CALIFORNIA WHEAT

This scenario is intended to represent wheat production (including barley and oats) in the San Joaquin Valley of California. The area of interest (AOI) examined for this scenario includes Fresno, Kern, Kings, Madera, Merced, and Tulare Counties which comprise approximately 42% of wheat, barley, and oats acreages in the state (USDA, 2002) (Figure 1). Wheat is grown predominately in the San Joaquin Valley (50%). The scenario nominally represents Kings/Fresno Counties, which comprise the largest acreage of wheat/barley/oats in the state and are located approximately in the center of the AOI (USDA, 2002a, NOAA, 2006). The city of Fresno, CA is located in this region at an elevation of 333 feet above sea level (NOAA, 2006). This area has distinct climatic differences, crop rotation patterns, and wheat varieties than other wheat production regions of California (USDA, 2002a). However, the Kings/Fresno area is characteristic of wheat production in the San Joaquin valley region in which Durum-type wheat is produced in this southern area of California (USDA, 2002a). In 2000 Durum™ accounted for 16% of the total acres planted with California producing an average of 1.3 million tons of wheat per year. The state ranks 19 in U.S. wheat production providing 2% of the national production (USDA, 2002a).

Wheat is a grass that is cultivated as a food grain and is ranked second in grain production with Common wheat and Durum wheat being the most common type grown. Wheat crops are planted in the fall months from October to December and harvested from May 20 to September 1 with the majority of this type of small grain acreage is irrigated (USDA, 2002a).

Wheat is grown on a variety of soils in California. The San Joaquin series is the most common soil found in wheat producing areas of Fresno, Kern, Kings, Madera, Merced, and Tulare Counties, accounting for approximately 6% of wheat bearing soils acreage (Table 5; USDA, 2006). San Joaquin soils are found on the Eastern side of the Sacramento and San Joaquin Valleys. The soils are extensive in MLRA-17 (USDA, 1999). They are fine, mixed, active, thermic Abruptic Durixeralfs soil found on slopes of 0 to 9% (USDA, 1999; Table 5). San Joaquin soils are used for cropland and livestock grazing; small grains, irrigated pasture and rice; vineyards, fruit and nut crops (USDA, 1999) and and are among the top soils for expected irrigated and non-irigated yields (Table 5). Location and metfile selections are often the most important developments affecting scenario vulnerability and protectiveness. The San Joaquin series was selected for this scenario because it is both representative of wheat bearing soils, is predominant in the main production area of the San Joaquin Valley, is a hydrologic group D soil (representing 40% of soils by drainage), and includes the 90% of soils in erodibility (Table 5).

San Joaquin is a benchmark soil in Hydrologic Group D, which includes 40% of wheat bearing soils in drainage (Table 5). San Joaquin soils have a USLE K factor ranging from 0.32 to 0.37, which is common to approximately 60% of wheat bearing soils and includes the 90th percentile of these soils in erodibility. Only 8 percent of wheat bearing soils in the AOI have a USLEK greater than 0.37, however they are generally of minor extent, are group B or C soils, and/or are less steep than San Joaquin soils. Approximately 2% of wheat bearing soils have a pH lower than San Joaquin wheat bearing soils (6.1 to 7.2) although pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. San Joaquin soils have an A horizon from 0 to 6 inches (0-15 cm) deep and a B horizon from 6 to 60 inches (15-152 cm) deep (USDA, 1999). San Joaquin loam 3-9 percent slopes was used to parameterize this scenario (USDA 2006). The subsoil rests abruptly on a mainly silica-cemented hardpan at depths ranging from 20 to 40 inches, therefore this scenario models fate and transport between the surface and hardpan.

Metfile W93193 is the meteorological data set representative of Kings/Fresno Counties, CA. Its data were collected at the Yosemite International Airport (WBAN 93193) in Fresno, CA, which receives an average annual rainfall of around 11.23 inches (NOAA, 2005) where nearly 90 percent of the annual precipitation occurs in the winter months from November to April (NOAA, 2006). The wettest months are January, February, and March (TWCII, 2006).

