CALIFORNIA WINE GRAPES

The following parameters are valid for characterizing the Northern Coastal wine grape producing regions of California, USDA grape crush districts 1 through 4. While a greater majority of California wine grape production takes place within the San Joaquin valley, the demand for Sonoma, Napa, Lake, and Mendocino County grapes, shown by the weighted average per ton delivered, places the Northern Coastal area grape production five to fifteen times higher by price (USDA, 2006a). The Northern Coastal development regions are driven by this demand to utilize a wide variety of farming conditions to maximize production.

Grapes are a perennial crop with persistent vines growing on trellises constructed in rows. Surface soil around the vine row is usually sealed, but some plants can grow between vine rows. The soil between rows is usually disked. Foliage coverage at maturity is 100% under the trellis and approximately 30% per acre due to spacing between rows (R. Smith, personal communication). Grapes need at least 3 ft of well drained soil with a rooting depth of 2-4 ft and are typically grown on sandy or sandy loam soils. Vine rows are usually kept weed free, but there is some growth in the winter. Vineyards are typically irrigated using drip irrigation. Decisions to irrigate are site specific and are based on soil moisture and crop rooting depth (R. Smith, personal communication)

Metfile W23234 was selected for this scenario since it is the closest metfile to the wine grape producing counties of interest (Sonoma, Napa, Lake, and Mendocino). Its data were collected in San Francisco, CA. The station is located approximately 2 meters above mean seal level (AMSL). San Francisco receives approximately 20 inches (51 cm) of rainfall annually with nearly 60% of the annual precipitation occurring in January, February, and March (NOAA, 2006). This station is the closest available weather station that includes data required for PRZM. The Sacramento Met station W23232 located at 38º 31' N, 121º 30' W and 6 meters above sea level is also near this area, but receives approximately 2 inches less rainfall per year (approximately 18 inches) (NOAA, 2006).

There are approximately thirty different wine grape bearing soils in Napa, Sonoma, and Mendocino Counties (USDA, 2006b). Approximately 65% of wine grape bearing soils are in drainage groups C and D. Representative wine grape bearing soils include Diablo, Goldridge, Haire, and Yolo series (R. Smtih, personal communication). Of these, the Haire series is the most common wine grape producing soil of Napa, Sonoma, and Mondocino Counties, and the seventh most common wine grape bearing soil overall in these counties (Table 5). The Haire series accounts for approximately 5% of wine grape bearing soil acreage (USDA, 2006b). Haire soils are fine, mixed, superactive, thermic Typic Haploxerults located on nearly level to moderately steep hills at elevations of 20 to 2,400 feet (USDA, 2003). They are among the top soils for expected irrigated yields (Table 5). Location and metfile selections are often the most important developments affecting scenario vulnerability and protectiveness. Because this scenario is intended to represent wine grape production along the northern coastal area of California, the metfile closest to the center of the major wine producing counties in the region was chosen. The Haire soil series was selected for this scenario because it is both representative of wine grape bearing soils, is predominant in the main production areas of both Napa and Sonoma Counties, represents the majority (45%) of soils in drainage, 90% for erodibility, and is among the steeper sloped wine grape bearing soils (Table 5).

Haire is a Hydrologic Group C soil, which represents the majority (45%) these soils in drainage. Haire soils have a USLE K factor of ranging from 0.32-0.43; approximately 87% of wine grape bearing soils have a USLE K factor between 0.32 and 0.43 (Table 5). Less than 1% of wine grape bearing soils have a pH lower than Haire soils (5.6 - 6.7), although soil pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. Haire soils have an A horizon from 0 to 24 inches (0-61 cm) deep, a B horizon from 24 to 36 inches (61-91 cm) deep, and a C horizon from 36 to 60 inches (91-152 cm) deep. Only two benchmark soils were identified as bearing wine grapes in drainage groups C or D (Clear Lake and Dibble), however Clear Lake was not suggested as a representative soil by local experts and Dibble is of only minor extent with respect to wine grape bearing soils (Table 5). Therefore, a benchmark soil of California was not selected for this scenario. Haire clay loam 15-30 percent

slopes was used to parameterize this scenario (USDA 2006b).

Table 1. PRZM 3.12 Climate and Time Parameters for Sonoma, California – Wine.

Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File from San Francisco, CA (W23234)
Ending Date	Dec. 31, 1990	Meteorological File from San Francisco, CA (W23234)
Pan Evaporation Factor (PFAC)	0.75	PRZM Manual Figure 5.1. Value represents North Coast region of California.
Snowmelt Factor (SFAC)	0	The Weather Channel Interactive, Inc. (TWCII, 2006)
Minimum Depth of Evaporation (ANETD)	17.5 cm	PRZM Guidance

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Sonoma, California – Wine.

