

## CALIFORNIA ROW CROP

This scenario is intended to represent general row crop production in the Central California Coast/Coastal Valleys Range, primarily MLRAs 14 & 15, and parts of MLRA 20, hereafter referred to as area of interest (AOI). Row crops include crops such as artichokes, carrots, beans, asparagus, celery, peppers, and spinach. Based on 2002 USDA Census of Agriculture data, approximately 230,480 acres of these crops was grown in California (USDA, 2002). Within the AOI, approximately 46% of the row crop acreage occurs in the counties of Monterey, Kern, Ventura, Santa Barbara, and San Luis Obispo. Monterey and Kern are the top producing counties in the state representing 35% of the total acreage (USDA, 2002).

Carrots are the most common row crop in the AOI, representing roughly 30% of the total acreage. Carrots are always direct seeded in a narrow groove, and sown in 6 or 8 lines in beds 38 to 42 inches wide on residue conditions (USDA 1999; Monterey County cooperative extension agent). Carrots are irrigated by sprinklers during the entire season at a maximum application rate of 0.63 cm/hr. (USDA 200a). Carrot plants have a maximum root depth of 18 inches and prefer deep, well drained sandy loams soils with a pH range of 5.5 and 7.0 (USDA 200a; Monterey County cooperative extension agent). In the coastal regions, the carrots are planted from December to August for harvest in April to January (Monterey County Cooperative Extension Agent). Carrots are mechanically harvested with self-propelled, multi-row harvesters.

Metfile W23234 (Santa Maria) is the meteorological data set used to representative Central California Coast/Coastal Valleys Range Row crop production. The station is located along the coast in Santa Barbara County within MLRA 15. It is roughly 106 miles to the south of Monterey County which contains the field used to represent this scenario. The Fresno station is approximately 20 miles closer to the geographic center of Monterey County, however the Santa Maria station was deemed more representative for several reasons. First, this scenario is generally a coastal scenario. Fresno is an inland station whereas the coastal Santa Maria station is more representative of the Coastal Climate of this scenario. In addition, the Santa Maria station receives approximately three inches more annual rainfall than the Fresno station, increasing the conservative nature of the scenario (NOAA, 2006).

The Mocho series is the most common row crop soil found in Central California Coast/Coastal Valleys Range accounting for 13% of row crop acreage (USDA, 2002; Table 5). It is a fine-loamy, mixed, superactive, thermic Fluventic Haploxerolls soil found on slopes of 0 to 9% (USDA, 2001), which includes the maximum slope on which row crops are grown (R. Smith, Personal Communication). The soils are mostly irrigated and intensively used for forage, field and truck crops, some fruit and dry areas are used for grain and range (USDA, 2001). Location and metfile selections are often the most important developments affecting scenario vulnerability and protectiveness. Metfile selection has been discussed above. Soil selection is also an important protectiveness factor. Based on USDA data, the majority (54%) of row crop bearing soils in the region are hydrologic group B soils. Discussions with a local expert indicates that row crops in the region are in limited to hydrological soil group A and B soils, with the Mocho series being representative of row crops in the region. The Mocho series was selected for this scenario because it is both highly representative of row crop bearing soils (R. Richards, personal communication) (Table 5), it represents the 90<sup>th</sup> percentile of vulnerability in erodibility, and it includes the maximum slope on which row crops are grown (R. Richards, personal communication) (Table 5). This scenario has been parameterized based on Mocho silt loams, 0-2 % slopes.

Mocho is a Hydrologic Group B soil, which does not include the 90<sup>th</sup> percentile of these soils in drainage based on soil survey data (USDA, 2006), however as noted above, local expert information indicated that row crops are limited to groups A and B. Because exposure scenarios are intended to represent the “high end” of what might occur in an actual agricultural setting, local expert knowledge and soil survey data led to the selection of Mocho soils. Mocho soils have a USLE K factor of 0.49, which is common to 10% of row crop bearing soils and includes the 90<sup>th</sup> percentile of these soils in erodibility. Approximately 77% of row crop bearing soils have a pH lower than Mocho soils (7.9-8.2). However, soil pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. Based on the

official soil series description (USDA, 2001), Mocho soils have an A horizon from 0 to 18 inches (0-46 cm) deep and a C horizon from 18 to 72 inches (46-183 cm) deep (USDA, 2001).