Table 1. PRZM 3.12 Climate and Time Parameters for Kings County, California – Wheat.

Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File from Fresno, CA (W93193)
Ending Date	Dec. 31, 1990	Meteorological File from Fresno, CA (W93193)
Pan Evaporation Factor (PFAC)	0.70	PRZM Manual, Figure 5.1 (EPA, 1998). Value represents midway and toward the eastern edge of the San Joaquin Valley.
Snowmelt Factor (SFAC)	0	The Weather Channel Interactive, Inc. (TWCII, 2006) and PRZM Manual, Table 5.1 (EPA, 1998)
Minimum Depth of Evaporation (ANETD)	32.5 cm	PRZM Manual, Figure 5.2 (EPA, 1998) Set to the midpoint of the reported range for Kings County area (30-35)

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Kings County, California – Wheat.

Parameter	Value	Source/Comments
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004)
USLE K Factor (USLEK)	0.37 tons EI^{-1*}	USDA NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/) Value listed for the soil series San Joaquin Approximate values are listed in PRZM Manual, Table 5-3 (EPA, 1998).
USLE LS Factor (USLELS)	0.79	PRZM Manual, Table 5-5 (EPA, 1998); LS equation (Haan and Barfield, 1978) LS value for 400' slope length and 4.5% slope Steve Wright, Farm Advisor, University of California Cooperative Extension
USLE P Factor (USLEP)	1.0	PRZM Manual, Table 5-6 (EPA, 1998). Default for wheat with no contour practices. Steve Wright, Farm Advisor, University of California Cooperative Extension.
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	1	PRZM Manual, Figure 5.12 (EPA, 1998)
Slope (SLP)	4.5%	Set to the midpoint of the reported range based on soils; Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004) Steve Wright, Farm Advisor, University of California Cooperative Extension.
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	1	Steve Wright, Farm Advisor, University of California Cooperative Extension
Irrigation Type (IRTYPE)	3 (Sprinkler)	Steve Wright, Farm Advisor, University of California Cooperative Extension
Leaching Factor (FLEACH)	0.1	Irrigation Guidance for developing PRZM Scenario, Table 3; (June 15, 2005).
Fraction of Water Capacity when Irrigation is Applied (PCDEPL)	0.5	Set to default as per Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).
Maximum Rate at which Irrigation is Applied (RATEAP)	0.1 cm hr^{-1}	Set to default as per Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).

Table 3. PRZM 3.12 Crop Parameters for Kings County, California – Wheat.

Parameter	Value	Source/Comments
Initial Crop (INICRP)	1	Set to one for all crops Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Initial Surface Condition (ISCOND)	3	Steve Wright, Farm Advisor, University of California Cooperative Extension
Number of Different Crops (NDC)	1	Set to number of crops in simulation.
Number of Cropping Periods (NCPDS)	30	Set to weather data in meteorological file Fresno, CA (W93193).
Maximum rainfall interception storage of crop (CINTCP)	0.15	Recommended value for wheat. PRZM Manual, Table 5-4 (EPA, 1998)
Maximum Active Root Depth (AMXDR)	30 cm	PRZM Manual, Table 5-9 (EPA, 1998) and Steve Wright, Farm Advisor, University of California Cooperative Extension
Maximum Canopy Coverage (COVMAX)	100%	Steve Wright, Farm Advisor, University of California Cooperative Extension
Soil Surface Condition After Harvest (ICNAH)	3	Steve Wright, Farm Advisor, University of California Cooperative Extension
Date of Crop Emergence (EMD, EMM, IYREM)	1/1	Steve Wright, Farm Advisor, University of California Cooperative Extension. Set to first of calendar year. PRZM Manual, Table 5-9 (EPA, 1998) and USDA, 1997 (not used)
Date of Crop Maturity (MAD, MAM, IYRMAT)	31/03	Steve Wright, Farm Advisor, University of California Cooperative Extension PRZM Manual, Table 5-9 (EPA, 1998)
Date of Crop Harvest (HAD, HAM, IYRHAR)	15/06 (grain)	Steve Wright, Farm Advisor, University of California Cooperative Extension PRZM Manual, Table 5-9 (EPA, 1998)
Maximum Dry Weight (WFMAX)	0	Not used in scenario (EPA, 2004)
Maximum Canopy Height (HTMAX)	153 cm	Steve Wright, Farm Advisor, University of California Cooperative Extension
SCS Curve Number (CN)	92, 89, 90	Gleams Manual Table H-4, Fallow = SR/CT poor; Cropping = Row Crop SR/CT poor (second number; Fallow = row crop SR/CT poor (3rd number) (USDA, 1990)
Manning's N Value (MNGN)	0.023	C23WWBDC RUSLE Project (USDA, 2000). Winter wheat, conventional till, Fresno CA.
USLE C Factor (USLEC)	0.027 - 0.604	C23WWBDC RUSLE Project (USDA, 2000). Winter wheat, conventional till, Fresno CA.

