ephemeral conditions. Potential effects from the cessation of these artificial flow augmentations would result in the reduction of existing surface water conditions as well as the incremental long-term reduction of riparian habitat for area wildlife. However, these potential effects temporarily would be offset by surface water discharges to the Big Sandy and Middle Yegua Creek drainages from the proposed Three Oaks Mine until approximately 2030, when the discharges from the Three Oaks Mine would end. As discussed in Section 3.5.2.1, it is anticipated that increased flows to Big Sandy and Middle Yegua Creeks temporarily would add to the establishment and health of riparian vegetation and increased surface water for area wildlife, until the streams return to natural intermittent or ephemeral conditions following termination of surface water discharges.

Aquatic Species

Impacts on aquatic resources are associated with changes in the duration and magnitude of flows, as discussed in Section 3.2.4.3, Surface Water. The following information summarizes impacts on aquatic biota and their habitat in relation to various cumulative project activities.

Surface Disturbance. Construction and operation of the Three Oaks and Sandow Mines would remove aquatic habitat consisting of ephemeral and intermittent streams and stock ponds during the life of the mines. Disturbance to date at the Sandow Mine has resulted in the removal of approximately 83.3 total acres of pond and intermittent/ephemeral stream habitat. Ongoing disturbance at Sandow and future disturbance at Three Oaks would remove an additional total of approximately 95 acres of pond habitat and 32.5 acres of intermittent/ephemeral stream habitat (**Table 3.2-14**). The impacts of removing surface water features on aquatic communities would be the same as discussed for the Proposed Action. Benthic macroinvertebrates and periphyton would be eliminated in the surface water features that are removed. Nongame fish species could be present in some of the ponds and stream reaches with perennial pools. Mine reclamation would replace most of the ponds and intermittent/ephemeral stream reaches, which would be recolonized by macroinvertebrates and periphyton. For those reclaimed areas that result in the same types of aquatic habitat, similar aquatic species would recolonize the water bodies. If reclamation results in a

different type of habitat (e.g., intermittent stream to end lake), additional new aquatic species likely would colonize the reclaimed water body. Following the proposed reclamation at both mines, a total of approximately 1,667 acres of ponded water features would be distributed on the reclaimed areas. Intermittent and ephemeral drainageways also would be replaced.

Short-term, local increases in suspended sediment could occur during mining and construction of road and bridge crossings at the Three Oaks and Sandow Mines and near the clay mine operations. The impacts on aquatic biota and their habitat would be similar to the impacts discussed for the Proposed Action. By implementing erosion control measures, any localized increases in sediment would be considered minor in downstream areas in Big Sandy, East Yegua, and Middle Yegua Creeks that contain game fish species such as sunfishes and largemouth bass.

After reclamation is completed at the Sandow and Three Oaks Mines, reduced runoff would occur downstream of the end lakes, as a result of recontouring the mined areas and constructing end lakes and wetlands. As a result of reduced runoff, flow decreases would occur in the Big Sandy, East Yegua, and Middle Yegua drainages. The estimated annual percent flow reduction would be approximately 4 to 5 percent in Middle Yegua Creek, 1 to 2 percent in East Yegua Creek, and 12 percent in Big Sandy Creek. The relatively low flow reductions in Middle and East Yegua Creeks are not expected to measurably affect aquatic communities. A slight decrease in aquatic habitat could occur in Big Sandy Creek, which likely would reduce macroinvertebrate and periphyton abundances. However, reduced runoff is not expected to measurably affect flows or aquatic habitat in lower Big Sandy Creek, lower Middle Yegua, or the Colorado River.

Water Level Change. The projected cumulative water level change would result in adverse effects on aquatic biota and their habitat due to reduced flows. In the area extending from the Colorado River to the northern end of the Sandow Mine, pumping would reduce flows in the Big Sandy and Middle Yegua drainages. East Yegua Creek would not be affected by water level changes because the Simsboro aquifer does not contribute water to this drainage. Since a larger portion of the Big Sandy Creek drainage lies within and adjacent to the Simsboro aquifer outcrop, the magnitude of flow reductions and length of streams affected would be greatest in this drainage. Flow reductions are estimated to be 0.5 to 1.0 cfs in Big Sandy Creek and less than 0.25 cfs in Middle Yegua Creek. One tributary to Middle Yegua Creek, Sandy Creek, could exhibit flow reductions from 0.1 to 0.2 cfs. The effect of reduced flows on aquatic communities would be a loss of habitat in the affected reaches. Under natural conditions, portions of these drainages dry up during low-flow periods and drought conditions. Groundwater drawdown could contribute additional effects to these water bodies by increasing the extent of dry stream conditions and loss of aquatic habitat. The length and area of perennial pools, which presently represent the predominant type of persistent aquatic habitat, would decrease due to flow reductions. The loss of aquatic habitat would reduce populations of macroinvertebrates, periphyton, and nongame fish.

Although some recovery would occur in the Three Oaks Mine vicinity after mine-related pumping is terminated, drawdown from continued municipal pumping still would affect baseflow contributions to the Big Sandy drainage and Middle Yegua Creek. Therefore, continued reductions in aquatic habitat would occur in these drainages, which could reduce macroinvertebrate, periphyton, and nongame fish abundances.

Water Discharge. Existing Sandow Mine discharges into East Yegua and Walleye Creeks have resulted in augmented flows (11 to 25 cfs) in stream reaches up to an estimated 10 to 15 miles downstream of the discharge points. This activity has resulted in a loss of intermittent/ephemeral habitat and associated aquatic communities in the affected reaches. At the same time, it has created a temporary beneficial impact for other species by creating additional perennial flow habitat. The cessation of Sandow Mine discharges would end artificial flow augmentation and return the streams to their original intermittent/ephemeral regime. Habitat would change to small intermittent reaches or pools that contain macroinvertebrate and periphyton species adaptable to low or no-flow conditions.

Flows in Middle Yegua Creek would not be affected by the end of Sandow Mine discharges into Walleye Creek until after approximately year 2030, when discharges from the Three Oaks Mine would end. Until 2030, discharges from dewatering and depressurization pumping would augment flows and increase aquatic habitat in Middle Yegua and Big Sandy Creeks, as discussed under the Proposed Action. On a regional basis, this habitat increase would somewhat offset the effects of ending discharges at the Sandow Mine.

Special Status Species and Species of Special Concern

Surface Disturbance. The cumulative effects area for surface disturbance would be the same as discussed for general wildlife resources. Overall, cumulative impacts for these interrelated projects would parallel those discussed for the proposed project. Consequently, the cumulative effects to sensitive species would be directly related to habitat loss or alternation, fragmentation, and animal displacement that primarily have resulted from industrial activities as well as the alteration of native habitats into pastureland and cropland in the project area. Habitat or alteration also potentially could result in the direct loss of smaller, less mobile species.

As discussed for general terrestrial wildlife, projects within the cumulative effects area would affect approximately 27,218 acres. However, the disturbance acreage eventually would be revegetated or reclaimed to surface water features (i.e., ponds and end lakes) post-mining. Consequently, direct impacts to sensitive wildlife species from surface disturbance activities would result in the incremental short-term loss of potentially suitable habitat until final reclamation is complete.

Impacts could result in direct mortalities of two special status species (timber/canebrake rattlesnake and Texas horned lizard) and three species of special concern (Leonora's dancer, loggerhead shrike, and plains spotted skunk), if present, from mine-related activities within the permit area, as discussed in Section 3.5.2. The timber/canebrake rattlesnake and loggerhead shrike would have the highest likelihood of being directly affected by interrelated actions, based on their known habitat association and occurrence within the cumulative effects area. However, based on Alcoa's committed environmental protection measure for the timber/canebrake rattlesnake and the commitment to either clear vegetation outside of the breeding season or conduct breeding bird surveys prior to disturbance during the breeding season (see **Table 2-15**), it is anticipated that the Three Oaks Mine's potential contribution to cumulative impacts for these species would be low. Although it is possible that the Texas horned lizard, Leonora's dancer, and plains spotted skunk could occur in disturbance areas associated with the cumulative projects, no population-level effects would be anticipated, based on their rarity and relatively wide distribution in the project region.

Water Level Change. Potential impacts to sensitive wildlife species as a result of water level change would be the same as those discussed for terrestrial wildlife. Water level change could reduce available water and result in the incremental long-term effects to the riparian and wetland communities. Sensitive species likely impacted by the reductions of perennial pools and riparian and wetland habitats would include Leonora's dancer, Texas garter snake, timber/canebrake rattlesnake, wood stork, white-faced ibis, and plains spotted skunk, based on their habitat association and potential for occurrence in the cumulative effects area. However, the level of impacts to these species would be based on their relative sensitivity to water level changes.

As discussed for general terrestrial wildlife, although some recovery to the Simsboro aquifer is expected to occur following the termination of mine-related water level changes in the vicinity of the Three Oaks Mine, drawdown from continued municipal pumping would negatively affect surface water and riparian and wetland habitats in the cumulative effects area. However, these effects would be offset by the development of approximately 1,667 acres of ponds and end lakes in the reclaimed areas of the Three Oaks and Sandow Mines. In addition, the perimeter of these ponded water features would be reclaimed with riparian vegetation. These ponded water features in addition to the reclamation and enhancement of riparian habitats would offset the amount of surface water and riparian habitats that would be impacted from water level change.

Water Discharge. As discussed for general terrestrial wildlife, the cessation of discharges from the Sandow Mine would result in the termination of artificial flow augmentation in East Yegua and Walleye Creeks, returning these creeks to their original intermittent/ephemeral conditions. Potential effects from the cessation of these artificial flow augmentations would result in the reduction of existing enhanced surface water conditions in those drainages as well as the incremental long-term reduction of riparian habitat to pre-mining conditions. However, these potential effects would be somewhat offset by surface water discharges to the Big Sandy and Middle Yegua drainages from the proposed Three Oaks Mine until approximately 2030, when discharges from the Three Oaks Mine would end. It is anticipated that increased flows to Big Sandy and Middle Yegua Creeks temporarily would add to the establishment and health of riparian vegetation and increased surface water for area wildlife, until the streams return to their natural conditions following termination of surface water discharges.

3.5.3.2 Three Oaks with SAWS

Terrestrial Species

Surface Disturbance. The effects of surface disturbance under this scenario would be the same as described under the Three Oaks Mine without SAWS scenario.

Water Level Change. The effects of water level change on wildlife and their habitats would be the same as discussed for the Three Oaks Mine without SAWS scenario. However, the implementation of SAWS would result in different patterns of temporal habitat reduction relative to surface water. Prior to 2013, the potential impacts of water level change on surface water as well as on riparian and wetland habitats along Big Sandy and Middle Yegua Creeks would be overshadowed by the contributions from the Three Oaks Mine

discharges. However, after the year 2013, flow augmentation would cease in Big Sandy and Middle Yegua Creeks as a result of SAWS' use of Three Oaks Mine water. As a result, late season flows and perennial pools on or near the gaining reaches likely would decrease or cease as a result of water level change. Consequently, water level change in these reaches likely would result in the loss of available surface water as well as riparian and wetland habitats for area wildlife. After approximately 2030, the effects of water level change as a result of SAWS and the development of the Three Oaks Mine watershed components would reduce the amount of surface water as well as riparian and wetland habitats for area wildlife. This reduction in flow is expected to have similar indirect impacts on area wildlife and their habitats as discussed for the Three Oaks Mine without SAWS.

Water Discharge. In the years prior to 2013, the potential impacts to surface water flows and wildlife and their habitats would be the same as discussed for the Three Oaks without SAWS scenario. In 2013, water discharge contributions to Big Sandy and Middle Yegua Creeks would end as a result of the implementation of SAWS. The effect of reduced flows would result in a reduction of surface water as well as a reduction in riparian and wetland habitat for area wildlife. Impacts to area wildlife and their habitats as a result of this reduction would be the same as discussed for the Three Oaks Mine without SAWS scenario. However, it is expected that seasonal discharges during periods of high runoff would maintain intermittent flow to the downstream channels during the life of the mine. Although it is likely that riparian and wetland habitats that were created prior to 2013 would be reduced, these creeks would return to their present intermittent/ephemeral regime and corresponding terrestrial wildlife composition, depending on the level of effects and the relative species' sensitivity.

Aquatic Species

Potential cumulative impacts to aquatic biota and their habitat under this scenario generally would be similar to the types of impacts discussed for the Three Oaks Mine without SAWS. The effects of groundwater drawdown on aquatic habitat would be similar, except that there would be a wider regional impact area that extends northward along the Simsboro outcrop.

Surface Disturbance. The effects of surface disturbance under this scenario would be the same as described under the Three Oaks Mine without SAWS scenario.

Water Level Change. The effects of water level change on aquatic habitat would result in reductions in aquatic habitat, as discussed for the Three Oaks Mine without SAWS scenario. However, the implementation of SAWS would result in a different pattern in habitat reductions relative to decreases in surface flow. Prior to 2013, water level change effects on aquatic biota and their habitat would be overshadowed by the contributions from Three Oaks Mine discharges. After 2013, the flow augmentation and increased aquatic habitat would cease in Middle Yegua and Big Sandy Creeks as a result of SAWS' use of the mine depressurization water. In relative terms, the drawdown effects on Big Sandy and Middle Yegua Creeks after 2030 would be greater with the inclusion of SAWS. The effects of groundwater drawdown from SAWS and municipal pumping on Big Sandy Creek also could reduce flows to the Colorado River. The reduction in aquatic habitat could reduce macroinvertebrate abundance. The effect of habitat reduction on fish would depend on the area and types of habitat affected.

