

New Jersey / Eastern Pennsylvania Outdoor Ornamental Nursery Scenario

This scenario is one of a suite of scenarios intended to represent outdoor ornamental nursery scenarios in the United States. It should be noted that nurseries are diverse and represent a range of topographic, cultivation, and plant types. Scenarios, when possible have been developed to represent conservative nursery practices that will yield “high-end” runoff, but not unrealistic of actual nurseries in the area. Similarly, selection of curve numbers are based on best available data from TR-55 until further calibration can be performed using regional runoff data, which at the time of scenario development is generally unavailable for nurseries. Figure 1 provides an overview of available curve numbers from TR-55 in order to provide context to the relative magnitude of the curve number used in this scenario. The closest curve number that could be associated with outdoor nurseries is for “farmsteads”, due to similar cover conditions. Curve numbers are generally among the highest available, exceeded primarily by soils in poor condition.

This scenario is parameterized to generally represent outdoor ornamental nursery production in New Jersey and Eastern Pennsylvania. The scenario nominally represents outdoor ornamental nurseries in Cumberland County, NJ since it is the county with the most number of acres in production in the region. In 2002, the state of New Jersey ranked 8th in the U.S. for total number of ornamental nursery acres in the outdoors (i.e., not under glass), with nearly 25 thousand acres in the open (USDA 2002a). In 2002, Pennsylvania ranked 5th in the U.S. for outdoor nursery acreage. In New Jersey, approximately 25% (6,410 acres) of the total acreage is located in Cumberland County. Most of the nurseries in the regions are wholesale (J. Johnson, personal communication). Nursery stock is an important agricultural commodity in Cumberland County. In 2002, Cumberland was the top nursery stock producing county in the state and the fourth largest in the U.S (USDA 2002b). The total value of agricultural products sold in Cumberland County in 2002 was approximately 123 million dollars, of which approximately 50% of the revenue was generated from the sale of Christmas trees, nursery, and greenhouse crops (USDA 2002b). MLRA 149A dominates Cumberland county and much of New Jersey.

Plants cultivated by outdoor nurseries are diverse, with approximately 1500 varieties of plants grown in local nurseries (J. Johnson, personal communication). For this scenario, crop parameters have been selected when possible to be representative of typical outdoor nursery practices in New Jersey / Eastern Pennsylvania. Most nurseries in the region are wholesale in nature (J. Johnson, personal communication). According to the USDA 2003 nursery crops summary (USDA, 2004), the most commonly produced nursery plants in New Jersey are broadleaf evergreens (3 million plants). Irrigation is often used. Methods include overhead guns, travelers, trickle center pivots, and mini-sprinklers (J. Johnson, personal communication).

Metfile W93730 is the closest meteorological station to Cumberland County, NJ and is within approximately 31 miles of the county centroid. Its data were collected in

Atlantic City, NJ located in the southern part of the state. The station is located approximately 20 meters above mean sea level (AMSL). Atlantic City receives an average rainfall of 41 inches (NOAA, 2006).

Exact locations and geographic extent of nurseries in the region are not available; therefore soils were selected based on soil recommendations from local experts, the geographic extent of the listed soils in the area, the drainage group, slope, and erodibility. In developing this scenario, preference was given to selecting a benchmark soil that is in hydrologic group “C” or “D”, and is capable of supporting outdoor nurseries (EPA, 2004). Based on local information, most of the nurseries are grown on moderately well to well drained soils. Most of the nurseries are located on sandy loam or silt loam soils (J. Johnson, personal communication). The Woodstown series was selected for this scenario since it is a sandy loam, is of large extent in the region (USDA, 2002c) and is the most common benchmark soil in Cumberland County that is also in hydrologic group C.

Woodstown is a Hydrologic Group C soil, and represents approximately 3% of the soils in Cumberland County. Woodstown soils have a USLE K factor of 0.28, which is within the range of the four most common soils in Cumberland County (Table 5). Nearly all of the soils in Cumberland County have a pH lower than Cumberland soils. 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 soils series description, Woodstown soils have an A horizon from 0 to 7 inches (0-18 cm) deep, an E horizon from 7 to 11 inches (18-28 cm) deep, a B horizon from 11 to 29 inches (28-74 cm) deep, and a C horizon from 29 to 70 inches (74-178 cm) deep (USDA, 2002c).

Table 1. PRZM 3.12 Climate and Time Parameters for Eastern Pennsylvania and New Jersey – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File Atlantic City, NJ (W93730)
Ending Date	Dec. 31, 1990	Meteorological File Atlantic City, NJ (W93730)
Pan Evaporation Factor (PFAC)	0.77	PRZM Manual Figure 5.1. Value represents most of southern New Jersey.
Snowmelt Factor (SFAC)	0.16	PRZM Manual Table 5-1. Max of the min range of values for mixed coniferous/deciduous open areas.
Minimum Depth of Evaporation (ANETD)	17.5 cm	PRZM Manual Figure 5.2 (EPA, 1998) Set to guidance default for free draining soils.