Table 4. PRZM 3.12 San Joaquin Loam, Shallow, 3 To 9 Percent Slopes, Soil Parameters for Eastern Fresno County, California – Wheat.

Parameter	Value	Source/Comments
Total Soil Depth (CORED)	56 cm	NRCS Official Soil Series Descriptions (OSD) (http://soils.usda.gov/technical/classification/osd/index.html) (USDA, 2005). The subsoil rests abruptly on a mainly silica-cemented hardpan at depths ranging from 20 to 40 inches, therefore this scenario models fate and transport between the surface and hardpan (56cm) (NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov)
Number of Horizons (NHORIZ)	4	NRCS OSD (USDA, 2005); soil consists of two horizons: A and B. The A horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements.
Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 10 cm (HORIZN = 2) 26 cm (HORIZN = 3) 10 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov) and NRCS OSD. The A horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements.
Bulk Density (BD)	1.55 g/cm^3 (HORIZN = 1) 1.55 g/cm^3 (HORIZN = 2) 1.55 g/cm^3 (HORIZN = 3) 1.58 g/cm^3 (HORIZN = 4)	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/); values are mean 1/3-bar moist bulk densities.
Initial Water Content (THETO)	0.282 cm^3/cm^3 (HORIZN =1) 0.282 cm^3/cm^3 (HORIZN =2) 0.232 cm^3/cm^3 (HORIZN =3) 0.332 cm^3/cm^3 (HORIZN =4)	NRCS SCD; values are mean 1/3-bar water contents.
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 5.0 cm (HORIZN = 2) 2.0 cm (HORIZN = 3) 5.0 cm (HORIZN = 4)	NRCS SDM and OSD
Field Capacity (THEFC)	0.282 cm^3/cm^3 (HORIZN =1) 0.282 cm^3/cm^3 (HORIZN =2) 0.232 cm^3/cm^3 (HORIZN =3) 0.332 cm^3/cm^3 (HORIZN =4)	NRCS SCD; values are mean 1/3-bar water contents.
Wilting Point (THEWP)	0.133 cm^3/cm^3 (HORIZN =1) 0.133 cm^3/cm^3 (HORIZN =2) 0.148 cm^3/cm^3 (HORIZN =3) 0.236 cm^3/cm^3 (HORIZN =4)	NRCS SCD and SDM; value is the THEFC value minus the available water capacity midpoint value in the Soil Data Mart reports for San Joaquin Loam soils.
Organic Carbon Content (OC)	0.44% (HORIZN = 1) 0.44% (HORIZN = 2) 0.15% (HORIZN = 3) 0.15 % (HORIZN = 4)	NRCS SDM; values for horizons 1 to 3 = mean %OM / 1.724.