<b>Table 1. PRZM 3.12 Climate and Time Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Starting Date	Jan. 1, 1961	Meteorological File from Monterey County, California (Santa Maria) (W23234) NOAA, 2006
Ending Date	Dec. 31, 1991	Meteorological File from Monterey County, California (Santa Maria) (W23234) NOAA, 2006
Pan Evaporation Factor (PFAC)	0.75	PRZM Manual Figure 5.1. Value represents the central coast region.
Snowmelt Factor (SFAC)	0	The Weather Channel Interactive, Inc. (TWCII, 2006)
Minimum Depth of Evaporation (ANETD)	17.5 cm	PRZM Manual (EPA 1998)

<b>Table 2. PRZM 3.12 Erosion and Landscape Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	PRZM Manual (EPA, 1998)
USLE K Factor (USLEK)	0.49 tons EI <sup>-1</sup> *	USDA NRCS Soil Data Mart ( <a href="http://soildatamart.nrcs.usda.gov/">http://soildatamart.nrcs.usda.gov/</a> ) Value listed for the soil series Mocho.
USLE LS Factor (USLELS)	0.2	LS value for 1% slope and 400' slope length PRZM Manual (EPA, 1998)
USLE P Factor (USLEP)	0.6	Set to default 0.6 for row crops on 0-2% slopes with no contour plowing. Contour plowing is not common (R. Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties)
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	1	PRZM Manual Figure 5.12 (EPA, 1998) Type I, IREG=1
Slope (SLP)	1%	Slopes range from 0 to 2%. Set to the midpoint of the reported range. Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	2	Fields are sprinkler-irrigated during the entire growing season. (USDA, 200a)
Irrigation Type (IRTYP)	3 (sprinkler)	Fields are sprinkler-irrigated during the entire growing season. (USDA, 200a)
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).

<b>Table 2. PRZM 3.12 Erosion and Landscape Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Maximum Rate at which Irrigation is Applied (RATEAP)	0.1 cm hr <sup>-1</sup>	Set to default as per Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).
* EI = 100 ft-tons * in/ acre*hr		
<b>Table 3. PRZM 3.12 Crop Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Initial Crop (INICRP)	1	Set to one for all crops (EPA, 2004).
Initial Surface Condition (ISCOND)	3	3 = residue. Plant residue is left on the ground from previous crop. Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension Monterey, Santa Cruz and San Benito Counties
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)	0.25	PRZM manual Table 5-4 (EPA, 1998). Recommended value for soybeans (EPA, 2004).
Maximum Active Root Depth (AMXDR)	46 cm	Maximum rooting depth is 18 inches (46 cm). Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties
Maximum Canopy Coverage (COVMAX)	100	Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties
Soil Surface Condition After Harvest (ICNAH)	3	3 = residue. Plant residue is left on the ground from previous crop. Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties
Date of Crop Emergence (EMD, EMM, IYREM)	01/01	Emergence occurs from December thru July. Set to the first crop of the year. (R. Smith, Vegetable Crop and Weed Science Farm Advisor)
Date of Crop Maturity (MAD, MAM, IYRMAT)	01/04	Crops are harvested at maturity. Set to one week prior to harvest. (R. Smith, Vegetable Crop and Weed Science Farm Advisor)
Date of Crop Harvest (HAD, HAM, IYRHAR)	08/04	Harvest occurs from April thru December. Set to the first crop. (R. Smith, Vegetable Crop and Weed Science Farm Advisor)
Maximum Dry Weight (WFMAX)	0.0	Not used in scenario
Maximum Crop Height (HTMAX)	38	Maximum crop height is 15 inches (38). Richard Smith, Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension; Monterey, Santa Cruz and San Benito Counties
SCS Curve Number (CN)	86, 78, 82	Gleams Manual Table H-4 (USDA, 1990); fallow = SR/hydrologic group C; cropping and residue = SR+CT, poor condition. CT is used to grow row crops.

<b>Table 3. PRZM 3.12 Crop Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Manning's N Value (MNGN)	0.011	RUSLE Project; C24BGBGC for California Green Beans with conventional till (USDA, 200b). Data are from San Francisco, which is the closest RUSLE file with similar crop practices and coastal CA climate.
USLE C Factor (USLEC)	0.083 - 0.795	RUSLE Project; C24BGBGC for California Green Beans with conventional till (USDA, 200b). Data are from San Francisco, which is the closest RUSLE file with similar crop practices and coastal CA climate.

<b>Table 4. PRZM 3.12 Mocho Silt Loam, 0 To 2 Percent Slopes Soil Parameters for Monterey, California – Row Crop.</b>		
<b>Parameter</b>	<b>Value</b>	<b>Source/Comments</b>
Total Soil Depth (CORED)	173 cm	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> )
Number of Horizons (NHORIZ)	2	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> ). Horizon A spans scenario horizons 1 and 2 in order to conform to PRZM input requirements.
Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 163 cm (HORIZN = 2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> )
Bulk Density (BD)	1.35 g/cm <sup>3</sup> (HORIZN = 1) 1.35 g/cm <sup>3</sup> (HORIZN = 2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> ); values are mean 1/3-bar moist bulk densities of a soil sampled as a Mocho soil.
Initial Water Content (THETO)	0.283 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =1) 0.283 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> ); values are mean 1/3-bar water contents of a soil sampled as a Mocho soil.
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 1.0 cm (HORIZN = 2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> );
Field Capacity (THEFC)	0.283 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =1) 0.283 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> ); values are mean 1/3-bar water contents of a soil sampled as a Mocho soil.
Wilting Point (THEWP)	0.148 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =1) 0.148 cm <sup>3</sup> /cm <sup>3</sup> (HORIZN =2)	NRCS Soil Data Mart (SDM) ( <a href="http://soildatamart.nrcs.usda.gov">http://soildatamart.nrcs.usda.gov</a> ); values are mean 15-bar water contents of a soil sampled as a Mocho soil.
Organic Carbon Content (OC)	1.74% (HORIZN = 1) 1.74% (HORIZN = 2)	NRCS SDM; values = mean %OM / 1.724.