Water Discharge. In the years prior to 2013, the potential impacts on surface flows and aquatic habitat would be the same as discussed for the Three Oaks without SAWS scenario. Water discharges would result in increased perennial habitat below the discharge points and loss of intermittent/ephemeral habitat. In 2013, SAWS would begin to use water pumped from the mine water management system. As a result, discharge no longer would occur in Big Sandy Creek and Middle Yegua Creek. The effect of the reduced flows would result in a decrease in the amount of enhanced aquatic habitat. Essentially, these streams would return to their present intermittent/ephemeral regime.

The overall net effect of water level change and surface water discharges would be increased aquatic habitat downstream of the discharge points due to increased flows until 2013. Between approximately 2013 and 2030, less enhanced aquatic habitat would be available due to water level reductions. After approximately 2030, the combined effects of water level change and watershed modifications would substantially reduce the amount of enhanced aquatic habitat. This effect would be most evident near the Three Oaks Mine permit area and within several miles downstream in both creeks.

A substantial reduction in enhanced aquatic habitat in East Yegua Creek would occur due to watershed modifications and cessation of Sandow Mine discharges. The greatest habitat reduction would occur upstream of U.S. Highway 77; however, effects also would be evident in the lower portion of the stream.

Special Status Species and Species of Special Concern

Surface Disturbance. The effects of surface disturbance under this scenario would be the same as described under the Three Oaks Mine without SAWS scenario.

Water Level Change. The effects of water level change on sensitive species would be the same as discussed for the Three Oaks without SAWS scenario. However, the implementation of SAWS would result in different patterns of temporal habitat reduction as it relates to surface water. Prior to 2013, the potential impacts of water level change on surface water as well as on riparian and wetland habitats along Big Sandy and Middle Yegua Creeks would be overshadowed by the contributions from the Three Oaks Mine discharges during the life of the mine. However, after the year 2013, flow augmentation would cease in Big Sandy and Middle Yegua Creeks as a result of SAWS' use of Three Oaks Mine depressurization water. Between approximately 2013 and 2030, late season flows and perennial pools on or near the gaining reaches would likely decrease or cease as a result of water level change. As a result, water level change in these reaches would likely result in the loss of available surface water as well as riparian and wetland habitats for some sensitive wildlife species. As a result, increased intra- and inter-specific competition may cause a reduction in sensitive species composition and population numbers in the affected areas. After 2030, the effects of groundwater drawdown as a result of SAWS and the development of the Three Oaks Mine watershed components would reduce the amount of surface water as well as riparian and wetland habitats for area wildlife. This reduction is expected to have similar indirect impacts on sensitive species as discussed for the Three Oaks Mine without SAWS.

Water Discharge. In the years prior to 2013, potential impacts to surface water flows and sensitive wildlife species would be the same as discussed for the Three Oaks without SAWS scenario. In 2013, water discharge contributions to Big Sandy and Middle Yegua Creeks would end as a result of the implementation

of SAWS. The effect of reduced flows would result in a reduction of surface water as well as a reduction in riparian and wetland habitat for sensitive species. Impacts to sensitive species and their habitats as a result of this reduction would be the same as discussed for the Three Oaks without SAWS scenario. However, it is expected that seasonal discharges during periods of high runoff would maintain intermittent flow to the downstream channels during the life of the mine. Although it is likely that riparian and wetland habitats that were created prior to 2013 would be reduced, these creeks would return to an intermittent/ephemeral regime and corresponding terrestrial wildlife composition, depending on the level of effects and the relative species' sensitivity.

3.5.3.3 Three Oaks without SAWS (No Action Alternative)

Terrestrial Species

Under this cumulative scenario, there would be no surface disturbance from the Three Oaks Mine. There would be no removal of existing surface water features (i.e., seeps and springs) or water management modifications or discharges from mine development under this alternative. Non-mine-related water level change would result in flow reductions and the reduction of riparian and wetland habitats within the cumulative drawdown area. Potential effects to wildlife from these reductions would be similar to those discussed for the Three Oaks Mine with SAWS.

Aquatic Species

The impacts of the SAWS without Three Oaks scenario primarily relate to flow changes. There would be no removal of existing surface water features or watershed modifications under this scenario. Potential impacts of this scenario from groundwater drawdown on aquatic biota and their habitat would be the same as effects discussed for the Three Oaks Mine with SAWS. Aquatic habitat would be reduced in Big Sandy and Middle Yegua Creeks due to groundwater drawdown effects on surface flows. On a regional basis, this scenario also would result in habitat reductions in the Colorado River due to decreased flow contributions from Big Sandy Creek. Habitat reductions also would occur in streams located along the Simsboro outcrop in Milam, Robertson, Falls, and Limestone Counties. Potential impacts to aquatic biota would be similar to those described for Three Oaks with SAWS scenario.

Special Status Species and Species of Special Concern

Under this scenario, there would be no surface disturbance from the Three Oaks Mine. There would be no removal of existing surface water features (i.e., seeps and springs) or water management modifications or discharges from mine development under this scenario. Non-mine-related water level changes would result in flow reductions and the reduction of riparian and wetland habitats within the cumulative drawdown area due to groundwater pumping. Potential effects to area wildlife and riparian and wetland habitats from these reductions would be similar to those discussed under the Three Oaks with SAWS scenario.

3.5.4 Monitoring and Mitigation Measures

FW-1: Raptor Collision Protection. Standard raptor-proofing designs, as outlined in *Mitigating Bird Collision with Power Lines* (APLIC 1994), would be incorporated into the design of the new and relocated power lines and new substation, as applicable, to prevent the potential collision to foraging and migrating bird species (i.e., raptors and waterfowl) in the project area.

FW-2: Raptor Electrocution Protection. Standard safe designs, as outlined in *Suggested Practices for Raptor Protection on Power Lines* (APLIC 1996), would be incorporated into the design of the relocated 14.4-kV power line and the new 25-kV power distribution lines in areas of identified avian concern to prevent electrocution of raptor species attempting to perch on the lines. These measures would include, but would not be limited to, a 60-inch separation between conductors and/or grounded hardware and recommended use of insulating materials and other measures depending on line configuration (APLIC 1996).

FW-3: Aquatic Monitoring. To determine if fish and macroinvertebrate populations are affected by drawdown and discharge volumes, aquatic biology monitoring is recommended on lower Big Sandy Creek. If substantial reductions in fish and macroinvertebrate numbers are indicated, Alcoa would manage groundwater discharge to increase the volume released into Big Sandy Creek. Alternately, if groundwater pumping for SAWS should be implemented, it is assumed that CPS would be responsible for similar monitoring and mitigation.

3.5.5 Residual Adverse Effects

Residual adverse effects to terrestrial species, including special status species and species of special concern, would include the permanent net loss of approximately 825 acres of terrestrial habitat, resulting from the conversion of these lands to aquatic resources (ponds and end lakes) in conformance with the RRC approved post-mining land uses. For fisheries, residual adverse effects would include post-mining reductions in flows and riverine habitat due to watershed modification and water level changes.

3.6 Paleontological Resources

Paleontological resources encompass all forms of life (plants, animals, and other organisms) from prehistoric or geologic time as evidenced by fossils. These fossils are remnants of past life (i.e., skeletons, tracks, or leaf imprints) preserved in the earth's crust. Paleontological resources provide information regarding extinct organisms in the remote past pertaining to the geologic history and past environments of a region (Bates and Jackson 1984; Raschke 2001).

3.6.1 Affected Environment

The study area for paleontological resources comprises the Three Oaks Mine permit area and road relocations. The cumulative effects area for paleontological resources encompasses the areas of disturbance associated with the existing Sandow Mine and local clay pits as well as the proposed Three Oaks Mine. Information regarding the geology of the mine area and the region is based on reports and maps from the Bureau of Economic Geology (BEG) and geophysical surveys undertaken by Alcoa. These surveys indicate that the mine area overlies three geological formations. These formations (Hooper, Simsboro, and Calvert Bluff) are associated with the Wilcox Group (see Section 3.1, Geology and Mineral Resources) (Alcoa 2001b [Volume 2]). The formations of the Wilcox Group date to the Eocene Epoch (37.5 to 54 million years before present) of the Cenozoic Era (Thompson 1998).

Geologically, the formations of the Wilcox Group are associated, to varying degrees, with fluvial-deltaic systems of a coastline (Ayers and Lewis 1985; Alcoa 2001b [Volume 2]). In ascending stratigraphic order, the Hooper Formation is associated with deposits in both fluvial and deltaic systems; the Simsboro Formation is associated with fluvial deposits that fed basinward deltas; and the Calvert Bluff Formation is associated with deposits in a delta-dominated environment (Alcoa 2001b [Volume 2]).

No paleontological surveys have been conducted in the permit area. However, past paleontological investigations conducted in the area by the Geological Survey of Texas, USGS, and BEG have indicated that paleontological resources associated with the formations of the Wilcox Group (including the Calvert Bluff Formation) are common throughout the region (BLM 1980a; Sellards et al. 1990). Representative fossils associated with the Hooper Formation of the Wilcox Group include various species of Gastropoda (e.g., snails), Pelecypoda (e.g., bivalves such as clams and oysters), and Cephalopoda (i.e., mollusks with tentacles) (Sellards et al. 1990). The fossils of the Simsboro and Calvert Bluff Formations of the Wilcox Group are not indicated to have marine fossils; however, they do have abundant fossilized flora (Sellards et al. 1990). Some of the fossilized flora identified within Bastrop County in association with the Simsboro and Calvert Bluff Formations include spindletree species (e.g., *Euonymus splendus*), fig species (e.g., *Ficus berryi* and *Ficus vaughami*), and species of the laurel family (e.g., *Oreodaphne* spp.) (Sellards et al. 1990). Due to the prevalence of fossils associated with the Calvert Bluff Formation throughout this region, these paleontological resources are not considered unique (BLM 1980a; Sellards et al. 1990).

3.6.2 Environmental Consequences

3.6.2.1 Proposed Action

Under the Proposed Action, all surface disturbance associated with the ancillary support facilities (including the transportation and utility corridor), road and utility relocations, and mine area development would occur on or within the Calvert Bluff Formation. No physical disturbance would occur on or within the underlying Simsboro or Hooper Formations.

Construction of the ancillary support facilities and road and utility relocations could impact near-surface paleontological resources, if present. Development of the mine area would pose a higher potential for impact to these resources, due to the extent and depth of the proposed physical disturbance. As a result, implementation of the Proposed Action would result in a direct impact to paleontological resources, if present, that are associated with the Calvert Bluff Formation within the areas of proposed disturbance. This impact would result in the loss of context and, as a result, the loss of scientific information and educational value associated with the resource. However, due to the prevalence of paleontological resources associated with the Calvert Bluff Formation throughout the region, these effects are considered to be minor.

Potential indirect impacts to paleontological resources could include erosional effects as a result of runoff or mine water discharge. However, based on the proposed surface water control system and implementation of erosion control measures as discussed in Section 2.5, Proposed Action, the potential for impact is considered to be low. As discussed in Geology and Mineral Resources under Section 3.1.2.1, dewatering and depressurization pumpage at the Three Oaks Mine is not anticipated to cause subsidence. Therefore, there would be no indirect impact to paleontological resources as a result of these activities.

3.6.2.2 No Action Alternative

Under the No Action Alternative, ground-disturbing activities associated with the Three Oaks Mine would not occur. As a result, any paleontological resources associated with the Calvert Bluff Formation in the proposed disturbance area would not be affected by mining activity. However, some of these resources may be affected by natural impacts (i.e., erosion).

3.6.3 Cumulative Impacts

All surface and subsurface disturbance associated with the existing Sandow Mine and local clay pits and the proposed Three Oaks Mine has occurred or will occur on or within the Calvert Bluff Formation. Development of the Three Oaks Mine would result in a minor incremental increase in impacts (i.e., loss of context, scientific information, and educational value) to paleontolgocial resources associated with this formation. However, as discussed in Section 3.6.2.1, these effects are considered to be minimal due to the prevalence of paleontological resources associated with the Calvert Bluff throughout the region.

Based on the development of surface water controls and implementation of erosion control measures at the Three Oaks Mine, it is assumed that any potential incremental increase in indirect impacts as a result of erosion would be minor.

3.6.4 Monitoring and Mitigation Measures

No monitoring or mitigation is being considered for paleontological resources.

3.6.5 Residual Adverse Effects

Residual adverse effects to paleontological resources would include the possible loss of scientific data and educational value associated with potential fossil resources in the proposed disturbance area.

3.7 Cultural Resources

Cultural resource issues include the potential direct impacts of project disturbance, indirect impacts associated with increased activity in the permit area, as well as potential groundwater and surface water impacts to cultural sites.