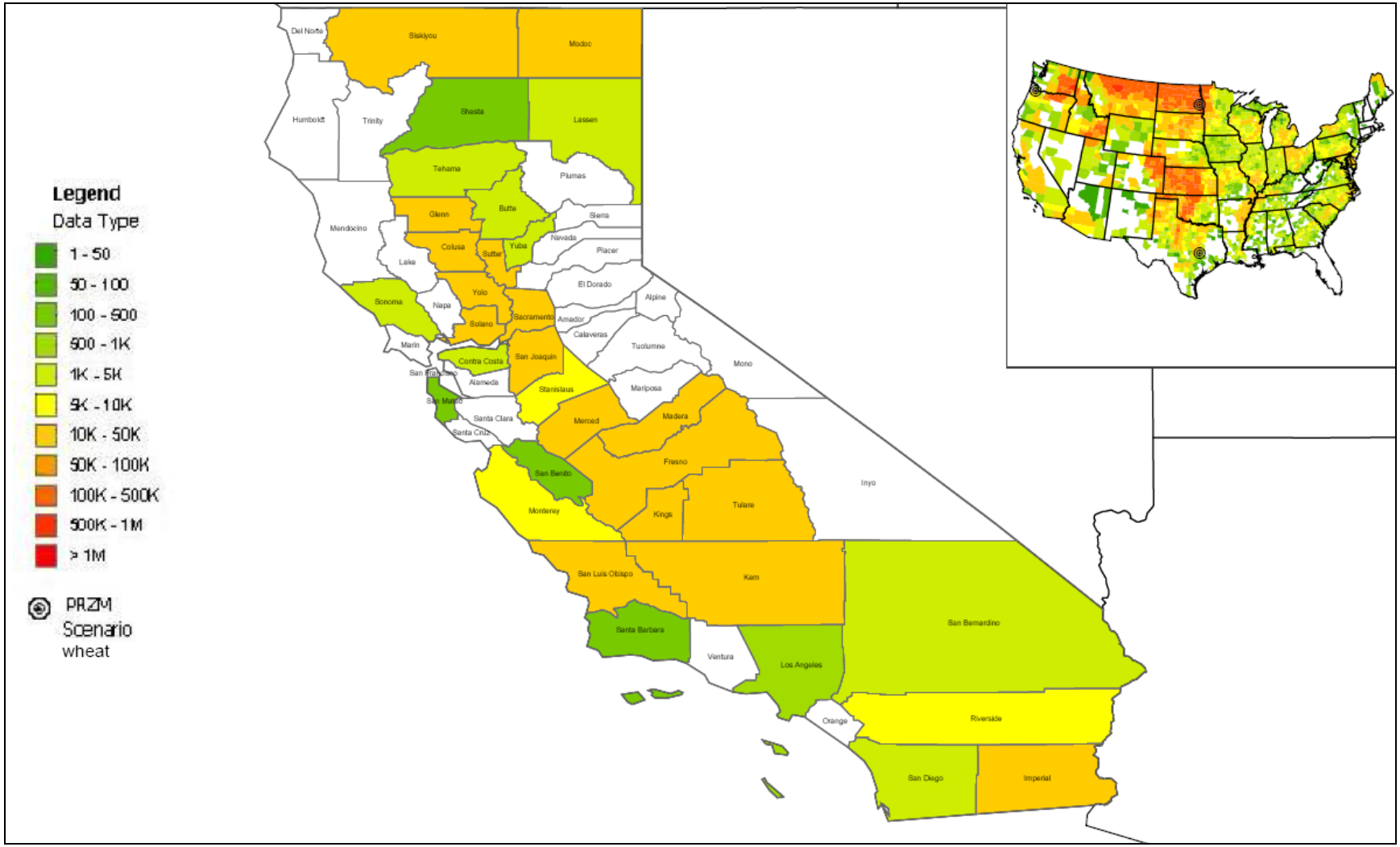

Figure 1. 2002 harvested acres for wheat, oats, and barley based on USDA Census of Agriculture for California and conterminous United States (inset) Estimates do not include data for individual farms which NASS has excluded to protect the identify of individual farms.