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Eastern Pennsylvania and New Jersey – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	PRZM Manual (EPA, 1998)
USLE K Factor (USLEK)	0.28	USDA NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/) Value listed for the soil series Woodstown.
USLE LS Factor (USLELS)	0.5	LS equation (Haan and Barfield, 1978) LS value for 2.5% slope and 400' slope length
USLE P Factor (USLEP)	1.0	Set to 1.0 for orchards as per PRZM Scenario Guidance (EPA, 2004).
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	4	PRZM Manual Figure 5.12 (EPA, 1998)
Slope (SLP)	2.5%	Jerry Johnston, Rutgers Cooperative Research and Extension. Midpoint of the range (0-5%) for Woodstown soils. PRZM Scenario Guidance (EPA, 2004).
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	2	
Irrigation Type (IRTYPE)	3 (Sprinkler)	All types are used, including sprinkler. James Johnson, Ornamental Horticulture Agent, Rutgers Cooperative Research and 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 New Jersey / Eastern PA – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Initial Crop (INICRP)	1	Default value
Initial Surface Condition (ISCOND)	2	2 = cover crop. James Johnson, Ornamental Horticulture Agent, Rutgers Cooperative Research and Extension. Grass is used extensively.
Number of Different Crops (NDC)	1	Set to number of crops in simulation. Default value.
Number of Cropping Periods (NCPDS)	30	Set to weather data in meteorological file: Atlantic City, NJ (W93730)
Maximum rainfall interception storage of crop (CINTCP)	0.1	Table 5-4 PRZM manual, light density crops (EPA, 1998).
Maximum Active Root Depth (AMXDR)	203 cm	James Johnson, Ornamental Horticulture Agent, Rutgers Cooperative Research and Extension. Maximum rooting could be as much as 7 feet. Set to the maximum soil depth of the listed series.

Table 3. PRZM 3.12 Crop Parameters for New Jersey / Eastern PA – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Maximum Canopy Coverage (COVMAX)	60%	Based on high-resolution color aerial photography of ornamental nurseries in Cumberland county.
Maximum Canopy Height (HTMAX)	183 cm (6ft)	Height varies widely as many different cultivars are grown. Transplants may be up to 6ft tall (Halcomb 2002)
Soil Surface Condition After Harvest (ICNAH)	2	2 = cover crop. James Johnson, Ornamental Horticulture Agent, Rutgers Cooperative Research and Extension. Grass is used extensively.
Date of Crop Emergence (EMD, EMM, IYREM)	01/01/61	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Date of Crop Maturity (MAD, MAM, IYRMAT)	02/01/61	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Date of Crop Harvest (HAD, HAM, IYRHAR)	31/12/61	Values are set to keep E/T and canopy coverage terms working correctly for this evergreen scenario.
Maximum Dry Weight (WFMAX)	0.0	Not used in scenario
SCS Curve Number (CN)	82, 82, 82	TR-55, Table 2-2c (USDA 1986). Value for farmsteads, buildings, lanes, driveways, and surrounding lots.
Manning's N Value (MNGN)	0.023	RUSLE Project; Sb5OCOCM for York, PA orchards with cover in alleyways (USDA, 2000). These data were used to approximate values for nurseries in eastern PA and New Jersey as no data for ornamental nurseries were included in the project.
USLE C Factor (USLEC)	0.056 - 0.258	RUSLE Project; Sb5OCOCM for York, PA orchards with cover in alleyways (USDA, 2000). These data were used to approximate values for nurseries in eastern PA and New Jersey as no data for ornamental nurseries were included in the project. Note: RUSLE dates and C factors from the RUSLE project have been reordered and tied to emergence dates.

Table 4. PRZM 3.12 Woodstown Sandy Loam Soil Parameters for Cumberland County, New Jersey – Ornamental Nurseries		
Parameter	Value	Source/Comments
Total Soil Depth (CORED)	203 cm	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov)
Number of Horizons (NHORIZ)	6	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Top horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements. PRZM Scenario Guidance (EPA, 2004).
Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 10 cm (HORIZN = 2) 46 cm (HORIZN = 3) 10 cm (HORIZN = 4) 15 cm (HORIZN = 5) 112 cm (HORIZN = 6)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Top horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements. PRZM Scenario Guidance (EPA, 2004).
Bulk Density (BD)	1.55 g/cm ³ (HORIZN = 1) 1.55 g/cm ³ (HORIZN = 2) 1.55 g/cm ³ (HORIZN = 3) 1.50 g/cm ³ (HORIZN = 4) 1.55 g/cm ³ (HORIZN = 5) 1.60 g/cm ³ (HORIZN = 6)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Midpoint of the reported range. PRZM Scenario Guidance (EPA, 2004).