3.7.1 Affected Environment

3.7.1.1 Prehistoric Background

The cultural resources study area comprises the Three Oaks Mine permit area and road relocations. The cumulative effects area includes the study area and surface disturbance associated with the Sandow Mine and clay pits in the vicinity of the Three Oaks Mine. Investigations into the prehistory of this region of Texas have revealed evidence of human occupation from the Paleoindian age through the Late Prehistoric (11,500 to 260 B.P.). However, the prehistoric occupation sequences identified in the permit area only reflect prehistoric utilization from the Early Archaic to the Late Prehistoric (8,800 to 260 B.P.). This long span of occupation is believed to mainly include hunter-gatherers organized into small groups or bands that exploited floral and faunal resources during their migratory rounds. The prehistoric site types observed within the mine area are generally lithic scatters (chipped stone flakes scattered in varying concentrations) that infrequently have associated formal tools (i.e., projectile points, scrapers, blades, etc.) or features (i.e., hearths or burned rock middens) present. These prehistoric sites are predominantly located in proximity to tributaries feeding into the Colorado (i.e., Big Sandy Creek) or Brazos (i.e., Willow-Mine-Middle Yegua system) Rivers. Sites also have been identified, to a lesser extent, on prominent knolls and ridgelines where an unobstructed view of the surrounding terrain was afforded. Partially based on the low occurrence of ground stone, these sites have been interpreted to be brief occupation campsites that primarily focused on the procurement of food through hunting activities (Turpin and Sons, Inc. [TAS] 2001).

Additional examinations of some of the sites in this region, through excavations, have not produced significant information; this work has provided little information about the inhabitants, and few sites have been placed on the NRHP. The low research value of these sites may be attributed to the compromised depositional context (i.e., removed or destroyed deposits due to land clearing, farming, etc.) of the sediment in the area, the diffuse nature of the sites themselves, or a combination of these traits.

3.7.1.2 Historic Background

Investigations into the history of the region indicate that people began homesteading in the permit area in the 1850s. These early homesteaders consisted of various ethnic groups predominantly made up of German immigrants. Initially, early settlement seemed to favor areas in Bastrop County over those in Lee County. However, settlement in Lee County as well as the surrounding areas increased after the Civil War. At this time, the economy for the region and the general project area was depressed and did not perceptibly recover until the 1870s. The creation of community cemeteries, churches, and schools reflect this settlement growth. Within the permit area, primary industries were represented by cotton gins and coal and clay mining operations. Coal mining eventually tapered off and was eclipsed by clay mining for the production of brick and pottery, a practice that continues to the present. The farming communities in the permit area began to

noticeably dwindle after World War II. This decline is evidenced by the abandonment of many sites in the area and may be attributed to the residents moving into urban settings to work in factories (TSHA 2000a,b; TAS 2001).

The historic sites within the permit area consist of the remnants of farmsteads and homesteads and their associated debris. Several small cemeteries also were identified; however, these have been relocated outside of the permit area (i.e., site numbers 41LE206 and 41BP581). The majority of the historic sites were razed, overbuilt, or relocated.

3.7.1.3 Cultural Resources Identified In the Permit Area

As early as 1981 and as recently as 2001, cultural resource inventories have been undertaken within the permit area. These surveys were conducted under protocols developed by the THC. Generally, the surface was inspected by walking in 30-meter intervals following the contours of the terrain or, when possible, by compass headings. This visual surface inspection was supplemented by shovel probing the subsurface. The shovel probes were utilized to test high probability areas or to assist in delineating the extent of a site's boundary. Due to the prevalence of exposed basal clay, shovel probing was limited and focused on areas that retained deeper soils (i.e., hill tops, slopes, and their bases). For the investigation of historic resources in the permit area, aerial photographs and historic maps (i.e., 1904 and 1950 USGS maps, soil survey maps, and county highway maps) were reviewed. The archival research also utilized historic records (i.e., deed, tax, and probate) from the county courthouses, and from the State archives, tax, census, and death records were investigated. Finally, interviews with some of the local residents and descendants of those who lived in the area were undertaken (TAS 2001).

The University of Texas at San Antonio (UTSA), Espey Huston and Associates, Inc. (EHA), and TAS have undertaken cultural resource inventories within the permit area and surrounding vicinity. These various surveys have investigated approximately 16,100 acres. Approximately 560 acres of the permit area have not been surveyed due to private landowner constraints (TAS 2001), of which approximately 150 acres occur in the mine area. A portion of the small road relocation that would fall outside of the permit area also has not been surveyed; however, the entire relocation of CR 89 outside the RRC permit area would constitute only approximately 6 acres where an existing roadway would be widened and upgraded.

Between 1981 and 1984, the UTSA surveyed approximately 3,146 acres. This survey was conducted on behalf of the CPS and documented 27 archaeological sites, of which 2 sites are located outside of the permit area. The 25 sites inside the permit area include 14 historic, 8 prehistoric, and 3 multi-component (containing both historic and prehistoric components) sites. At the time of the survey, all of these recorded sites were judged to be insignificant in terms of NRHP criteria (TAS 2001).

In 1987, a cultural resource inventory was conducted by EHA on the far northeastern end of the proposed transportation and utility corridor. Approximately 430 acres were surveyed; 2 prehistoric sites were discovered and recorded in this area. At the time of the survey, both of these prehistoric lithic scatter sites were judged to be insignificant in terms of NRHP criteria (TAS 2001).

From 1999 to 2001, TAS conducted surveys for both Alcoa and CPS. For these surveys, approximately 12,500 acres were investigated, with 180 archaeological sites discovered (66 prehistoric, 108 historic, and 6 multi-component). Of these 180 recorded archaeological sites, 13 are outside of the permit area. The remaining 167 archaeological sites (65 prehistoric, 97 historic, and 5 multi-component) are located within the permit area. The prehistoric and multi-component sites and the majority of the historic sites recorded from this survey were judged to be insignificant at the time of the survey and did not meet the criteria for listing on the NRHP. However, the THC has requested additional information or recommended testing of 10 of the prehistoric sites and 6 of the historic sites in the permit area (Alcoa 2002c [Volume 1]).

Through the combined surveys (UTSA, EHA, and TAS), a total of 194 sites (75 prehistoric, 111 historic, and 8 multi-component) were identified in the permit area. Of the 194 archaeological sites, 134 are located in the proposed disturbance area. Specifically, these 134 sites consist of 71 sites located in the mine area, 30 sites located in the ancillary facilities area, 7 sites located within the transportation and utility corridor, 6 sites located within or immediately adjacent to the proposed road relocations, and 20 sites located within or immediately adjacent to the proposed utility reroutes. The remaining 60 sites are within the permit area but outside of the proposed areas of disturbance.

An initial review of the report of the findings, as presented in the original RRC permit application (Alcoa 2000 [Volume 1]), was completed by the THC. The report was revised in October 2001 by TAS in response to the THC's initial review and subsequent field surveys (Alcoa 2001b [Volume 2], 2001c [Volume 2]). The revised report has been reviewed by the THC, and their findings are presented in Supplement No. 3 to the RRC permit application (Alcoa 2002c [Volume 1]). To-date, the THC has determined that five of the historic sites (41BP202, 41BP275, 41BP557, 41BP594, and 41LE306) identified in the permit area are eligible to the NRHP (THC 2001, 2002b). One hundred seventy-three sites identified in the permit area have been determined by the THC to be ineligible for inclusion in the NRHP. Additional information or testing has been requested by the THC for 16 sites (10 prehistoric and 6 historic in the permit area) (THC 2001, 2002a).

3.7.1.4 Ethnography and Ethnohistory

From 1999 to 2001, ethnographic interviews were undertaken and focused on local residents and descendants of residents that lived or currently live within the mine area. In total, TAS conducted at least 20 separate interviews of individuals or couples. These personal communications provided valuable information relative to the history of the mine area (TAS 2001).

In the spring of 1999, consultation was undertaken with tribal groups associated with the permit area. Initially, four tribal groups (i.e., Apache, Comanche, Tonkawa, and the Wichita) were contacted to inquire if they had any interest in Three Oaks Mine activities. Only the Tonkawa and Wichita tribal groups responded to this initial contact, acknowledging an association with the permit area and expressing a desire to be updated of these activities as they progress. Due to the lack of response from the Apache and the Comanche tribal groups and the recently identified association of the Kiowa tribal group, further tribal consultation was undertaken. A second attempt at contact was made in the fall of 2001 with the Apache and the Comanche tribal groups, and initial contact was made with the Kiowa tribal group. To date, no response has been received from these groups.

Consultation with the five identified tribal groups (i.e., Apache, Comanche, Kiowa, Tonkawa, and Wichita) has not resulted in the identification of any culturally significant properties within the permit area, although the Wichita tribal group has indicated an interest if any aboriginal remains are encountered. As the permit area is privately held land, any prehistoric human remains encountered would not be subject to federal requirements of the Native American Graves and Repatriation Act (NAGPRA). Also, prehistoric human remains on private land are not afforded protection by any state law concerning unmarked graves. However, because the permit area would be federally permitted (i.e., USACE), compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended through 2000 (16 U.S.C. 470) is required, and any human remains could be classified as an archaeological site, requiring consultation with the THC, USACE, and the Advisory Council for Historic Preservation. Consultation with the five identified tribal groups (Apache, Comanche, Kiowa, Tonkawa, and Wichita) is ongoing. The five identified tribal groups will be kept advised of work as it continues.

3.7.2 Environmental Consequences

3.7.2.1 Proposed Action

Development of the mine area and construction of the ancillary facilities, transportation and utility corridor, and road and utility relocations could result in direct impacts to cultural resources due to ground-disturbing activities. These impacts would include the vertical and horizontal displacement of soil containing cultural materials and the resulting loss of integrity, loss of information, and the alteration of the site setting. Indirect impacts to cultural resources could include potential erosional effects from runoff or mine water discharge and an increased potential for illegal collection and vandalism within or adjacent to the project area due to increases in both surface disturbance and the number of people in the area. Potential erosional effects are anticipated to be minor based on the proposed surface water control system and implementation of erosion control measures as discussed in Section 2.5, Proposed Action. Mitigation is being considered to minimize the potential for illegal collection and vandalism (see mitigation measure CR-1 in Section 3.7.4, Monitoring and Mitigation Measures). As discussed in Geology and Mineral Resources under Section 3.1.2.1, it is anticipated that dewatering and depressurization activities would not result in subsidence. As a result, no impacts to cultural resources would occur as a result of these activities.

Physical modification of prehistoric and historic archaeological sites would affect the physical integrity of the resource; modification of the surroundings could affect integrity with respect to site setting. An undertaking is considered to have an effect on a cultural property if it alters any of the attributes that may qualify the resource for inclusion in the NRHP. Any physical alteration that results in an adverse impact to a cultural resource that is eligible for inclusion in the NRHP is considered a significant impact. A determination of no adverse effect or no effect is applied to undertakings if all cultural resources in the area have been shown to be not significant and not eligible for inclusion in the NRHP, or the impacts to the qualities that make the resource significant (as defined in 36 CFR 60.4) are mitigated.

Based on the surveys completed to-date in the proposed areas of disturbance, a total of 134 archaeological sites would be directly impacted as a result of mine construction and operation in the proposed disturbance areas (see **Figure 2-3**). These include 4 of the 5 NRHP-eligible sites (41BP202, 41BP275, 41BP557, and 41BP594) located within the mine area. Two of the eligible sites (41BP202 and 41BP275) are within the

mine block that would be mined during years 11-15. Site 41BP557 is within the mine block that would be mined during years 21-25, and site 41BP594 is within the mine block that would be mined during years 21-25. The remaining archaeological sites have either been determined by the THC to be ineligible to the NRHP, or are undergoing further evaluation or testing prior to subsequent THC and USACE review and eligibility determination (THC 2002a,b).

Approximately 150 acres within the mine area have not been surveyed to-date. Section 106 consultation would need to be initiated and completed for this area prior to any ground disturbing activities.

The fifth NRHP-eligible site (41LE306) within the permit area would be outside of the area of proposed disturbance. However, mining activity has the potential to visually affect this site, which is located in the vicinity of the proposed transportation and utility corridor. Visual impacts are equally as important as direct impacts, and as a result, need to be evaluated accordingly. To minimize visual impacts to this historic property, mitigation would be developed and implemented in accordance with the site protection or treatment plans created in coordination with the THC, USACE, and RRC.

No cultural resource sites eligible to the NRHP would be disturbed by mining or mining-related activities until written or signed agreement is obtained from the THC, RRC, and USACE. A site protection plan has been developed and is included in the RRC permit application. In the event of unanticipated discoveries, including human remains, during mine construction and operation, Alcoa would protect the discovery and contact the USACE and THC in accordance with appropriate state and federal laws.

3.7.2.2 No Action Alternative

Under the No Action Alternative, the 134 archaeological sites within the proposed mine disturbance area (including 4 of the 5 sites eligible to the NRHP) would not be affected as a result of mining-related activities. In addition, mining-related visual effects to the fifth NRHP eligible site would not occur. As a result, impacts to cultural resources within the permit area would be limited to exposure to the elements and deterioration from natural impacts (i.e., erosion).

3.7.3 Cumulative Impacts

Cumulative activities related to other ongoing or proposed projects in the area cannot be quantified at this time. The clay mining and brick manufacturing industry in the area has affected approximately 1,000 acres of privately owned surface; however, such operations are not subject to the same regulations as the Three Oaks Mine. In addition, the Sandow Mine will have disturbed approximately 15,103 acres by mine-closure.

Although difficult to identify, the cumulative impacts to archaeological sites would include natural impacts (i.e., erosion and dilapidation), as well as direct disturbance and removal of cultural sites that were located, or currently may be located, within the interrelated actions' areas of disturbance. However, all NRHP-eligible sites at the Three Oaks Mine would be mitigated in accordance with site protection or treatment plans in coordination with THC, USACE, and RRC, thereby minimizing direct cumulative impacts to cultural resources. The visual cumulative impacts to aboveground architecture, cultural features, and historic landscapes, however, are more difficult to ascertain. Mining activity and industrial ventures in the area have

a potential to visually affect these cultural elements, while not directly affecting their physical characteristics. However, based on the distance between the interrelated actions, no cumulative visual impacts are anticipated.