Table 5. Wheat Bearing Soils of Fresno, Kern, Kings, Madera, Merced, and Tulare Counties, California – Ranked by Area.

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	Wheat (bushels)	
										Irrigated	Non-Irr.
San_Joaquin	137,186	5.69%	D	0.32-0.37	0-9	6.1-7.2	0.75-1.5	42-66	19-38	50-90	20-25
Exeter	128,019	5.31%	C	0.24-0.37	0-9	6.7-7.3	0.5-1.5	44-66	19-41	90	15
Tulare	118,377	4.91%	D	0.28	0-1	8.2	2.5	22.1	27.9	100	-
Tranquillity	111,500	4.62%	D	0.28	0-1	8.1-8.2	1.3	6-20	30-39	2.8-2.9	-
Garces	108,362	4.49%	D	0.49	0-2	7.8-8.5	0.25-0.75	30.4-44.8	41.2-55.6	70-80	-
Delhi	98,283	4.07%	A	0.2-0.24	0-15	6.7-7	0.75	80-96	1.5-17.5	83-90	-
Nord	87,970	3.65%	B	0.28	0-1	7.5	1.5	69.6	16.4	100	-
Colpien	87,886	3.64%	B	0.37	0-2	7.5	2	39.8-39.8	37.7	100	-
Cerini	80,820	3.35%	C	0.37	0-5	7.7	0.8	32	40	3-3.7	-
Grangeville	72,564	3.01%	A/B	0.32-0.37	0-2	7.3-9.8	1.5-3.5	30.4-70.5	16.5-55.6	80-83	-
Westhaven	68,099	2.82%	C/B	0.37-0.43	0-5	7.6-7.9	1.2-1.25	30-68	16-45	3-100	-
Centerville	63,663	2.64%	D	0.2-0.24	0-30	7.3-7.5	1.5	22-22.1	27.9-28	75-85	15
Calflax	57,824	2.40%	C	0.37	0-2	7.4-8	0.8	28	40	2.8-3.1	-
Akers	57,796	2.40%	B	0.32	0-2	7.9	0.75	70.5	16.5	100	-
Cometa	56,725	2.35%	D	0.32-0.37	0-30	6.1	0.75	42.1-66	19-37.9	60	25
Hanford	50,820	2.11%	B	0.32	0-2	6.7	0.75	67.9	19.6	100	-
Panoche	48,060	1.99%	B	0.32-0.37	0-5	7.8	0.7	35-60	25-40	3.5	-
Cibo	45,843	1.90%	D	0.24-0.37	15-50	7.3-7.5	1.5	26-26.1	28.9-29	-	20
Ciervo	41,880	1.74%	D	0.28	0-1	8.2	0.9	32	28	2.5	-
Gambogy	41,870	1.74%	B	0.32	0-2	7.9	2	39.8	37.7	90	-
Redding	41,692	1.73%	D	0.24-0.37	0-15	5.8	1.25	43-65.9	19.1-39.5	-	20
Flamen	41,140	1.71%	C	0.37	0-2	6.7	2.5	39.8	37.7	60	-
Calgro	37,008	1.53%	C	0.2	0-2	7.9	0.5	67	20	60	-
Lokern	36,290	1.50%	C/D	0.28-0.32	0-2	8.2-8.5	2	23.3	29.2	80-100	-
Crosscreek	36,210	1.50%	B	0.37	0-2	8.3	0.75	39.8	37.7	75	-
Tagus	34,600	1.43%	B	0.32	0-2	7.6	1.5	44.8	41.2	115	-
Lethent	34,379	1.43%	C/D	0.37-0.43	0-1	8-9.5	0.7-2	21.7-35	37-54.8	2.7-75	-
Tachi	33,038	1.37%	D	0.2	0-1	8	2	3	29	-	-

Table 5. Wheat Bearing Soils of Fresno, Kern, Kings, Madera, Merced, and Tulare Counties, California – Ranked by Area.

