CALIFORNIA OLIVES

This scenario is intended to represent olive production in California's San Joaquin Valley, primarily in Tulare, Madera, Fresno, and Kings Counties, hereafter referred to as the Area of Interest (AOI). Nearly 65% of California's olive acreage is located in the AOI, primarily in Tulare County (53% of the total) (USDA, 1999). Moreover, based on 2005 California Pesticide Usage Reporting (CalPIP, 2006), approximately 80% of pesticides used on California olives (by pounds of chemical) were applied in the AOI. Lesser amounts of olives are grown and lesser amounts of pesticides are applied in the Sacramento Valley, primarily Butte, Glenn and Tehama counties (CalPIP, 2006). Scenario parameters were selected to be generally representative of Tulare County. The County is located on the extreme southern end of the Great San Joaquin Valley and is partially surrounded by a horseshoe-shaped rim of mountains (NOAA 2006).

Over 99% of the olives grown in the United States are grown in California with approximately 35,300 bearing acres of olives (USDA, 1999). The olive is a thick evergreen tree that is cultivated in California for use in the table olive industry. The table olive industry includes four commercially grown olive (*Olea europea* L.) cultivars (CVs): Manzanillo (the most common), Sevillano, Ascolano, and Mission which account for over 99% of the total olive acreage in the State (USDA, 1999). Olives grown in California cover approximately 33,051 acres in the San Joaquin Valley and Northern Sacramento Valley and yields approximately 4-7 tons/acre (University of California, 1995). The numbers of acreage in increasing aaccording to the USDA Crop Profile for Olives in California in which there are approximately 35,300 acres of olives (USDA, 1999) in 1999 and in 2002 the USDA Census of Agriculture estimated 38,783 acres of olives in California (USDA, 2002).

Olives can grow on a wide range of soils and soil quality with approximately 38-39 acre inches of water per acre per year required for optimal production in the San Joaquin Valley (USDA, 1999). Drip and micro-sprinkler irrigation are the most popular methods of irrigation, used by approximately 70% of the acreage (USDA, 1999). Other types of irrigation methods used include flood, furrow, sprinkler, drip and micro sprayer. The typical spacing of olive trees are: standard: 30' x 30' (48 trees/acre); high density: 30'x 30' hexagonal/equilateral triangle design (56 trees/acre); and hedgerow: 15' x 30' (97 trees/acre) (University of California, 1995). Harvesting begins when 50% of the olives taken in daily samples fall within standard medium, large, or extra large size and the percentage is increasing at a rate of 3-5% per week, beginning in mid-September and finishing in mid-November (University of California, 1995).

The Porterville series is the third most common soil found in the AOI where olives are grown, accounting for 25% of olive bearing soils (USDA, 2006; Table 5). It is a fine, smectitic, thermic Aridic Haploxererts soil found on slopes of 0 to 15% (USDA, 1997; USDA, 2006). The soils are of moderate extent and are used mainly for range, pasture, irrigated oranges, lemons, olives, figs and some grapes (USDA, 1997). A local extension agent also confirmed that olives are grown on Porterville soils in the AOI (B. Peacock, personal communication). Location and metfile selections are often the most important developments affecting scenario vulnerability and protectiveness. Because some olive production occurs in Northern California where it is generally wetter (NOAA, 2006), a comparison of soils in both Area I (Tulare, Madera, Fresno, and Kings Counties) and Area II (Butte, Glenn and Tehama Counties) was performed. In Area I (primary olive growing area), nearly 65% of olive bearing soils are in hydrologic group D. Conversely, nearly 97% of olive bearing soils in Area II are in hydrologic group C. Because hydrologic group significantly impacts curve number selection, the most sensitive parameter in PRZM (hydrologic group D soils have a higher tendency for runoff), this scenario is based in the San Joaquin Valley due to the extensive hydrologic group D olive bearing soils in the area. Based on USDA soils data (USDA, 2006), olive bearing soils in Area I (Table 5), are also located on steeper slopes than olive bearing soils in Area II (Table 6), which also increase runoff vulnerability (Table 5).

Porterville is a Hydrologic Group D soil, which includes nearly 65% percent of olive bearing soils in drainage. Porterville soils have a USLE K factor of 0.24-0.37 and includes the 90th percentile of soils in erodibility. Less than 2% of soils in the AOI have a USLE K factor greater than 0.37 (Table 5). 70% of olive bearing soils in the AOI have a pH lower than Porterville soils (7.5). However, soil pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. Porterville soils have an A horizon from 0 to 27 inches (0-69 cm) deep and a C horizon from 27 to 71 inches (69-180 cm) deep (USDA, 1997). No benchmark soils of California were selected for this scenario because the benchmark soils identified (e.g., Exeter) was a less vulnerable soil for runoff based on hydrologic group C (USDA, 2006).