3.7.4 Monitoring and Mitigation Measures

To-date, a memorandum of agreement (MOA) regarding specific mitigation and monitoring measures has not been developed. However, as discussed in Section 3.7.2.1, no cultural resources would be disturbed by mining activities until testing has been completed, THC eligibility determinations made, site protection or treatment plans have been implemented, where required, and subsequent written or signed agreement is obtained from the THC, USACE, and RRC. Also, approximately 150 acres within the mine area would need to be surveyed with consultation completed, in accordance with Section 106, prior to the initiation of ground disturbing activities in or adjacent to this area.

Based on this EIS analysis, the USACE is considering the following additional mitigation for cultural resources.

CR-1: Indirect Impact Mitigation. To minimize impacts as a result of illegal collection or vandalism, Alcoa would educate project-related personnel as to the sensitive nature of the resources and implement a strict policy against illegal collection.

3.7.5 Residual Adverse Effects

Significant cultural resources would be protected by measures developed by Alcoa in coordination with the THC, USACE, and RRC. Insignificant sites within the mine area would be lost.

3.8 Air Quality

Air quality issues associated with the Three Oaks Mine include potential impacts of mine emissions, fugitive dust, and the handling of lignite and bottom ash. Air quality issues related to public health are discussed in Section 3.14.

3.8.1 Affected Environment

The study area and cumulative effects area for air quality both encompass parts of the five-county area comprising Bastrop, Lee, Milam, Travis, and Williamson Counties. Information on the climate, meteorology, air quality, air pollutant emissions, and local atmospheric dispersion characteristics of the area are presented below. The air quality study area is defined by the spatial extent of the Proposed Action and its direct impacts, as well as those areas where other reasonably foreseeable emission sources are likely to have additive impacts. Other reasonably foreseeable emission sources are those not already represented by the background concentrations and affected environment.

3.8.1.1 General Climatic Setting

The project area in central Texas experiences warm, humid summers and generally mild humid winters. Hot spells with maximum temperatures above 90°F for several consecutive days occur most summers, but heat waves with maximum temperatures of 95°F to 100°F or more for several days are infrequent. While mild conditions generally prevail in the winter, temperatures can drop to near 0°F; such cold spells are rarely lengthy. Spring and fall seasons feature moderate but changeable weather as part of the annual transition from summer to winter and back to summer.

Climate information for the Three Oaks Mine area is provided from a meteorology station at Austin, Texas. **Table 3.8-1** shows normal temperature means and extremes for each month and annually. During the hottest months of June, July, and August, the maximum temperature exceeds 90°F for more than 20 days each month. Temperature normals in the table are averages for the current standard 30-year climate reference period of 1961 to 1990, while the extremes are for the 59-year period of 1941 to 1999. The morning relative humidity often reaches over 80 percent, but during the warmest part of the afternoon the relative humidity typically falls to approximately 60 percent (**Table 3.8-2**).

Average precipitation in the project area exceeds 30 inches per year, with nearly all of the water falling as rain. The wettest month is generally May, receiving more than 4.7 inches, while the driest months are December, January, and March, each receiving approximately 1.8 inches of rainfall. Although vigorous winter storms occasionally produce snow in the area, on average, less than 1 inch of snow is received annually (**Table 3.8-3**).

3.8.1.2 Local Winds and Atmospheric Dispersion

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: wind speed and direction, mixing height, and stability. Monthly and annual prevailing wind direction, average speeds,

Table 3.8-1
Existing Climate - Temperatures in the Three Oaks Mine Area (°F)

Month	Extreme High	Extreme Low	Normal High	Normal Low	Normal Average	Average Number of Days Maximum Temperature is Greater than or Equal to 90°F
January	90	-2	58.9	38.6	48.8	0
February	99	7	63.4	42.1	52.8	0
March	98	18	71.9	51.1	61.5	1
April	98	35	79.4	59.8	69.6	2
May	102	43	84.7	66.5	75.6	7
June	108	53	91.1	71.5	81.3	21
July	109	64	95	73.9	84.5	28
August	106	61	95.5	73.9	84.8	28
September	104	41	90.5	69.8	80.2	17
October	98	30	82.1	60	71.1	4
November	91	20	71.8	49.9	60.9	0
December	90	4	62	41.2	51.6	0
Annual	**109**	**-2**	**78.9**	**58.2**	**68.6**	**107**

Table 3.8-2
Existing Climate – Relative Humidity in the Three Oaks Mine Area

Month	Relative Humidity (%)	
	Morning	Afternoon
January	78	62
February	79	61
March	79	58
April	82	59
May	88	63
June	89	59
July	87	54
August	86	53
September	85	58
October	83	58
November	82	61
December	79	62
Annual	**83**	**59**

Table 3.8-3
Existing Climate – Precipitation in the Three Oaks Mine Area

Month	Normal Precipitation (inches)	Days with Precipitation Greater than 0.01 inch	Average Snowfall (inches)
January	1.71	8	0.5
February	2.17	8	0.3
March	1.87	7	Trace
April	2.56	7	Trace
May	4.78	9	Trace
June	3.72	7	0
July	2.04	5	0
August	2.05	5	0
September	3.30	7	0
October	3.43	7	0
November	2.37	7	0.1
December	1.88	8	Trace
Annual	**31.88**	**84**	**0.9**

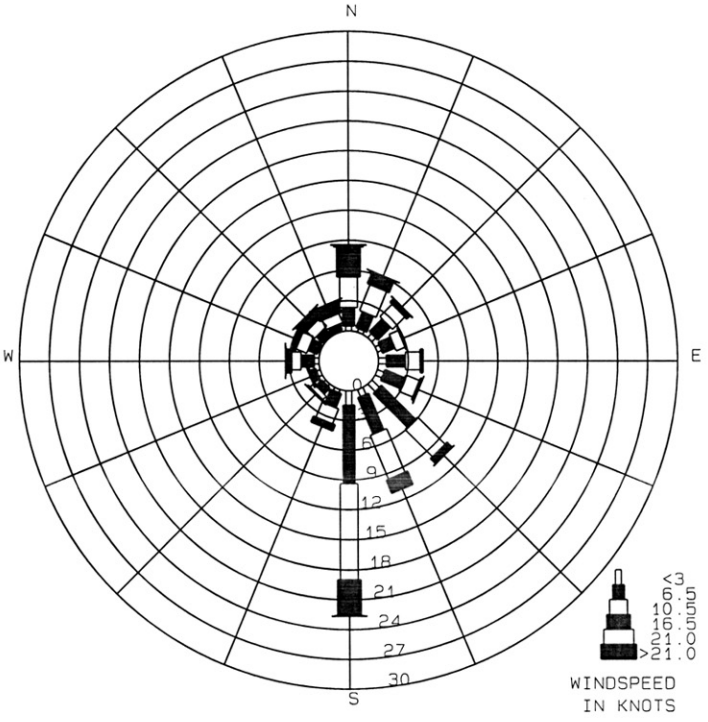
and peak gusts are displayed in **Table 3.8-4**. An annual wind rose for the Austin, Texas, Municipal Airport is presented in **Figure 3.8-1**. Mixing height is the thickness of the layer of air above ground level within which rising warm air from the surface mixes by convection and turbulence. Local atmospheric conditions such as wind, temperature and stability, terrain configuration, and source location determine the degree to which pollutants are diluted in this mixed layer. Mixing heights vary diurnally, with local weather systems, and with season. For the project area, mean morning and afternoon mixing heights for each season are shown in **Table 3.8-5**. The mean annual morning mixing height is estimated to be approximately 2,277 feet, and the mean annual afternoon mixing height is approximately 5,213 feet (Holzworth 1972).

Table 3.8-4
Existing Climate – Wind Conditions

Month	Prevailing Wind Direction	Average Wind Speed (miles per hour)	Peak Gust (miles per hour)
January	North	10	52
February	North	10	55
March	South	11	56
April	South	10	51
May	South-southeast	9	63
June	South	9	54
July	South	8	44
August	South	8	47
September	South	8	81
October	South	8	46
November	South	9	49
December	North	9	63
Annual	**South**	**9**	**81**

Austin Texas
WIND ROSE ANALYSIS (PERCENT)
1/ 1/92 through 12/31/92
10 METER DATA

WIND DIRECTION	WIND SPEED (KNOTS) <= 3.0	<= 6.5	<=10.5	<=16.5	<=21.0	>21.0	TOTAL	AVG SPEED
N	0.47	1.87	3.01	2.97	0.18	0.07	8.56	9.38
NNE	0.35	1.72	2.77	1.23	0.07	0.01	6.15	8.17
NE	0.55	1.81	1.73	0.48	0.07	0.00	4.63	6.83
ENE	0.43	1.37	0.97	0.11	0.01	0.00	2.89	6.15
E	0.76	1.94	1.47	0.33	0.00	0.00	4.50	6.15
ESE	0.69	2.14	1.48	0.25	0.02	0.00	4.59	6.07
SE	1.04	4.84	3.88	0.75	0.01	0.00	10.52	6.48
SSE	0.76	4.00	4.76	1.48	0.00	0.00	11.00	7.20
S	1.45	7.95	9.57	3.61	0.06	0.01	22.64	7.45
SSW	0.33	1.54	1.62	0.66	0.00	0.00	4.14	7.31
SW	0.27	0.87	0.46	0.17	0.02	0.00	1.79	6.22
WSW	0.36	0.60	0.22	0.02	0.00	0.00	1.21	4.97
W	0.44	1.35	0.91	0.60	0.03	0.03	3.38	7.28
WNW	0.20	1.00	1.15	0.38	0.08	0.05	2.86	7.92
NW	0.15	0.88	1.05	0.96	0.14	0.01	3.18	9.05
NNW	0.11	0.64	1.00	1.09	0.17	0.02	3.04	9.88
CALM	4.93						4.93	
TOTAL	13.31	34.49	36.03	15.10	0.87	0.20	100.00	



Austin Texas 1992 Wind Rose

Three Oaks Mine

Figure 3.8-1

1992 Annual Wind Rose
Austin, Texas

Source: USEPA Support Center for Regulatory Air Models (SCRAM).

Table 3.8-5
Existing Climate – Mixing Height Conditions in Three Oaks Mine Area

Period	Average Mixing Height (feet)				
	Winter	Spring	Summer	Fall	Annual
Morning	1,506	2,454	3,002	2,146	2,277
Afternoon	3,648	5,092	6,952	5,157	5,213

The combination of relatively high mean wind speeds and a deep mixed layer at the earth's surface indicates that pollutants emitted from sources near the ground would be dispersed throughout a greater volume, thereby reducing the potential for elevated concentrations to occur.

3.8.1.3 Air Quality

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource, because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Under the Federal Clean Air Act and Texas Clean Air Act, the USEPA and TNRCC establish acceptable air quality standards and upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations within the standards are generally not considered to be detrimental to public health and welfare.

The U.S. Congress has established the framework for air quality regulations through passage of the Clean Air Act of 1990 (CAA). The CAA requires the administrator of the USEPA to establish national ambient air quality standards for air contaminants for which emissions, in the judgment of the USEPA, cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. The presence of emissions in the ambient air results from numerous and diverse mobile and stationary sources. National primary ambient air quality standards define levels of air quality that the USEPA judges are necessary, with an adequate margin of safety, to protect public health. National secondary ambient air quality standards define levels of air quality that the USEPA judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Ambient Air Quality Standards (NAAQS)

The criteria for impacts to air quality are the lowest concentrations at which adverse human health or ecological effects from exposure to air pollution are known or suspected to occur. For criteria pollutants, these levels have been established through the state and national Ambient Air Quality Standards (AAQS). The AAQS are concentrations established by law to protect public health and welfare from the air pollutants. The main health-based standards are the federal PM_{10} standard and the fine dust particulate matter with an aerodynamic diameter of 10 microns or less in diameter ($PM_{2.5}$) standard. The USEPA has established primary and secondary standards for seven pollutants:

- Particulate matter with an aerodynamic diameter of 10 micrometers or less (PM_{10});
- Particulate matter with an aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$);
- Sulfur dioxide (SO_2);
- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Ozone (O_3); and
- Lead (Pb).

The relative level of pollutant concentrations in the study area can be determined by comparison with an appropriate national and/or state ambient air quality standard. Ambient air quality standards are presented in **Table 3.8-6**. These are the standards applicable to the region in central Texas that encompasses the permit area. An area is designated by the USEPA as "in attainment" for a pollutant if ambient concentrations of that pollutant are below the AAQS. An area is not in attainment if violations of AAQS for that pollutant occur. Areas where insufficient data are available to make an attainment status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes. For the purposes of statewide regulatory planning, the permit area has been designated as in attainment or unclassifiable for all criteria air pollutants.

Table 3.8-6
Existing Climate – Texas and National AAQS

Pollutant	Averaging Period	Ambient Air Quality Standards	
		Primary (µg/m^3)	Secondary (µg/m^3)
CO	8-hour	10,000[1]	-
	1-hour	40,000[1]	-
NO_2	Annual	100	100
	1-hour	-	-
SO_2	Annual	80	-
	24-hour	365[1]	-
	3-hour	-	1,300[1]
	1-hour	-	-
	30-minute	1,048[5]	
PM_{10}	Annual	50	50
	24-hour	150[3]	150[3]
	3-hour	200[5]	-
	30-minute	400[5]	-
$PM_{2.5}$	Annual	15	-
	24-hour	65	-
Pb	30 days average	-	-
	Quarter	1.5[2]	1.5[2]
O_3	1-hour	235	235
	8-hour	157[4]	157[4]

[1]Not to be exceeded more than once per year.
[2]Never to be exceeded.
[3]Attained when 99% of the daily concentrations, averaged over 3 years, are equal to or less than the standard.
[4]Attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard.
[5]Texas standard.