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	Wheat (bushels)	
										Irrigated	Non-Irr.
Madera	32,577	1.35%	D	0.32-0.37	0-3	6.5-7.9	0.75	34-68.5	21.5-39.5	83	-
Twisselman	28,139	1.17%	D/C	0.32	0-5	8.2	0.25-0.75	5.3-22.1	27.9-44.7	80-100	-
Polvadero	27,680	1.15%	B	0.32	0-15	8.4	0.6	65	20	1.6-2	-
Buttonwillow	27,045	1.12%	C	0.24	0-2	8.2	2	23.3	29.2	100	-
Posochanet	26,330	1.09%	C	0.32-0.43	0-2	7.9-8.5	0.75-1.4	7.2-32	34-70.3	3.3-80	-
Hesperia	25,967	1.08%	B	0.32	0-2	7	0.75	68	19.5	100	-
Porterville	24,707	1.02%	D	0.24-0.37	0-8	7.5	1.5-2	22-22.1	27.9-28	-	15
Quonal	24,420	1.01%	B	0.32	0-2	8.5	0.75	7.2	47.8	75	-
Gareck	23,850	0.99%	B	0.24	0-2	7.5	0.4	65.9	19.1	90	-
Nahrub	23,530	0.98%	D	0.43	0-1	9.5	0.5	21.7	54.8	75	-
Millsholm	18,917	0.78%	D	0.43-0.49	8-50	6.5	0.75-2	34.2-39.2	37.3	-	25
Biggriz	17,070	0.71%	B	0.37	0-2	7.9	0.65	39.8	37.7	100	-
Yettem	13,646	0.57%	B	0.24	0-2	6.7	1.5	66	22.5	100	-
Steuber	12,720	0.53%	B	0.24	0-5	7.5	0.75	67.4	19.6	-	20
Yribarren	11,310	0.47%	C/D	0.37-0.43	0-5	8.2	0.25-0.8	30-39.2	33.6-38	2.6-85	-
Rosamond	11,292	0.47%	C	0.28	0-2	8.2	0.75	65.9	19.1	50	-
Deldota	10,950	0.45%	D	0.24	0-1	8	1.5	25	30	2.9	-
Atesh	10,550	0.44%	C	0.24	0-2	8.2	0.5	65.9	19.1	75	-
Lakeside	10,405	0.43%	C	0.37	0-1	7.5	1.5	35.4	33.6	80	-
Dello	9,976	0.41%	C	0.1-0.24	0-2	7.5	0.75	67-95	1.5-19	35	-
Lerdo	9,355	0.39%	C	0.37	0-2	8.5	2	35.4	33.6	45	-
Altamont	9,126	0.38%	D	0.24	15-50	7.3	2	23.3	29.2	-	20
Ayar	8,620	0.36%	D	0.28	30-50	7.9	2	7.2-26.1	28.9-47.8	-	20
Avenal	8,325	0.35%	C	0.43	0-5	7.2	1.5	39.2	37.3	100	-
Destazo	7,410	0.31%	B	0.2	0-2	8.2	0.75	67.4	19.6	35	-
Gepford	7,160	0.30%	D	0.28	0-1	8.2	1.5	3	42	45	-
Guijarral	7,120	0.30%	B	0.32	2-5	7.9	0.8	65	25	1.7	-
Houser	6,940	0.29%	D	0.28-0.37	0-1	8.2-8.5	0.75-0.8	5.3-70.9	16.6-44.7	90	-
Wasco	6,808	0.28%	B	0.24-0.32	0-5	7-7.2	0.5-0.8	60-67.4	19.6-28	3-100	-

Table 5. Wheat Bearing Soils of Fresno, Kern, Kings, Madera, Merced, and Tulare Counties, California – Ranked by Area.