### *Sensitive Parameter Uncertainties*

#### Soil Data

Data sets on the Mocho series were used when possible, such as horizon depth and organic matter content values from the USDA NRCS Soil Data Mart (SDM) and Official Soil Series Descriptions (OSD). In general, the selection of a hydrological soil group C or D soil is preferred to yield “high end” runoff and erosion. In this case, a hydrologic group B soil has been justified for use based on discussions with local agricultural experts in the region, which indicated that row crops are limited to hydrological group A and B soils. Additional information would be required to reject the selection of hydrologic group B soil as a representative soil for this scenario.

**Table 5. General Row Crop Bearing Soils of Kern, Monterey, San Luis Obispo, Santa Barbara, and Ventura Counties (California) Ranked by Area.**

Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	% Clay	Yield				
											Arti-chokes	Carrots	Celery	Dry beans	D li be
MOCHO	65,338	12.78%	B	0.17-0.49	0-9	7.9-8.2	3	18.1-68.8	16.2-53.5	15-31	160	--	900	--	
SORRENTO	48,150	9.42%	B	0.15-0.32	0-9	7.3-7.5	3	18.1-65.9	19.1-50.9	15-31	--	1100	950	--	
SALINAS	47,008	9.20%	C/B	0.2-0.37	0-9	7-8.2	2.5	18.1-41.6	33.6-50.9	21-31	160	--	1000	--	
CROPLEY	46,171	9.03%	D/C	0.15-0.28	0-9	7-8.2	2	5.3-22.1	27.9-44.7	50	--	--	860	--	4
CHUALAR	44,295	8.67%	B	0.32	0-9	7	2.5	44.8	41.2	14	--	1120	--	--	
LOS OSOS	42,586	8.33%	C	0.17-0.32	5-30	6.1-6.7	2.5-3	35.4-39.2	33.6-37.3	23.5-31	--	--	--	--	
DIABLO	37,969	7.43%	D	0.15-0.24	5-30	7.3-7.5	2.5	22.1-23.3	27.9-29.2	47.5-50	--	--	830-920	--	18
LOCKWOOD	37,430	7.32%	B	0.43-0.49	0-9	6.5	3.5	39.8	37.7	22.5	--	1200	--	--	6
ARROYO SECO	22,040	4.31%	B	0.37	0-9	7.3	2	45.4-67.4	19.6-41.6	13	--	1060	770-800	--	
PACHECO	15,835	3.10%	C	0.32	0-2	7.3-7.9	3	18.1-35.4	33.6-50.9	31	--	--	825	--	
HUENEME	11,869	2.32%	C	0.24	0-2	7.9	1.25	67.9-83.5	9-19.6	7.5-12.5	--	--	800	--	4
LEWKALB	11,580	2.27%	C	0.32	0-2	8.2	0.25	68.3	19.7	12	--	525	--	--	
BOTELLA	11,429	2.24%	B	0.2-0.28	0-9	6.5	3-4	34.2-41.6	33.6-37.4	21-31	--	--	1000	--	
DOCAS	10,930	2.14%	B	0.43	0-9	8.2	2	6.9	62.1	31	--	1160	--	--	
MARINA	10,843	2.12%	B	0.24	0-9	5.8	0.75	96	1.5	2.5	--	--	600-680	--	
ANACAPA	8,355	1.63%	B	0.28	0-9	7.2	2	67.9	19.6	12.5	--	--	875	--	
ELKHORN	8,120	1.59%	B/C	0.32	2-30	6.3-6.5	2-4	65.4-67.3	19.6-20.2	12.5-15	90-120	1120-1160	870-900	--	
DANVILLE	8,025	1.57%	C	0.37	0-9	7	2.5	57	18	25	--	1000	925	--	
GLORIA	6,635	1.30%	D	0.37	2-15	6.2	1.25	65.9	19.1	15	--	1040	--	--	
MARIMEL	5,300	1.04%	D/C	0.15-0.28	0-2	7.5	3	18.1-55.1	17.4-50.9	27.5-31	--	--	700-1000	--	
TUJUNGA	4,943	0.97%	A	0.24-0.28	0-5	7-7.2	0.75	80.5-96.8	0.7-17	2.5	--	--	--	42	
MOCHO	1,845	0.36%	A	0.24	0-2	7.9	1.5	70.5	16.5	13	--	--	900	20	

VARIANT															
SAN BENITO	1,654	0.32%	B	0.2	9-15	7.2	2.5	35.4	33.6	31	--	--	--	--	
BAYSHORE	1,435	0.28%	B	0.28	0-2	8.2	2.5	18.1	50.9	31	140	--	--	--	
CHESTERTON	1,318	0.26%	D	0.37	5-15	6.1	0.75	67.8	22.2	10	--	--	740	--	

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