In addition to the AAQS, Texas imposes additional restrictions on SO_2 concentrations. "No person in the State of Texas may cause, suffer, allow, or permit emissions of SO_2 from a source or sources operated on a property of multiple sources operated on contiguous properties to exceed a net ground level concentration of 0.4 part per million by volume (ppmv) averaged over any 30-minute period" (TAC Title 30, Part 1, Chapter 112, Subchapter A, §112.3a).

Ambient monitoring for PM_{10} was conducted at four sites in the vicinity of the Sandow Mine for the period of 1990 to 1995. Monthly average, maximum 24-hour, and minimum 24-hour concentrations of PM_{10} are shown in **Table 3.8-7**. There were no exceedences of the AAQS for PM_{10} during this time.

Prevention of Significant Deterioration (PSD)

For areas that have attained the AAQS, the CAA provides for a new source review program to ensure that no significant deterioration of the existing air quality would result from the construction and operation of new emission sources or from the modification of existing emission sources. Pursuant to the CAA, the USEPA has promulgated Prevention of Significant Deterioration (PSD) regulations that provide for a pre-construction review by the state air quality agency of "major" emission sources of air pollutants that are regulated under the CAA. For 28 designated sources of air contaminants, a major stationary source is defined as a stationary source that has the potential to emit 100 or more tons per year of any of the pollutants regulated under the CAA, including any fugitive emissions (non-stationary source). Other stationary sources of pollutants are defined as major if the proposed emissions of any pollutant regulated by the CAA are 250 or more tons per year, excluding fugitive emissions. Lignite mining operations are not one of the 28 designated sources that are considered major at 100 tons per year; however, they potentially could be a major source if point sources emit more than 250 tons per year of a regulated pollutant. In the case of the proposed lignite mining operation, PM_{10} associated with fugitive dust emissions is the only pollutant regulated by the CAA that would be emitted in significant quantities. Therefore, since the lignite mining operation would not be one of the 28 major sources, and there are only non-stationary and minor stationary sources associated with the proposed operation, the PSD regulations do not apply to the proposed operation.

The existing power generating stations operated by Alcoa and TXU are not adjacent to the proposed lignite mine; therefore, they are separate sources for PSD purposes. The project area is designated as a Class II area under the PSD regulations. The Class II designation allows for moderate growth or some degradation of air quality within certain limits above baseline air quality. These limits include the AAQS discussed above and identified in **Table 3.8-6** as well as other incremental limits set by the USEPA and TNRCC that are not to be exceeded. Under the PSD provisions, Congress established a land classification scheme for those areas of the country with air quality better than the AAQS. Class I allows very little deterioration of air quality; Class II allows moderate deterioration, as discussed above; and Class III allows more deterioration. However, in all cases, the pollution concentrations shall not violate any of the AAQS or other federal or state limits. Congress designated certain existing areas as mandatory Class I, which precludes redesignation to a less restrictive class, in order to acknowledge the value of maintaining these areas in relatively pristine condition. These mandatory Class I areas include international parks, national wilderness areas, and national memorial parks in excess of 5,000 acres, and national parks in excess of 6,000 acres existing as of August 7, 1977. No PSD Class I areas are within Air Quality Control Region (AQCR) 15. The nearest

Table 3.8-7
Sandow Mine
Summary of PM_{10} Data From March 5, 1990, through December 28, 1994 (µg/m^3)

Date	Average (Month)				Minimum (24-hour)				Maximum (24-hour)			
	West-1	West-2	South	North	West-1	West-2	South	North	West-1	West-2	South	North
1990												
January	--	--	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--	--	--
March	15	15	13	14	12	11	10	12	17	17	16	16
April	17	16	16	18	12	12	11	17	23	23	23	19
May	22	22	19	19	6	6	12	5	32	32	28	37
June	21	20	18	22	15	14	15	17	31	30	25	29
July	37	36	38	35	24	24	18	18	64	62	60	58
August	39	39	31	34	25	24	22	26	50	51	37	42
September	19	16	14	17	7	7	9	12	34	22	20	22
October	21	21	20	19	12	12	10	12	35	35	32	30
November	14	15	15	15	10	10	10	3	25	25	25	28
December	12	12	15	12	7	8	8	6	20	20	29	23
1991												
January	18	15	15	13	17	6	12	4	20	19	19	18
February	13	13	13	11	11	11	9	7	16	16	17	15
March	24	24	19	18	12	13	13	7	33	34	25	26
April	21	21	17	16	18	18	9	9	23	24	24	22
May	18	20	21	21	13	12	16	13	22	26	26	26
June	26	24	26	23	14	14	15	11	52	51	52	53
July	21	22	21	21	12	13	12	11	29	29	35	39
August	25	22	24	21	12	11	11	10	39	34	37	32
September	18	16	17	13	9	9	9	12	30	26	30	14
October	24	22	17	19	12	12	8	9	37	35	25	27
November	18	14	14	13	7	6	10	6	26	22	20	20
December	17	16	13	9	8	7	6	5	37	34	29	14
1992												
January	13	14	11	15	6	8	4	2	24	24	23	25
February	13	12	12	11	7	7	7	7	15	15	24	13
March	13	11	12	14	10	6	9	11	16	16	15	20
April	14	13	11	15	10	9	9	10	16	16	13	19
May	20	19	19	16	9	8	12	9	33	31	29	22
June	14	14	13	13	11	11	12	13	16	17	13	13

Table 3.8-7 (Continued)

Date	Average (Month)				Minimum (24-hour)				Maximum (24-hour)			
	West-1	West-2	South	North	West-1	West-2	South	North	West-1	West-2	South	North
July	42	41	37	41	13	13	13	26	64	63	62	63
August	20	20	23	19	11	11	12	12	43	43	38	36
September	19	19	16	19	13	13	9	13	22	23	22	24
October	24	23	24	22	15	14	14	15	38	38	37	27
November	10	10	10	9	4	5	8	5	21	21	12	14
December	16	16	14	15	10	11	11	12	21	21	17	19
1993												
January	13	13	14	16	6	9	10	10	19	17	20	23
February	16	16	17	21	8	8	11	19	23	21	20	22
March	12	12	12	12	4	4	8	4	21	21	17	18
April	18	18	17	20	14	14	12	15	26	25	23	29
May	13	15	14	14	13	8	12	5	13	21	16	27
June	25	24	25	24	15	13	15	11	48	48	48	49
July	35	34	40	34	15	15	21	15	55	52	56	52
August	31	30	32	29	18	20	18	19	48	47	48	45
September	19	18	17	15	9	9	11	8	28	28	29	26
October	12	12	15	11	5	5	11	6	16	15	19	15
November	9	10	13	10	5	5	8	7	18	19	20	17
December	15	15	17	17	4	4	4	9	27	27	26	27
1994												
January	16	15	18	17	7	7	6	12	26	27	29	25
February	16	16	16	18	11	10	10	14	19	20	19	19
March	15	15	15	16	12	12	11	11	23	24	23	26
April	15	16	15	15	11	13	11	9	19	20	22	20
May	19	21	17	19	9	10	7	9	30	34	24	27
June	19	21	18	22	10	10	12	11	30	33	30	36
July	28	29	27	28	16	18	16	19	37	41	35	37
August	22	22	21	24	9	9	8	11	36	37	40	45
September	15	15	16	15	10	10	8	9	22	21	24	21
October	14	13	15	14	5	5	4	4	23	21	25	19
November	16	17	14	14	10	11	8	8	30	29	22	24
December	12	12	16	11	9	9	12	9	15	15	21	13

Class I area to the proposed project site is Caney Creek National Wilderness Area in Arkansas, more than 300 miles to the northeast.

New Source Performance Standards (NSPS)

The CAA requires the USEPA to publish a list of categories of stationary sources that, in its judgment, cause or contribute significantly to air pollution that may reasonably be anticipated to endanger public health or welfare. The USEPA is then required to establish standards of performance for new sources (NSPS) within each category that reflect the degree of emission limitation and the percentage reduction achievable through application of the best technological system of continuous emission reduction. The USEPA must determine whether the emission reduction technology has been adequately demonstrated, taking into consideration the costs of achieving the emission reductions, any air quality health and environmental impact, and energy requirements. Thus far, the USEPA has promulgated performance standards for over 60 sources of air pollutants; however, there are no NSPS for mining operations.

National Emission Standards for Hazardous Air Pollutants (NESHAPs)

Prior to the 1990 Clean Air Act Amendments (CAAA), the CAA required the USEPA to publish a list of hazardous air pollutants (HAPs), which are defined as those pollutants for which no ambient air quality standard is applicable and which in the judgment of the USEPA cause or contribute to air pollution that may reasonably be anticipated to result in an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness. The USEPA was then required to establish standards for those HAPs that, in its judgment, provide an ample margin of safety to protect the public health. The initial national emission standards for HAPs (NESHAPs) were promulgated under 40 CFR 61 for specific types of processes and operations. However, none of the promulgated NESHAPs are applicable to lignite mining operations.

As part of the 1990 CAAA, the list of HAPs was increased to 189 contaminants, and a list of additional emission source categories, for which new emission standards were to be written, was promulgated by the USEPA. The new standards are being proposed and promulgated by the USEPA under 40 CFR 63 and are know as Maximum Achievable Control Technology (MACT) standards. However, none of the MACT standards proposed or promulgated to-date apply to lignite mining operations.

State Implementation Plan (SIP) for Particulate Matter

The CAA requires each state to submit a plan that provides for implementation, maintenance, and enforcement of the primary and secondary standards in each air quality control region within the state. Development of the state implementation plan (SIP) consists of a lengthy rulemaking process, including public notice, in which the state adopts regulations intended to meet minimally acceptable federal criteria in the manner most consistent with the state's air quality goals. Once a SIP is approved by the USEPA, the primary authority for enforcement of the SIP is delegated to the state. If a state fails to submit an adequate SIP, the CAA requires the USEPA to prepare and promulgate an implementation plan setting forth any necessary regulations.

The PM_{10} SIP for Texas consists of the State regulation contained in TNRCC Regulation I, Control of Air Pollution From Visible Emissions and Particulate Matter, 30 TAC Chapter 111. The primary Regulation I rule that would apply to the proposed Three Oaks Mine is Rule 111.155, which establishes net ground-level concentration limits for particulate matter of 200 $\mu g/m^3$ averaged over any 3 consecutive hours and 400 $\mu g/m^3$ averaged over any 1-hour period. This rule applies to concentrations of TSP and not just to PM_{10}.

TNRCC Chapter 118, Control of Air Pollution Episodes

TNRCC Regulation 118 provides for control of air pollution episodes. It defines a Level 1 air pollution episode for particulate matter (PM_{10}) as 24-hour average concentrations equal to or greater than 420 $\mu g/m^3$. A Level 2 air pollution episode for particulate matter (PM_{10}) is defined as a 24-hour average concentration equal to or greater than 500 $\mu g/m^3$. A Level 1 air pollution episode exists if the following criteria are met: 1) the concentration of any of the air contaminants is equal to or greater than the levels specified for Level 1 and 2) in the case of all air contaminants except ozone, meteorological conditions conducive to high levels of air contamination are predicted to continue for at least 12 hours. (For ozone, the criteria includes meteorological conditions that would be conducive to the likely recurrence of high ozone levels within the next 24 hours). A Level 2 air pollution episode exists if the commission determines that emergency reductions of emissions must be initiated to prevent ambient concentrations specified for Level 2. The requirements of Regulation 118 do not apply to episodes caused by naturally occurring dust storms.

3.8.2 Environmental Consequences

3.8.2.1 Proposed Action

There are no Class I areas within 100 kilometers (approximately 60 miles) of the proposed Three Oaks Mine. Therefore, there would be no air quality impacts on Class I areas due to the operation of the mine.

Construction, Operation, and Reclamation Impacts

Construction and mining activities at the proposed Three Oaks Mine would be sources of TSP, PM_{10}, and $PM_{2.5}$. Fuel-burning mobile (on road and off road) sources would emit low levels of gaseous pollutants (e.g., SO_2, NO_x, CO, and volatile organic compounds [VOCs]). Storage tanks for fuels, oil, and chemicals are potential sources of VOCs. Reclamation activities associated with the Three Oaks Mine also would result in an increase in fugitive and gaseous emissions in the local area during reclamation. However, construction, mining, and reclamation activities at the Three Oaks Mine generally would be a replacement of diminishing similar sources at the Sandow Mine.

Construction would result in temporary air quality impacts due to increases in local fugitive dust levels. Dust generated from these open sources is termed “fugitive” because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would include land clearing, earth moving, scraping, hauling, and materials storage and handling; truck loading operations; and wind erosion from stockpiles.