Two metfiles are located roughly within 65 miles of Tulare County. Bakersfield (Metfile W23155) is located approximately 61 miles to the south of the center of Tulare County. Fresno is located approximately 64 miles to the northwest of the center of Tulare County; however it is a more representative station of the AOI, which includes Fresno and Madera Counties. Fresno was chosen since it receives approximately five inches more rainfall per year than Bakersfield (NOAA, 2006), making it a more conservative scenario. The Met station (W93193.dvf) is located at 36º 47' N, 119º 43' W and at an elevation of approximately 102 meters above sea level. This station receives an average of approximately 11 inches (28 cm) of rainfall annually, with the majority of rainfall occurring between November and March (NOAA, 2006. Snow in the valley is infrequent, with only a trace occurring in about one year out of seven).

Table 1. PRZM 3.12 Climate and Time Parameters for Tulare County, California – Olives.

Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File from Fresno, California (W93193).
Ending Date	Dec. 31, 1990	Meteorological File from Fresno, California (W93193).
Pan Evaporation Factor (PFAC)	0.70	PRZM Manual, Figure 5.1 (EPA, 1998). Value represents south-central California.
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). Midpoint of the reported range for south-central California.

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Tulare County, California – Olives.

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 Porterville Approximate values are listed in PRZM Manual, Table 5-3 (EPA, 1998).
USLE LS Factor (USLELS)	1.98	PRZM Manual, Table 5-5 (EPA, 1998); LS equation (Haan and Barfield, 1978) LS value for 400' slope length and 8% slope Bill Peacock, Farm Advisor, University of California Cooperative Extension
USLE P Factor (USLEP)	1.0	PRZM Manual, Table 5-6 (EPA, 1998) Default for olives with no contour practices. Bill Peacock, 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)	8%	Set to the midpoint for the soil range (0-15%). This is a reasonable value, but slopes can be as high as 12% based according to Bill Peacock, Farm Advisor, University of California Cooperative Extension. Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Tulare County, California – Olives.

Parameter	Value	Source/Comments
Irrigation Flag (IRFLAG)	1	Drip and micro-sprinkler irrigation are the most popular methods of irrigation, used by approximately 70% of the acreage (USDA, 1999). Fogger (low volume) irrigation used on 80% of crops and the remainder (20%, high volume) is furrow irrigation. Bill Peacock, Farm Advisor, University of California Cooperative Extension
IRTYPE	4 (drip)	Drip and micro-sprinkler irrigation are the most popular methods of irrigation, used by approximately 70% of the acreage (USDA, 1999).
Leaching Factor (FLEACH)	0.0	Irrigation Guidance for developing PRZM Scenarios, Table 3; (June 15, 2005). Default value for drip irrigation.
Fraction of Water Capacity when Irrigation is Applied (PCDEPL)	0.50	Set to default value. Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).
Maximum Rate at which Irrigation is Applied (RATEAP)	0.037 cm hr^{-1}	Irrigation Guidance for developing PRZM Scenarios, Table 1; (June 15, 2005). For CN = 85 and f = 0

Table 3. PRZM 3.12 Crop Parameters for Tulare County, California – Olives.

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	Bill Peacock, 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 from Fresno, California (W93193).
Maximum rainfall interception storage of crop (CINTCP)	0.25	Recommended value for orchards. Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Maximum Active Root Depth (AMXDR)	60 cm	Bill Peacock, Farm Advisor, University of California Cooperative Extension
Maximum Canopy Coverage (COVMAX)	90%	Bill Peacock, Farm Advisor, University of California Cooperative Extension
Soil Surface Condition After Harvest (ICNAH)	3	Bill Peacock, Farm Advisor, University of California Cooperative Extension
Date of Crop Emergence (EMD, EMM, IYREM)	01/01	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Date of Crop Maturity (MAD, MAM, IYRMAT)	02/01	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Date of Crop Harvest (HAD, HAM, IYRHAR)	31/12	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Maximum Dry Weight (WFMAX)	0	Not used in scenario (EPA, 2004)
Maximum Canopy Height (HTMAX)	457.2 cm	Bill Peacock, Farm Advisor, University of California Cooperative Extension
SCS Curve Number (CN)	87, 85, 86	Gleams Manual Table H-4; meadows; no fallow conditions (USDA, 1990)

Table 3. PRZM 3.12 Crop Parameters for Tulare County, California – Olives.

Parameter	Value	Source/Comments
Manning's N Value (MNGN)	0.070	RUSLE Project; C23OFOFN for California (Fresno) orchards with full cover (USDA, 2000). These data are the closest data available to represent olives in Central CA.
USLE C Factor (USLEC)	0.003 - 0.029	RUSLE Project; C23OFOFN for California (Fresno) orchards with full cover (USDA, 2000). These data are the closest data available to represent olives in Central CA.