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	Wheat (bushels)	
										Irrigated	Non-Irr.
Corning	6,765	0.28%	D	0.32-0.37	0-8	5.8	0.5-0.75	43-65.9	19.1-39.5	-	24
Zerker	6,575	0.27%	B	0.37	0-9	7.9	0.75	41.6-58.2	17.8-37.4	80-95	-
Tujunga	5,770	0.24%	A	0.17	0-2	6.7	0.75	80.5	17	85	-
Armona	5,420	0.22%	C	0.24	0-1	8.2	1.5	67.9	19.6	65	-
Tehachapi	5,281	0.22%	C	0.28	2-9	7.3	1.5	57	18	-	25
Alamo	5,244	0.22%	D	0.24	0-2	7	2.5	22-22.1	27.9-28	-	25
Remnoy	5,020	0.21%	D	0.43	0-2	9.8	0.5	29.1	53.4	80	-
Wyman	4,953	0.21%	B	0.37	0-3	6.7	1.5	34.2	37.3	80	-
Pottinger	4,470	0.19%	B	0.43	2-15	8.2	2	33.5	36.5	-	35
Marguerite	4,017	0.17%	B	0.37-0.43	0-3	6.7-7.5	1.5	17.7-43	33.6-53.8	80	-
Jerryslu	3,590	0.15%	C	0.43	0-2	8.5	0.25	43.8	40.2	80	-
Honcut	3,318	0.14%	B	0.32	2-5	6.7	1.5	67.3	23.2	-	15
Raynor	3,073	0.13%	D	0.24-0.28	3-15	7.2-7.5	1.5	22.1	27.9	-	15
Excelsior	3,020	0.13%	A/B	0.17-0.32	0-1	7.8-8.5	0.6-0.75	67.5-85	6-21	2-90	-
Digiorgio	2,982	0.12%	B	0.2	0-2	7.9	0.75	55.1	17.4	85	-
Capay	2,745	0.11%	D	0.24-0.28	0-9	7	1.5	5.3-31.5	27.9-44.7	70	17
Westcamp	2,630	0.11%	C	0.43	0-2	8.5	0.75	11.7	69.8	90	-
Los_Robles	2,392	0.10%	B	0.37	0-3	6.7	1.5	34.2-39	37.3-37.5	80	-
Montpellier	2,300	0.10%	C	0.32	3-8	6.5	0.5	67.1	18.9	-	43
Foster	2,238	0.09%	B	0.32-0.37	0-1	7.5	3.5	35.4-70.5	16.5-41.2	83	-
Rossi	1,600	0.07%	D	0.49	0-1	8.5	2.5	26.5	53.5	70	-
Rocklin	1,522	0.06%	D	0.37	0-3	6.1	0.75	42.1-65.9	19.1-37.9	66	40
Sehorn	1,470	0.06%	D	0.28	30-50	6.5	2	26.1	28.9	-	25
Piper	1,296	0.05%	C/B	0.28	0-5	7.9	1.25	68-71.3	16.7-20	45	-
Yokohl	1,180	0.05%	D	0.37	0-3	6.7	0.75	42	38	83	-
Atwater	798	0.03%	D	0.28	0-3	6.7	0.75	68	23.5	83	30
Delvar	770	0.03%	C	0.32	2-9	7.3	2	34.2	32.3	90	-

Table 5. Wheat Bearing Soils of Fresno, Kern, Kings, Madera, Merced, and Tulare Counties, California – Ranked by Area.

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	Wheat (bushels)	
										Irrigated	Non-Irr.
Positas	671	0.03%	D	0.37	30-45	6.2	1.35	42	38	-	25
Myers_Variant	410	0.02%	D	0.24	2-9	8.2	0.75	9.8	22.7	-	40
Dinuba_Variant	264	0.01%	D	0.37	0-1	8.2	1.5	67.4	19.6	80	-
Hopeton	253	0.01%	D	0.32	0-3	6.5	2	31.5	31	-	15

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