During construction, operation, and reclamation, vehicle exhaust emissions would be generated; however, such emissions would be small compared to potential fugitive emissions from earth moving, hauling, and other construction activities. Particulate concentrations due to construction, operation, and reclamation activities would vary, and impacts would depend on the activity location and the daily wind and weather. Watering of road surfaces and stockpiles, posting and enforcing of speed limits, placing gravel on coal haul roads, or other measures would be taken to limit fugitive dust emissions. While measures such as watering would reduce the emissions from such activities, some level of fugitive dust emissions would be unavoidable due to the nature of the work. Although some air quality impacts inevitably would occur during construction and reclamation, they would be transitory and limited in duration relative to the mine operations phase, and they would end at the completion of that particular phase of the work. Once reclamation is completed, emissions from that source would cease, and nearby pollutant concentrations would return to background levels.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of the project. The primary pollutant would be fugitive dust (TSP and PM_{10}) generated by the draglines, loaders, haul trucks, crushers, screens, conveyors, stockpiles, and other processes. All criteria pollutant emission rates from individual sources (not fugitive sources) would be less than 250 tons per year; therefore, the Three Oaks Mine would not be a "major stationary source" as defined by the USEPA (see PSD under Section 3.8.1.3). **Table 3.8-8** lists the estimated operating parameters for the mine. These operating parameters have been used to estimate emissions from the mine during the operational phase.

Table 3.8-8
Estimated Operating Parameters for the Three Oaks Mine

Operation	Amount (average)	Units
Coal production	6,200,000	tons/year
Mine operations	365 7	days/year days/week
Truck loading - Lignite at pit - Topsoil at pit	 6,200,000 1,672,507	 tons/year cubic yards/year
Truck dumping - Topsoil at storage area	 1,672,507	 cubic yards/year
Dragline material handling - Overburden	 140,891,595	 cubic yards/year
Haul trucks - Topsoil hauling - Lignite hauling	 26,414 51,667	 vehicle miles traveled/year vehicle miles traveled/year
Road repair	5,000	hours
Disturbed areas (wind erosion) - Lignite pit - Overburden storage - Topsoil storage	 259 300 50	 acres acres acres
Conveyors - Feeder breaker - Radial stacker - Conveyor drops - Aux reclaim hopper - Vibratory feeders	 6,200,000 6,200,000 6,200,000 6,200,000 6,200,000	 tons/year tons/year tons/year tons/year tons/year
Water truck	5,000	hours

Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface, because each time a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material. On a storage pile, this would occur whenever aggregate material is either added to or removed from the surface. A disturbance of an exposed area also may result from the turning of surface material to a depth exceeding the size of the largest pieces of material present. The emission factor for wind-generated particulate emissions from mixtures of erodible and non-erodible surface material subject to disturbance may be expressed in units of tons per acre per year or other appropriate units.

Dust emissions may be generated by wind erosion of open storage piles and exposed areas within an industrial facility. These sources typically are characterized by non-homogeneous surfaces impregnated with non-erodible elements (particles larger than approximately 1 centimeter in diameter). Field testing of coal piles and other exposed materials using a portable wind tunnel has shown that: 1) threshold wind speeds exceed 5 meters per second (11 miles per hour [mph]) at 15 centimeters above the surface or 10 meters per second (22 mph) at 7 meters above the surface, and 2) particulate emission rates tend to decrease rapidly (half-life of a few minutes) during an erosion event (USEPA 1995). In other words, these aggregate material surfaces are characterized by finite availability of erodible material (mass/area) referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential.

Table 3.8-9 lists estimated particulate and gaseous emissions from each potential source at the mine, with implementation of the proposed control system that would be used to reduce emissions.

Table 3.8-9
Annual Emissions Estimate for Three Oaks Mine

Source	PM_{10}	NO_x	VOC	CO	SO_2
Emission Rates (tons/year)					
Haul truck roads (gravel)	139.5	--	--	--	--
Water truck roads (gravel)	12.8	--	--	--	--
Draglines	114.6	--	--	--	--
In-mine coal loading	0.4	--	--	--	--
Leveling overburden	2.3	--	--	--	--
Grading haul roads, overburden	0.5	--	--	--	--
Coal transport handling	15.0	--	--	--	--
Diesel engines[1]	53.8	657.3	60.2	274.2	55.6
Gasoline engines[1]	0.4	6.0	8.1	247.1	0.3
Total	**339.3**	**663.3**	**68.3**	**521.3**	**55.9**

[1]Calculated based on total fuel usage at Sandow Mine for mobile sources.

Source: Alcoa 2002.

Information about the existing Sandow Mine, located directly northeast of the permit area, provides the most reliable basis for estimating the air quality impacts of the proposed Three Oaks Mine. Three Oaks would produce approximately the same amount of lignite per year (average of 7.0 million tons) as Sandow. Mining

methods also would be similar to Sandow: 1) overburden would be excavated by electric draglines, 2) lignite would be moved by backhoes and front-end loaders into haul trucks, 3) lignite would be delivered to stockpile areas or crushers, and 4) lignite would be transported to the power units via covered conveyor (as at Sandow) or via haul trucks on paved or watered gravel roads. Measured particulate concentrations (**Tables 3.8-10** and **3.8-11**) at the existing Sandow Mine are well below the AAQS, indicating that there are no significant impacts due to particulate emissions from the existing mine or from other sources in the local region. As indicated above, maximum 24-hour and annual PM_{10} values at Sandow Mine monitoring sites have been well below air quality standards.

Table 3.8-10
PM_{10} Ambient Monitoring Data for the Sandow Mine
($\mu g/m^3$)

Year	Site Location			
	West-1	West-2	South	North
Annual (Standard = 50.0)				
1990	21.0	20.6	19.6	20.1
1991	20.2	18.9	17.8	16.7
1992	17.9	17.9	17.8	16.8
1993	18.8	18.1	19.5	18.7
1994	17.3	17.9	17.4	17.8
High 24-Hour (Standard = 150.0)				
1990	64.4	61.6	59.9	58.4
1991	52.0	51.0	52.0	53.0
1992	64.0	63.0	62.0	63.0
1993	55.0	52.0	56.0	52.0
1994	37.0	41.0	40.0	45.0

Note: Based on most recent information. Monitoring was discontinued as results did not indicate exceedences, and mining operations were moving farther away from the monitors.

Source: Alcoa 2002b.

Due to the low emission levels of gaseous pollutants (i.e., NO_x, CO, SO_2, and VOCs) the impacts from these pollutants would not exceed state or federal AAQS. The proposed Three Oaks Mine is anticipated to comply with all existing air quality standards in Texas, including those for TSP and PM_{10}.

Emissions and Correction Parameters

If typical values for threshold wind speed at 15 centimeters are corrected to typical wind sensor height (7 to 10 meters), the resulting values exceed the upper extremes of hourly mean wind speeds observed in most areas of the country. In other words, mean atmospheric wind speeds are not sufficient to sustain wind erosion from flat surfaces of the type tested. However, wind gusts may quickly deplete a substantial portion of the erosion potential. As erosion potential has been found to increase rapidly with increasing wind speed, estimated emissions should be related to the gusts of highest magnitude.

The air quality impact of a fugitive dust source depends on the quantity and drift potential of the dust particles released into the atmosphere. The larger dust particles settle out near the source, while fine

Table 3.8-11
Summary of 1997 Particulate Data Sandow Mine

Date	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	Ratio $PM_{2.5}/PM_{10}$
5/22/97	23.0	24.5	0.937
5/28/97	10.8	18.6	0.580
6/3/97	24.9	33.2	0.750
6/9/97	8.7	15.0	0.582
6/15/97	16.0	24.4	0.656
6/21/97	13.9	26.5	0.524
6/27/97	16.8	29.1	0.577
7/3/97	29.8	62.0	0.480
7/9/97	13.9	32.1	0.433
7/15/97	26.8	38.7	0.693
7/21/97	19.2	22.3	0.862
7/27/97	11.2	19.0	0.589
8/2/97	37.2	39.6	0.939
8/8/97	18.5	22.1	0.835
8/14/97	11.2	19.7	0.569
820/97	9.5	18.4	0.516
8/26/97	28.8	33.4	0.864
Sample number	17	17	17
Mean (17 samples)	18.8	28.2	0.670
Standard deviation	8.3	11.4	0.164
Minimum (24-hour)	8.7	15.0	0.433
Maximum (24-hour)	37.2	62.0	0.939
National Ambient Air Quality Standards			
24-hour	65	150	0.433
Annual	15	50	0.300

Note: Based on 1997 study conducted to assess possible impacts of proposed rate change at that time. Routine $PM_{2.5}$ monitoring is not required; hence, more recent data are not available.

Source: Alcoa 2002b.

particles are dispersed over much greater distances. Theoretical drift distances, as a function of particulate diameter and mean wind speed, have been computed for fugitive dust emissions. For a typical wind speed of 10 mph, particles larger than 100 micrometers (µm) are likely to settle out within 20 to 30 feet from the source. (For comparison, a human hair has a thickness of about 100 µm.) Particles of 30 to 100 µm, depending on the extent of atmospheric turbulence, are likely to settle within a few hundred feet. Dust particles smaller than 30 µm are generally recognized as emissions that may remain suspended indefinitely. The fraction of fugitive emissions in the various size categories is derived from the major emission source categories for a typical mining operation and is summarized in **Table 3.8-12** (USEPA 1995).

Ambient Air Quality Impacts

The estimated PM_{10} ambient air impacts from the proposed Three Oaks Mine were calculated using USEPA and state agency approved air dispersion computer models. The emissions from 52 separate sources were

Table 3.8-12
Estimated Particle Size Distribution
Typical Western Surface Coal Mine

Source	Particle Diameter (µm)					
Process	<2.5	2.5 - 5.0	5.1 - 10.0	10.1 - 15.0	15.1 - 30.0	>30.0
Material handling	0.13	0.10	0.13	0.12	0.25	0.27
Unpaved roads	0.10	0.10	0.16	0.14	0.30	0.20
Composite	0.11	0.10	0.14	0.13	0.28	0.24

Source: USEPA 1995.

modeled. The emissions from the dragline and in-mine emissions (coal loading and mine roads) were modeled as pit sources. The remaining sources, including dirt haul roads, grading, leveling, overburden removal, etc., were modeled as area sources. For the model, Alcoa initially assumed that the first box cut would result in a 30-foot-high berm along the northwest property line. Hourly meteorological data from Austin for 1 year were used to predict PM_{10} concentrations.

The results of the modeling are shown in **Table 3.8-13** assuming a 30-foot berm and dirt roads. The predicted concentrations of PM_{10} from the Three Oaks Mine would be below the state and federal AAQS for PM_{10}. These data are consistent with the ambient air monitoring data from the Sandow Mine and from other western U.S. coal mines. The highest annual PM_{10} concentration impact predicted was 30.8 µg/m^3 and occurred along the northwest property boundary during the first year of mine operation. The highest 24-hour concentration impact was 64.6 µg/m^3 and also occurred at the northwest property boundary during the first year. These impact concentrations include background PM_{10} concentrations of 15 µg/m^3. Direct impacts plus the background concentrations do not cause an exceedence of the AAQS.

Table 3.8-13
PM_{10} Ambient Air Modeled Impacts
Dirt Roads and 30-foot Berm
(µg/m^3)

Period	Three Oaks Mine	Background	Total Mine And Background	AAQS
Annual	15.8	15.0	30.8	50.0
24-Hour	49.6	15.0	64.6	150.0

The offsite PM_{10} concentrations northwest of the mine would decrease as mining progresses. Mining activities would move farther away from the northwest property boundary after year 1. Mining activities are not expected to get as close to the southeast property boundary as the mine would be to the northwest property boundary in year 1.

Highest incremental annual PM_{10} concentrations (15.8 µg/m^3) would occur near the northwest boundary of the mine and fall off rapidly to the north-northwest. Within 7 kilometers (4 miles) of the mine, the incremental annual PM_{10} concentration would be below 1.0 µg/m^3. The incremental annual concentrations to the south of the mine would be less than 1.0 µg/m^3. Highest incremental 24-hour concentrations (49.6 µg/m^3) also

occur to the northwest of the mine, along the property boundary. The 24-hour concentrations to the south of the mine are much lower and are not expected to be above 20.0 µg/m^3 for background and incremental impacts.

For comparison, Alcoa has evaluated the environmental effect of placing gravel on the dirt haul roads. The gravel would reduce the silt content of the road surface and would reduce the resulting particulate emissions. Separate air dispersion model runs were made for gravel roads and 15-foot berms (full and partial) and gravel roads with no berm. The results of these model runs are shown in **Table 3.8-14**.

Table 3.8-14
PM_{10} Ambient Air Modeled Impacts
Gravel Roads and 15-foot Berm
(µg/m^3)

Scenario	Period	Three Oaks Mine	Background	Total Mine and Background	AAQS
Gravel, 15-foot berm	Annual	20.8	15.0	35.8	50.0
	24-hour	59.8	15.0	74.8	150.0
Gravel, 15-foot berm western boundary only	Annual	28.7	15.0	43.7	50.0
	24-hour	72.6	15.0	87.6	150.0
Gravel, No berm	Annual	37.1	15.0	52.1	50.0
	24-hour	106.0	15.0	121.0	150.0

The scenarios with gravel roads and 15-foot berms, even if the berms only are located along the western edge of the mine haul road, would result in maximum 24-hour and annual impacts that would be in compliance with AAQS. However, dispersion modeling analysis of the option with gravel roads and no berms shows that this scenario has predicted incremental impacts at 37.1 µg/m^3. Adding a background level of 15 µg/m^3 to the incremental impact yields a total impact of 52.1 µg/m^3. These modeled impacts indicate a potential exceedance of the annual AAQS (50 µg/m^3). As a result, mitigation measures may be appropriate to reduce the impacts below the AAQS at the mine permit boundary. Mitigation may include mine boundary changes, haul road location changes, and/or strategically placed berms (see mitigation measure AQ-1 in Section 3.8.4, Monitoring and Mitigation Measures).