Parameter	Value	Source/Comments
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	PRZM Manual (EPA, 1998)
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 Haire.
USLE LS Factor (USLELS)	5.18	PRZM Manual (EPA, 1998) Value listed for 15% slope at 400 feet
USLE P Factor (USLEP)	1.0	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Default for orchards with no contour practices
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	2	PRZM Manual Figure 5.12 (EPA, 1998)
Slope (SLP)	15%	Set to the midpoint of the reported range. R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Maximum utilized and allowed slope by Sonoma County ordinance. (Sonoma County Agricultural Commissioner, 1999)
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	2 (cropping period only)	PRZM Guidance (EPA, 1998). Consistent with other grape scenarios. R. Smith, UC Cooperative Extension Sonoma County; and Irrigation Guidance for developing PRZM Scenarios, Table 3; (EPA 2005).
Irrigation Type (IRTYP)	4 (drip)	Grapes are irrigated using drip irrigation. R. Smith, UC Cooperative Extension Sonoma County; and Irrigation Guidance for developing PRZM Scenarios, Table 3; (EPA 2005).
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)	0.60	Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005). Irrigation varies by site, but grapes are generally irrigated between 60-80% available water capacities. R. Smith, UC Cooperative Extension Sonoma County; and Irrigation Guidance for developing PRZM Scenarios, Table 3; (EPA 2005).

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Sonoma, California – Wine.		
Parameter	**Value**	**Source/Comments**
Maximum Rate at which Irrigation is Applied (RATEAP)	0.056 cm hr^{-1}	Irrigation Guidance for developing PRZM Scenarios, Table 1; (June 15, 2005). For CN = 79 and f = 0
* EI = 100 ft-tons * in/ acre*hr		

Table 3. PRZM 3.12 Crop Parameters for Sonoma, California – Wine.

Parameter	Value	Source/Comments
Initial Crop (INICRP)	1	Set to one for all crops (EPA, 2004).
Initial Surface Condition (ISCOND)	3	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Consistent with perennial orchard crops.
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: San Francisco, CA (W23234)
Maximum rainfall interception storage of crop (CINTCP)	0.25	Recommended value for orchards (EPA, 2004).
Maximum Active Root Depth (AMXDR)	122 cm	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Value varies based on soil density between 24" – 48".
Maximum Canopy Coverage (COVMAX)	30	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Value represents wide gaps between trellis rows. Coverage over individual rows will be 100%.
Soil Surface Condition After Harvest (ICNAH)	3	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Consistent with perennial orchard crops.
Date of Crop Emergence (EMD, EMM, IYREM)	03/01	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Emergence between late Feb. to early Apr.
Date of Crop Maturity (MAD, MAM, IYRMAT)	08/01	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County.
Date of Crop Harvest (HAD, HAM, IYRHAR)	08/01	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Harvest begins at crop maturity. Leaves drop in late Nov.
Maximum Dry Weight (WFMAX)	0.0	Not used in scenario
Maximum Height (HFMAX)	7'	R. Smith, Viticulture Advisor / UC Cooperative Extension Sonoma County. Controlled by trellis height.
SCS Curve Number (CN)	84, 79, 82	Gleams Manual Table H-4, for Meadows, no fallow conditions, Hydrologic Group C (USDA, 1990)
Manning's N Value (MNGN)	0.023	RUSLE Project; variable with date; C21GFGFN for Sacramento grapes with no tilling (USDA, 2000).
USLE C Factor (USLEC)	0.029-0.109	RUSLE Project; variable with date; C21GFGFN for Sacramento grapes with no tilling (USDA, 2000).

Table 4. PRZM 3.12 Haire clay loam 15-30 percent slopes, Soil Parameters for Sonoma, California – Wine.

Parameter	Value	Source/Comments
Total Soil Depth (CORED)	152 cm	NRCS Official Soil Series Descriptions (OSD) (http://soils.usda.gov/technical/classification/osd/index.html/) (USDA, 2006b)

Number of Horizons (NHORIZ)	4	NRCS OSD; soil consists of three horizons: A, B, 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) 26 cm (HORIZN = 2) 33 cm (HORIZN = 3) 83 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov)
Bulk Density (BD)	1.4 g/cm^3 (HORIZN = 1) 1.4 g/cm^3 (HORIZN = 2) 1.4 g/cm^3 (HORIZN = 3) 1.45 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)	0.312 cm^3/cm^3 (HORIZN =1) 0.312 cm^3/cm^3 (HORIZN =2) 0.333 cm^3/cm^3 (HORIZN =3) 0.152 cm^3/cm^3 (HORIZN =4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 1/3-bar water contents.
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 2.0 cm (HORIZN = 2) 3.0 cm (HORIZN = 3) 1.0 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov)
Field Capacity (THEFC)	0.312 cm^3/cm^3 (HORIZN =1) 0.312 cm^3/cm^3 (HORIZN =2) 0.333 cm^3/cm^3 (HORIZN =3) 0.152 cm^3/cm^3 (HORIZN =4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov); values are mean 1/3-bar water contents.
Wilting Point (THEWP)	0.197 cm^3/cm^3 (HORIZN =1) 0.197 cm^3/cm^3 (HORIZN =2) 0.275 cm^3/cm^3 (HORIZN =3) 0.097 cm^3/cm^3 (HORIZN =4)	NRCS SCD and SDM; values are mean 15-bar water contents.
Organic Carbon Content (OC)	1.16% (HORIZN = 1) 1.16% (HORIZN = 2) 0.15% (HORIZN = 3) 0.15% (HORIZN = 4)	NRCS SDM; values for horizons 1 to 4 = mean %OM / 1.724.