Table 4. PRZM 3.12 Porterville Clay, 9 To 15 Percent slopes Soil Parameters for Tulare County, California – Olives.

Parameter	Value	Source/Comments
Total Soil Depth (CORED)	285 cm	NRCS Official Soil Series Descriptions (OSD) (http://soils.usda.gov/technical/classification/osd/index.html) (USDA, 2006)
Number of Horizons (NHORIZ)	4	NRCS OSD (USDA, 2006); soil consists of two horizons: A and C. The A horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements.
Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 71 cm (HORIZN = 2) 102 cm (HORIZN = 3) 102 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov) and NRCS OSD
Bulk Density (BD)	1.35 g/cm^3 (HORIZN = 1) 1.35 g/cm^3 (HORIZN = 2) 1.35 g/cm^3 (HORIZN = 3) 1.35 g/cm^3 (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 1/3-bar moist bulk densities.
Initial Water Content (THETO)	0.366 cm^3/cm^3 (HORIZN =1) 0.366 cm^3/cm^3 (HORIZN =2) 0.395 cm^3/cm^3 (HORIZN =3) 0.395 cm^3/cm^3 (HORIZN =4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 1/3-bar water contents of a soil sampled as a Porterville soil.
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 1.0 cm (HORIZN = 2) 3.0 cm (HORIZN = 3) 3.0 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Field Capacity (THEFC)	0.366 cm^3/cm^3 (HORIZN =1) 0.366 cm^3/cm^3 (HORIZN =2) 0.395 cm^3/cm^3 (HORIZN =3) 0.395 cm^3/cm^3 (HORIZN =4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 1/3-bar water contents of a soil sampled as a Porterville soil.
Wilting Point (THEWP)	0.264 cm^3/cm^3 (HORIZN =1) 0.264 cm^3/cm^3 (HORIZN =2) 0.261 cm^3/cm^3 (HORIZN =3) 0.261 cm^3/cm^3 (HORIZN =4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 15-bar water contents of a soil sampled as a Porterville soil.
Organic Carbon Content (OC)	1.16% (HORIZN = 1) 1.16% (HORIZN = 2) 0.44% (HORIZN = 3) 0.44% (HORIZN = 4)	NRCS SDM; values for horizons 1 to 4 = mean %OM / 1.724.

Table 5. Olive Bearing Soils of Tulare Counties Area, California – Ranked by Area.											
Soil	**Total Acreage**	**% Area**	**Drainage**	**Erodibility**	**Slopes (%)**	**pH**	**OM (%)**	**% Sand**	**% Silt**	**Olives**	
										Irrigated	**Non-Irr**
CENTERVILLE	56,886	33.75%	D	0.2-0.24	0-30	7.3-7.5	1.5	22-22.1	27.9-28	3	-
EXETER	46,249	27.44%	C	0.24-0.37	0-9	6.7	0.5-1.5	44-66	19-41	4	-
PORTERVILLE	43,154	25.61%	D	0.24-0.37	0-15	7.5	1.5-2	22-22.1	27.9-28	3-4	-
HILDRETH	5,100	3.03%	D	0.24	0-5	7.2-7.5	2	22-49.8	7.7-28	2.5	-
WYMAN	4,892	2.90%	B	0.37-0.43	0-5	6.7	1.5	43	39.5	4	-
YETTEM	4,833	2.87%	B	0.24	0-2	6.7	1.5	66	22.5	4	-
HONCUT	2,952	1.75%	B	0.32	0-2	6.7	1.5	67.3	23.2	4	-
SEVILLE	2,262	1.34%	D	0.2	0-2	7.5	1.5	22.1	27.9	3	-
RAYNOR	1,269	0.75%	D	0.24	0-8	7.5	1.5	22.1	27.9	3	-
LEWIS	940	0.56%	D	0.43	0-1	8.5	0.75	39.2	37.3	1	-

Table 6. Olive Bearing Soils of Tehema, Glenn, and Butte Counties Area, California – Ranked by Area.												
Soil	**Total Acreage**	**% Area**	**Drainage**	**Erodibility**	**Slopes (%)**	**pH**	**OM (%)**	**% Sand**	**% Silt**	**% Clay**	**Olives**	
											Irrigated	**Non-Irr**
TEHAMA	62,581	96.62%	C	0.37-0.43	0-5	6.1-6.3	0.5-1.25	11.4-68	16-70.1	16-20	2	-
STOCKTON	1,271	1.96%	D	0.24	0-1	6.7	1.5	22.1	27.9	50	3	-
PORTERVILLE	919	1.42%	D	0.28	0-10	6.3	2	22.1	27.9	50	4	-

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