Selenium Emissions and Air Impact

During the EIS scoping process, concerns were raised about the presence of elevated levels of selenium in the overburden and the potential impact of selenium on the environment. There are no ambient air quality standards for selenium. An analysis of 676 core samples showed that a few seams of soils contained naturally occurring elevated selenium concentrations. The highest concentration of selenium found in a core sample at the Three Oaks Mine site was 30.2 ppm.

Using this worst-case selenium concentration and the predicted PM_{10} ambient concentrations at the property boundary, a worst-case annual exposure of 0.0007 µg/m^3 is predicted. The highest 24-hour concentration of selenium would be 0.0022 µg/m^3. The time-weighted average (TWA) concentration of selenium recommended by the American Conference of Governmental Industrial Hygienists is 200 µg/m^3,

based upon an 8-hour per day, 40-hour per week exposure(Alcoa 2002b; American Conference of Governmental Industrial Hygienists 2001). The maximum 24-hour concentration is nearly 100,000 times less than the 8-hour standard. In accordance with TNRCC guidelines, the highest 24-hour average concentrations can be converted to other averaging periods using the following scaling factors:

1-hour to 3-hour	0.9
1-hour to 8-hour	0.7
1-hour to 24-hour	0.4
1-hour to annual	0.08

Applying these scaling factors to the 24-hour selenium concentration of 0.0022 $\mu g/m^3$ would result in a predicted 8-hour maximum value of 0.0039 $\mu g/m^3$.

In the absence of ambient air quality standards for a particular substance, industrial standards such as the TWA Threshold Limit Value (TLV) often are scaled by a factor of 50 or 100 to provide a large margin of safety for public exposure to potentially hazardous substances. Adjusting the selenium TLV of 200 $\mu g/m^3$ by a factor of 100, the acceptable 8-hour public exposure limit would be 2 $\mu g/m^3$. This public exposure limit is nearly 500 times higher than the predicted maximum concentrations that would be produced by the mine at locations accessible to the public, indicating low human health risk due to selenium in fugitive dust at the proposed mine.

3.8.2.2 No Action Alternative

Under the No Action Alternative, air quality emissions would be limited to existing sources of fugitive dust in the area, such as paved and unpaved roads. Air emissions associated with the proposed Three Oaks Mine would not occur. Air emissions from Alcoa's aluminum smelter would be eliminated due to lack of fuel from the mine or other viable fuel source alternatives.

3.8.3 Cumulative Impacts

Cumulative impacts to air quality would include impacts from the proposed Three Oaks Mine emission sources, such as gaseous pollutants and fugitive dust; impacts from nearby existing and proposed industrial or mining operations; and impacts from background emission sources (e.g., natural background from windblown dust and public traffic on paved and unpaved roads in the region).

Existing air emissions sources in the Bastrop, Lee, Milam, Travis, and Williamson Counties are shown in **Table 3.8-15**. The most recent emission inventory data available were for 1999.

Emissions from the five-county area of all criteria pollutants except NO_X and SO_2 are predominately from mobile, non-road mobile, and area sources. Mobile sources are defined as any kind of vehicle or equipment with a gasoline or diesel engine, such as cars, trucks, and motorcycles. Non-road mobile sources include airplanes, boats, and farm equipment. Area sources include point source emissions that are too small to track individually, such as home or small office buildings or a diffuse stationary source, such as agricultural tilling or agricultural burning. Ammonia (NH_3) is not a criteria pollutant. It is included here due to its

Table 3.8-15
1999 Emission Inventory
Bastrop, Lee, Milam, Travis, and Williamson Counties
(tons per year)

County	PM_{10}	$PM_{2.5}$	NO_X	SO_2	VOC	CO	NH_3
Mobile, Non-road Mobile and Area Sources							
Bastrop	13,792	2,600	2,412	166	2,306	12,514	2,647
Lee	5,926	1,098	1,048	75	1,322	4,980	2,820
Milam	8,944	1,610	1,739	148	2,068	6,725	3,256
Travis	55,800	12,301	35,934	3,389	41,630	222,650	1,974
Williamson	28,003	5,554	10,241	992	9,212	52,975	2,952
Total	**112,465**	**23,163**	**51,374**	**4,770**	**56,538**	**299,841**	**13,649**
Point Sources							
Bastrop	4	4	2,342	6	93	536	35
Lee	0	0	767	0	195	624	0
Milam	2,389	1,495	25,157	80,100	1,550	21,246	4
Travis	224	149	3,169	208	412	1,439	48
Williamson	0	0	0	0	0	0	0
Total	**2,617**	**1,648**	**31,435**	**80,314**	**2,250**	**23,845**	**87**
Total Emissions							
Bastrop	13,796	2,604	4,754	172	2,399	13,050	2,682
Lee	5,926	1,098	1,815	75	1,517	5,604	2,820
Milam	11,333	3,104	26,896	80,248	3,619	27,970	3,260
Travis	56,025	12,450	39,100	3,597	42,042	224,089	2,022
Williamson	28,003	5,554	10,241	992	9,212	52,975	2,952
Total	**115,083**	**24,810**	**82,809**	**85,084**	**58,789**	**323,688**	**13,736**

Source: USEPA 1999.

importance in regional haze. The total PM_{10} emissions in these five counties amount to over 115,000 tons per year.

A breakdown of PM_{10} emissions by various sources is provided as **Table 3.8-16**. The two largest sources of PM_{10} emissions are fugitive dust and agriculture. These two sources account for over 93 percent of all PM emissions.

Cumulative impacts from existing operations are reflected in the existing measured particulate levels near the Sandow Mine (see **Tables 3.8-10** and **3.8-11**). Fugitive dust impacts from the existing Sandow Mine operations would diminish as the operations there are phased out.

As previously described, fugitive dust impacts from mining operations tend to be localized in the vicinity of the source. The spatial extent of impacts is therefore limited. For the Three Oaks Mine, the maximum spatial extent of annual PM_{10} impacts greater than 1 $\mu g/m^3$ and 24-hour impacts greater than 5 $\mu g/m^3$ is estimated to be less than 7 kilometers from the mine boundary. Highest annual and 24-hour concentrations would occur near the northwestern boundary of the facility. Annual and 24-hour incremental concentrations to the south of the mine are less than 1 $\mu g/m^3$ and 5 $\mu g/m^3$, respectively. Other nearby industrial operations would

Table 3.8-16
PM_{10} Emission Sources
(tons per year)

Emission Source	Bastrop	Lee	Milam	Williamson	Total
Fuel combination electric utility-coal	--	--	1,415.0	--	1,415.0
Fuel combination electric utility-oil	--	--	--	--	--
Fuel combination electric utility-gas	4.0	--	--	--	4.0
Fuel combination industrial-oil	1.0	--	0.4	2.0	3.4
Fuel combination industrial-gas	1.0	--	7.0	0.0	8.0
Fuel combination other-commercial/institutional oil	0.1	0.0	0.0	0.2	0.3
Fuel combination other-commercial/institutional gas	0.5	0.2	0.3	2.0	2.9
Fuel combination other-residential wood	75.0	24.0	40.0	57.0	196.0
Fuel combination other-residential other	1.0	0.4	1.0	2.0	4.4
Metals processing-non-ferrous metals processing	--	--	964.0	--	964.0
Metals processing-ferrous metals processing	--	--	4.0	--	4.0
Metals processing-metals processing	--	--	0.5	--	0.5
Other industrial processes-agriculture, food, and kindred products	--	--	6.0	25.0	31.0
Other industrial processes-miscellaneous industrial processes	--	--	24.0	--	24.0
Storage and transport-bulk materials storage	--	--	0.3	--	0.3
Waste disposal and recycling-incineration	3.0	1.0	4.0	7.0	15.0
Waste disposal and recycling-open burning	144.0	36.0	45.0	281.0	506.0
Highway vehicles-light-duty gas vehicles and motorcycles	9.0	3.0	6.0	41.0	59.0
Highway vehicles-light-duty gas trucks	5.0	2.0	4.0	23.0	34.0
Highway vehicles-heavy-duty gas vehicles	2.0	1.0	1.0	7.0	11.0
Highway vehicles-diesels	54.0	20.0	32.0	159.0	265.0
Off-highway-non-road gasoline	3.0	1.0	2.0	23.0	29.0
Off-highway-non-road diesel	21.0	16.0	30.0	281.0	348.0
Off-highway-aircraft	0.1	0.0	0.0	0.2	0.3
Off-highway-railroads	7.0	3.0	5.0	21.0	36.0
Off-highway-other	0.1	0.1	0.2	1.0	1.3
Miscellaneous-agriculture and forestry	1,044.0	1,109.0	2,390.0	3,800.0	8,343.0
Miscellaneous-other combustion	268.0	123.0	10.0	0.1	401.1
Miscellaneous-fugitive dust	12,153.0	4,586.0	6,341.0	23,271.0	46,351.0
Total	**13,795.6**	**5,925.7**	**11,332.7**	**28,003.5**	**59,057.6**

Source: Alcoa 2002b.

have limited overlap with impacts from the Three Oaks Mine. Since the Three Oaks Mine site would be the largest particulate emission source in the immediate vicinity, its impacts would dominate any cumulative impacts to air quality. When impacts from other sources in the area are added to the new air emissions at the Three Oaks Mine, the resultant cumulative concentrations of PM_{10} are expected to be less than the existing concentrations at Sandow, which are well below state and federal AAQS.

The proposed mining operation would not be a significant source of gaseous pollutants. However, the four existing lignite-fired power generating units at the Rockdale operations in Milam County are each major stationary sources. The four existing power generating stations are described in Section 1.1.2.2. The largest of the four power generating units at Rockdale is a utility boiler unit owned and operated by TXU. This unit, referred to as TXU Unit 4, was constructed in the early 1980s to meet the federal NSPS at the time. The

three other electrical generating units at Alcoa's Rockdale operations are owned and operated by Alcoa. These units (1, 2, and 3) are older units (built in the 1950s) that are less efficient at removing pollutants than Unit 4. Alcoa is currently upgrading the units, as described below. Alcoa's existing Rockdale operations near the existing Sandow Mine currently have an ongoing program for monitoring SO_2 concentrations at the existing facilities. Monitoring is expected to continue for ambient concentrations of SO_2 as well as meteorology (TNRCC 1995).

To reduce particulate emissions from Units 1, 2, and 3, Alcoa has installed electrostatic precipitators on each of the units. To reduce NO_x, an ozone precursor, Alcoa has applied for air permits under a TNRCC Agreed Order to install NO_x reduction equipment to reduce NO_x emissions from each of the units by 50 percent by the end of 2002. One unit was completed in the summer of 2000, and the other two units are scheduled to receive the equipment in 2002.

To reduce acid gases, including SO_2, from the three units, Alcoa may need to install additional pollution control equipment to meet possible new federal MACT standards for industrial boilers. Alcoa's VERP application includes SO_2 reductions. The decision to upgrade the boilers or shut them down would be made by Alcoa by the year 2005 (Hodges 2001).

The combustion of fuel in vehicles and heavy equipment generates emissions of NO_x, CO, SO_2, and VOCs. Emissions for the Three Oaks Mine are shown in **Table 3.8-9**. However, due to the rural nature of the region around the permit area and the low density of combustion sources (e.g., vehicles and other fuel-fired equipment), levels of gaseous air contaminants associated with the Three Oaks Mine are anticipated to remain well below levels determined to be detrimental to public health. The Three Oaks Mine would have minor incremental impact since the mine sources are located several miles away from the power plants and smelter operations which are the dominant sources in the region (see **Table 3.8-15**).

3.8.4 Monitoring and Mitigation Measures

Alcoa proposes measures to reduce dust emissions on haul roads, mining and crushing equipment, and the conveyor. The USACE is considering the following additional mitigation for air quality.

AQ-1: Haul Road Construction. To reduce the offsite impact of particulate emissions from the haul road near the northwest boundary of the permit area, Alcoa may construct protective berms in select locations and gravel the haul road. Alternately, Alcoa may move the haul road farther east away from the proposed mine boundary or move the permit boundary farther west away from the road. This mitigation is based on the results of Alcoa's air dispersion modeling.

3.8.5 Residual Adverse Effects

Some air quality impacts are unavoidable due to the nature of the proposed mine operations. The primary air quality effects would be increases in TSP and PM_{10} concentrations in the immediate vicinity of the mine. Adverse effects would be limited spatially to distances up to approximately 7 kilometers (4 miles) from the active mine disturbance. By supplementing natural rainfall with watering roads and stockpiles and other

forms of dust control, the impacts would be well below state and federal AAQS and thus would not adversely affect human health or welfare.

There would be no residual adverse impacts to air quality from the proposed mine following mine closure and final reclamation. Reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels would return to levels typical for the region. Once the disturbance ceases and wind erodible surfaces are reclaimed, air resources would return to the pre-mining condition.

3.9 Land Use and Recreation

Issues associated with land use and recreation include changes to and conflicts with existing land uses, and effects to environmental resources associated with recreation areas and opportunities.