Sensitive Parameter Uncertainties

Slope

Wine grapes grown in and around Sonoma County are typically produced on slopes around 10-30%, with 50% being the maximum slope allowed by the Vineyard Erosion & Sediment Control (VESCO) ordinance (Sonoma Country Agricultural Commissioner, 1999).

Soil Data

R. Smith, Viticulture Advisor for the UC Cooperative Extension of Sonoma County suggested that the highest potential for runoff to adjacent surface water bodies is from soils located in the valleys which would be represented by lower slope values.

Table 5. Wine Grape Bearing Soils of Napa, Sonoma, and Mendocino Counties (California) Ranked by Area.

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	% Clay	Wine grapes-IrrYield (tons)	Wine grapes-NIrrYield (tons)
BRESSA	68,329	14.15%	C	0.37	15-50	6.7	1.75	26.5	53.5	20	2	-
HUGO	36,431	7.54%	B	0.37	30-50	6.5	4	39.2	37.3	23.5	1.5	-
COLE	31,688	6.56%	C	0.32-0.37	0-5	6.5-6.7	2.5	22.4-39.8	33.6-55.1	22.5-31	3.5-7	2.6-5
CLEAR_LAKE	27,185	5.63%	D	0.24-0.32	0-5	6.5-7	1.5-2.5	22.1-63.1	19.4-31	17.5-50	4	3
SUTHER	26,927	5.58%	C	0.37	15-50	5.8	1.5	39.2	37.3	23.5	1.5	-
YORKVILLE	26,703	5.53%	D	0.32	15-50	6.5-6.7	1.5	33.6	36.9	29.5	1.5	-
HAIRE	25,422	5.26%	C	0.32-0.43	0-30	5.6-6.7	0.75-2	34.2-68.8	16.2-37.3	15-33.5	4-8	2
BOOMER	24,972	5.17%	B	0.37	30-50	6.1-6.3	2	39.8	37.7	22.5	2	-
JOSEPHINE	24,811	5.14%	B	0.37	30-50	5.8	3.5	41.6	37.4	21	4	-
SOBRANTE	22,096	4.58%	C/B	0.32-0.49	30-50	6.1-6.3	2	43	39.5	17.5	1.5	-
KIDD	21,555	4.46%	D	0.24-0.37	2-75	6.1	2	38-43.6	43.3-43.9	12.5-18.5	1.5-2	-
LAUGHLIN	20,849	4.32%	C	0.37	30-50	5.8	3.5	41.4	37.1	21.5	1.5	-
BALE	16,005	3.31%	C	0.32-0.37	0-5	6.1	2	35.4-41.4	33.6-37.1	21.5-31	-	5-6
YOLO	15,816	3.27%	B	0.28-0.43	0-5	6.7	2	6.7-65.9	19.1-67.7	15-31	-	6
GOULDING	14,688	3.04%	D	0.37	30-50	6.1	1.5	34.2	37.3	28.5	1.5	-
WRIGHT	13,615	2.82%	C	0.37	0-9	5.8	2.5	43	39.5	17.5	-	2-3
PLEASANTON	9,059	1.88%	B	0.37	0-9	5-6.1	1.5	34.2-43	37.3-38.5	18.5-28.5	-	6
TALMAGE	7,545	1.56%	B	0.24	0-2	6.1-6.5	2	45.4-65.7	22.8-41.6	11.5-13	3.5-3.7	-
RED_HILL	7,113	1.47%	B	0.28	2-75	6.1	2	33.3-35.4	31.7-33.6	31-35	2.5-4	2-3
FELTA	6,735	1.39%	B	0.37	30-50	5.8	2	39.2	37.3	23.5	2	-
FELTON	5,340	1.11%	C	0.43	30-50	6.7	7.5	39.8	37.7	22.5	2	-
TEHAMA	5,265	1.09%	C	0.37	0-5	6.1	0.75	13.9	70.1	16	-	4
FAGAN	5,265	1.09%	C	0.32	30-50	6.1	2	35.4	33.6	31	4	-
COOMBS	5,080	1.05%	B	0.37	0-5	5.6	0.75	39.2	37.3	23.5	-	4
LOS_ROBLES	2,940	0.61%	B	0.37	0-5	7	2	35.4	33.6	31	-	15

REDVINE	2,538	0.53%	C	0.28	2-15	5.8	3.5	57	18	25	-	7.5-10
MANZANITA	2,473	0.51%	B	0.37	0-9	5.8	0.75	26.3	52.7	21	4	-
DIBBLE	2,370	0.49%	C	0.28-0.37	30-50	5.8-6.1	0.75	34.2-39.2	37.3	23.5-28.5	2	-
CORTINA	1,945	0.40%	A	0.24	0-5	7	0.75	44.3	40.7	15	3	-
DIABLO	1,133	0.23%	D	0.24	30-50	7.3	1.25-2.5	22.1	27.9	50	4	-
CLOUGH	1,045	0.22%	D	0.37	15-30	5.3	2.5	41.6	37.4	21	1.5	-

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