3.9.1 Affected Environment

The land use study area comprises the permit area and nearby properties within approximately 2 to 5 miles of the permit area. This study area is the same for both direct and cumulative effects, although it is possible that projects outside of the area may affect the study area in a cumulative manner. The recreation study area is more complex; direct effects primarily would be limited to the same study area as for land use; however, potential population changes may drive indirect effects on public recreational facilities in surrounding communities and throughout Bastrop, Lee, and Milam Counties. This broader three-county area also is examined for cumulative recreation effects.

3.9.1.1 Land Use

The Three Oaks Mine permit area contains approximately 16,062 acres. CPS, the San Antonio public utility company, owns 9,911 acres and controls an additional 1,721 acres of the permit area. Alcoa owns 2,855 acres in the permit area and controls an additional 548 acres through leases. There also are a number of private owners of smaller parcels within the area (**Figure 3.9-1**). The CPS land is the only publicly owned land in the permit area.

The study area is a Post Oak Savannah landscape typical of much of the surrounding region. Much of the area is pastureland, with several sizable wooded areas and wooded drainage bottoms. Nearly all of the CPS land is leased for cattle grazing (Friesenhahn 2001). There is very little cultivated cropland in the study area, although some hay is harvested. CPS limits sale of hay from its leases to 50 percent of the production; the rest must be retained for use by the lessee (Friesenhahn 2001). Development is sparse with only 125 residences in, and within 1,000 feet of, the permit area (see **Figure 3.12-1**). Most of the residences are in clusters just outside of the permit area; only nine are located within the mine area. There is a small amount of non-agricultural commercial or industrial development in the permit area, comprised mainly of utility corridors for pipelines and major electric transmission lines. There also are two brick manufacturing plants just outside of the permit area at the southwest corner of the study area. Other land uses include a few churches and a private camp at the Star Ranch.

The land uses in the permit area are illustrated in **Table 3.9-1**. The categories in the table are as defined by the RRC (see Section 2.5.3.9). Generally, pastureland is distinguished from grazing land by the dominant forage plant species, with pastureland dominated by introduced species and grazing land dominated by native species. Undeveloped land is that which has not been previously developed or which has been allowed to return naturally to an undeveloped state through natural succession. Within the permit area, the undeveloped land is primarily woodlands with some grasslands or shrublands that have not been actively managed in recent years. The undeveloped grasslands and shrublands have been heavily colonized by

Table 3.9-1
Three Oaks Mine Permit Area Land Use

Land Use Category[1]	Acres	Percent
Pastureland	6,630	41
Grazing Land	2,929	18
Cropland	98	1
Undeveloped	5,907	37
Industrial/Commercial	225	1
Developed Water Resources	178	1
Residential	95	1
Total	**16,062**	**100**

[1]As defined by the RRC.

Source: Alcoa 2000 (Volume 6).

mesquite, eastern red cedar, and invasive weed species. As indicated in the table, the permit area is essentially entirely rural, whereas Lee and Bastrop Counties are both approximately 96 percent rural in character.

The nearest residential communities are at the southern end of the study area. Butler, a community of a few dozen people, is approximately 1 mile west of the permit area on the north side of U.S. Highway 290.

McDade, with approximately 345 residents, is a similar distance east of the permit area, also on the north side of U.S. Highway 290. Larger communities providing regional shopping and services to the area include Elgin (population 4,846) 4 miles to the west, Giddings (population 5,105) 20 miles to the east, Bastrop (population 4,044) 11 miles south of the permit area, and Rockdale (population 5,439) just north of the existing Sandow Mine. The nearest major city is Austin, approximately 25 miles west of the permit area.

There are several transportation and utility corridors crossing the study area (see **Figures 2-5, 2-6,** and **2-7** and **Tables 2-7** and **2-8**). The Union Pacific Southern Pacific Railroad parallels the southern border of the permit area for 1.25 miles. The existing roads and proposed road relocations are addressed in Section 3.11. There are two major pipelines crossing the area, a 20-inch TUFCO gas line and two 14–inch Seminole gas lines. There is a 138-kV LCRA electric transmission line; a 14.4-kV Bluebonnet power line; and several Aqua Water Supply Corporation water lines, as well as local service fiber optic, phone, and electric lines.

Current land use in the study area has changed very little from historical patterns (Alcoa 2000 [Volume 6]). Underground mining for lignite once took place in portions of the permit area, but these operations are no longer active. Clay mining is still active nearby, but is not being conducted in the permit area. The surrounding area remains predominantly rural with only slight increases in urban development in Bastrop and Lee Counties (Alcoa 2000 [Volume 6]) .

There are no land planning or land use regulations (e.g., zoning) guiding development in any of the three potentially affected counties. RRC regulations address mining and environmental standards, only. The larger communities in the vicinity of the mine have adopted land use plans to guide their growth and

Williamson County
Lee County
CR 304
CR 306
CR 309
CR 306
FM 619
CR 304
Proposed Disturbance Area
CR 307
Lee County
Bastrop County
CR 303
FM 696
FM 619
Three Oaks Permit Area
CR 89
CR 90
CR 305
CR 311
CR 304
CR 102
FM 696
CR 129
CR 102
Big Sandy Creek
CR 125
CR 126
CR 104
CR 103
CR 99
CR 333
McDade

3.9-3

Three Oaks Mine

Figure 3.9-1

CPS and Alcoa Land Ownership / Control Map

Legend

- Alcoa Owned
- Alcoa Leased
- CPS Owned
- CPS Leased
- Not Controlled by Alcoa or CPS

Source: Adapted from Alcoa 2001c.

N

0 2000 4000 Feet

6/19/02

development, but the nearest affected area is the extraterritorial jurisdiction area of Elgin, 3 miles west of the permit area.

Recreation

There are no public parks or recreation areas in or near the permit area. Recreation in the area is limited to private activities on private lands; there may be some private hunting, horseback riding, and similar activities. The Star Ranch provides some recreation for members only.

The nearest public recreation areas are the Lake Bastrop Recreation Area, Bastrop State Park, and Buescher State Park, all in the Bastrop vicinity. The state parks have camping facilities, and all three facilities provide a range of water-based recreation.

Bastrop County has developed a Parks, Recreation, and Open Space Master Plan to qualify for grants in an effort to meet identified recreation needs, particularly for youth in the county.

There are no wilderness areas, wild and scenic rivers, or other specially designated recreation or open space facilities in the permit area or vicinity.

3.9.2 Environmental Consequences

3.9.2.1 Proposed Action

Land Use

Approximately 8,654 acres would be disturbed under the Proposed Action over the 25-year life of the project (see **Table 2-5**). Nearly three-fourths of the total (6,466 acres) would be for the mine area itself. However, only approximately 640 acres would be actively disturbed by mining and associated activities at any one time due to sequential backfilling of the pits and concurrent reclamation (see Section 2.5).

Public use of the land in the permit area would not be affected, as the only public land (CPS ownership) is currently not open for public use, and the remainder of the land is currently privately owned and controlled. Use of private land would be curtailed in the mine disturbance area for the life of the mine with compensation paid to current owners through lease agreements. Existing land uses in all disturbance areas would be modified for the life of the mine. The 8,654 acres of disturbance of mostly rural land uses represent approximately 0.8 percent of the 1,048,100 total acres in Bastrop and Lee Counties. The resulting changes in land use patterns would continue for the life of the mine.

No data are available on current agricultural production from the permit area. However, combined pastureland and grazing land acreage of the permit area is approximately 1.2 percent of the total Bastrop and Lee Counties' acreage in the same categories, and cropland in the permit area represents approximately 0.1 percent of the two-county total cropland. Assuming that land uses in the disturbance area are distributed approximately the same as in the permit area, and that productivity of the land is average for

the two-county area, approximately 0.6 percent of livestock production and 0.03 percent of crop production in the two counties would be lost as a result of Three Oaks Mine development.

Existing roads and utility lines in the disturbance area would be relocated (see **Figures 2-5, 2-6,** and **2-7** and **Tables 2-7** and **2-8**) as part of the Proposed Action. Utility lines would remain in service throughout the life of the mine except for brief periods during construction when the relocated lines would be connected into existing lines. All utility relocation activities would be coordinated with the owners of the lines. Proposed road relocations are addressed in Section 3.11.2.

It is expected that the proposed development and operation of the Three Oaks Mine would result in some conflict with other nearby land uses, primarily residences within approximately 1,000 feet of the disturbance area. Some landowners may experience impacts to their wells due to groundwater drawdown, as discussed in Section 3.2.3. Conflicts may result from noise and light generated by the mine, especially during nighttime hours. These issues are addressed in more detail in Section 3.12.2. Traffic also would increase slightly on area roads, but the effects are expected to be minor (see Section 3.11.2).

Subsequent to closure of the Three Oaks Mine and completion of final reclamation, most of the post-mining land use in the disturbance area would be devoted to fish and wildlife habitat (4,520 acres); the second major category would be pastureland (3,031 acres). Industrial/commercial and residential areas would be substantially reduced from existing levels, although they currently represent only a small fraction of the area. The relocation of utility lines outside of the disturbance area would account for most of the reduction in post-mine industrial/commercial land. Cropland would be returned to approximately the same acreage as existing cropland acreage. Development of surface water features, designated as “water resources” by the RRC, would result in a net increase of approximately 825 acres within the mine area alone.

Recreation

The proposed project would cause minimal effects on recreation resources. There are currently no public recreation facilities in the permit area. The small amount of private recreation that now occurs would be precluded from the disturbance area for the life of the mine for safety and security reasons. This recreation activity (e.g., hunting and horseback riding, etc.) would be displaced to other public or private lands in the area; however, it would be of very small scale and would have minimal effects on recreation resources in the region. Potential water resources, vegetation, and wildlife impacts are discussed in Sections 3.2.3, 3.4.2, and 3.5.2, respectively.

The operating work force for the Three Oaks Mine would be transferred from the existing Sandow Mine. As a result, it would not generate new population-related demand for recreation facilities. Over a period of time, however, there may be some movement of the work-force-related population southward, closer to the Three Oaks Mine. This may cause a commensurate shift in recreation demand from Milam County toward Lee and Bastrop Counties; however, it is anticipated that the effect would be minimal. The construction work force would be provided primarily by contractors from the region and would, thus, be unlikely to affect population levels or recreation needs.

3.9.2.2 No Action Alternative

Under the No Action Alternative, there would be no mine-related changes to existing land uses or recreation activities in the permit area. The No Action Alternative would likely result in closure of the aluminum smelter at Rockdale and reduction in the scale of industrial activity there. However, continuing operation of the power plants would maintain the industrial character of the land use at that site. Jobs lost from closure of the Sandow Mine and the smelter could lead to a population decline, primarily in the Rockdale area, which would result in a reduction in urban growth pressure and a reduction in demand for recreation facilities and activities.

3.9.3 Cumulative Impacts

The land use and recreation effects of past and present actions in the study area are described in Section 3.9.1, Affected Environment. Consequently, the cumulative impacts of these activities and the Three Oaks Mine are addressed under the Proposed Action. Effects of the mine, when added to future actions, are addressed below.

Closure and reclamation at the Sandow Mine will result in reversion of most of the remaining mine disturbance area there to rural uses, primarily improved pastures. This will offset to some degree the conversion of existing land uses at the Three Oaks Mine site to mining uses, although the Sandow disturbance area is over 6 miles from the proposed disturbance area.

Groundwater withdrawal for the SAWS contract could adversely affect the ability of existing wells to produce water for residences and agricultural uses in the study area (see Section 3.2.3, Groundwater). However, a contractual commitment by SAWS to comply with the same well mitigation requirements as lignite mining operations, including the Three Oaks Mine, would help reduce cumulative adverse impacts (see Section 2.6.2.2, SAWS Contract).

Projected population growth in the cumulative effects area will increase pressure for residential development in the two-county area. However, there has been very little residential development in the permit area to-date, and that is not expected to change greatly. There may be a slight, temporary reduction in residential development in limited areas near the mining operations (see Section 3.12.2). However, this effect would be expected to cease soon after completion of reclamation. Subsequently, the open space on reclaimed portions of the permit area could attract residential development to the vicinity. Regionally, population increases will tend to increase urban development and in turn reduce the amount or types of rural land uses. Although the Three Oaks Mine would temporarily reduce rural land use acreage as well, the permit area would revert to mostly rural use after closure of the mine and completion of reclamation.

Cumulative land use and recreation effects of the planned non-mine-related transportation projects and the proposed Three Oaks Mine will be minimal. The widening of roads may require small amounts of additional ROW, which would likely reduce the total amount of rural land uses. However, the total cumulative reduction will be very slight.

The proposed Houston toad regional habitat conservation plan and utilities habitat conservation plan could result in a reduction in agricultural production in the two-county area, or, at least, prevent conversion of existing undeveloped land to agricultural production, depending on the final stipulations in the plans. If this were to occur, it would slightly add to the very small reduction in agricultural land caused by the disturbance at the Three Oaks Mine.

None of the other reasonably foreseeable future actions would be expected to affect land use or recreation in the study area.

3.9.4 Monitoring and Mitigation Measures

Alcoa is proposing to reclaim a majority of the project area to fish and wildlife habitat and pastureland land uses. No additional monitoring or mitigation measures are being considered for land use or recreation. As discussed in Section 2.5.1.2, Alcoa would be required to mitigate mine-related impacts to groundwater wells in accordance with RRC regulations.

3.9.5 Residual Adverse Effects

Most of the effects of the Three Oaks Mine on land use would be temporary and would cease on or before closure of the mine and completion of reclamation. No residual adverse effects to recreation resources have been identified.