Initial Water Content (THETO)	0.165 cm ³ /cm ³ (HORIZN =1) 0.165 cm ³ /cm ³ (HORIZN =2) 0.189 cm ³ /cm ³ (HORIZN =3) 0.232 cm ³ /cm ³ (HORIZN =4) 0.187 cm ³ /cm ³ (HORIZN =5) 0.120 cm ³ /cm ³ (HORIZN =6)	NRCS Soil Data Mart (SDM); values are mean 1/3-bar water contents of Woodstown soils. (EPA, 2004).
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 5.0 cm (HORIZN = 2) 2.0 cm (HORIZN = 3) 5.0 cm (HORIZN = 4) 5.0 cm (HORIZN = 5) 4.0 cm (HORIZN = 6)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). PRZM Scenario Guidance (EPA, 2004).
Field Capacity (THEFC)	0.165 cm ³ /cm ³ (HORIZN =1) 0.165 cm ³ /cm ³ (HORIZN =2) 0.189 cm ³ /cm ³ (HORIZN =3) 0.232 cm ³ /cm ³ (HORIZN =4) 0.187 cm ³ /cm ³ (HORIZN =5) 0.120 cm ³ /cm ³ (HORIZN =6)	NRCS Soil Data Mart (SDM); values are mean 1/3-bar water contents of Woodstown soils. PRZM Scenario Guidance (EPA, 2004).
Wilting Point (THEWP)	0.071 cm ³ /cm ³ (HORIZN =1) 0.071 cm ³ /cm ³ (HORIZN =2) 0.097 cm ³ /cm ³ (HORIZN =3) 0.152 cm ³ /cm ³ (HORIZN =4) 0.095 cm ³ /cm ³ (HORIZN =5) 0.036 cm ³ /cm ³ (HORIZN =6)	NRCS Soil Data Mart (SDM); values are mean 15-bar water contents of Woodstown soils. PRZM Scenario Guidance (EPA, 2004).
Organic Carbon Content (OC)	0.87% (HORIZN = 1) 0.87% (HORIZN = 2) 0.15% (HORIZN = 3) 0.06% (HORIZN = 4) 0.06% (HORIZN = 5) 0.06% (HORIZN = 6)	NRCS SDM; values for horizons 1 to 3 = mean %OM / 1.724. PRZM Scenario Guidance (EPA, 2004).

Sensitive Parameter Uncertainties

Meteorological File

As characterized above, Metfile W93730 (Atlantic City, NJ) is the closest metfile to Warren County, which was used to represent this scenario. The metfile is located approximately 31 miles from center of Cumberland County and is generally representative of the area.

Slope

The scenario USLELS value was calculated with the Haan and Barfield equation (1978) using a 2.5% slope and an assumed 400-foot slope length, as per PRZM scenario development guidance (EPA, 2004). A slope of 2.5% was selected because it is midpoint of the range for Woodstown soils according to USDA (USDA 2006). This value is also verified by a local extension agent which indicated maximum slopes for nurseries are 5 percent. This scenario may underestimate runoff for nurseries located on slopes greater than percent.

USLE C Factor and Manning's N Value

The RUSLE Project does not include data for ornamental nursery crops. Therefore, USLE C Factor and Manning's N values were selected from data on York Pennsylvania orchards with cover in the alleyways, due to the similarities between conditions. Personal communication with the local extension agent indicates that most nurseries use grass cover extensively between rows. Of the available locations, York Pennsylvania has the most similar meteorological conditions and cover in alley ways as this scenario.

Soil Data

No geospatial data were available to determine the exact locations and geographic extent of nurseries in the region. The USGS GIRAS Landuse/Landcover data for the Conterminous United States includes a nurseries classification; however the data are generally 25 years old at the time of this scenario development and preliminary review of the data indicates that nurseries are not well represented. This is likely due to the resolution of the data (30 m) and age of the data set (based on 1970's and 80's imagery). As a result, soils were selected based on soil recommendations of local experts, the geographic extent of the listed soils in the area, the drainage group, slope, and erodibility. The soil selected is a hydrologic group C soil.

Crop Parameters

Outdoor ornamental nurseries are highly diverse in the numbers, sizes, and types of plants grown. Ornamental nurseries also vary in the cultivation methods which can range from potted plants (container operations) to field nurseries that may harvest and package plants as bare root or balled and burlapped. This scenario has been parameterized to be representative of the most "typical" nursery plants in the area (see description above). Runoff and erosion may be over or underestimated depending on the type of nursery modeled and a sensitivity analysis has high value in this regard.

Curve Number

The curve number is the most sensitive parameter in PRZM scenarios. The curve number for this scenario was based on TR-55 (Table 2-2c). Nurseries can be covered in roads, wooded areas, field borders, and buildings. Therefore the curve number closest to this scenario was the value for a hydrologic group C soil representative of farmsteads, buildings, lanes, driveways, and surrounding lots. Runoff and erosion may be under or over-estimated for alternative nursery operations and model validation has high value in this regard. Based on preliminary investigation, no runoff data are available for validating runoff from outdoor nursery operations in this geographic area.

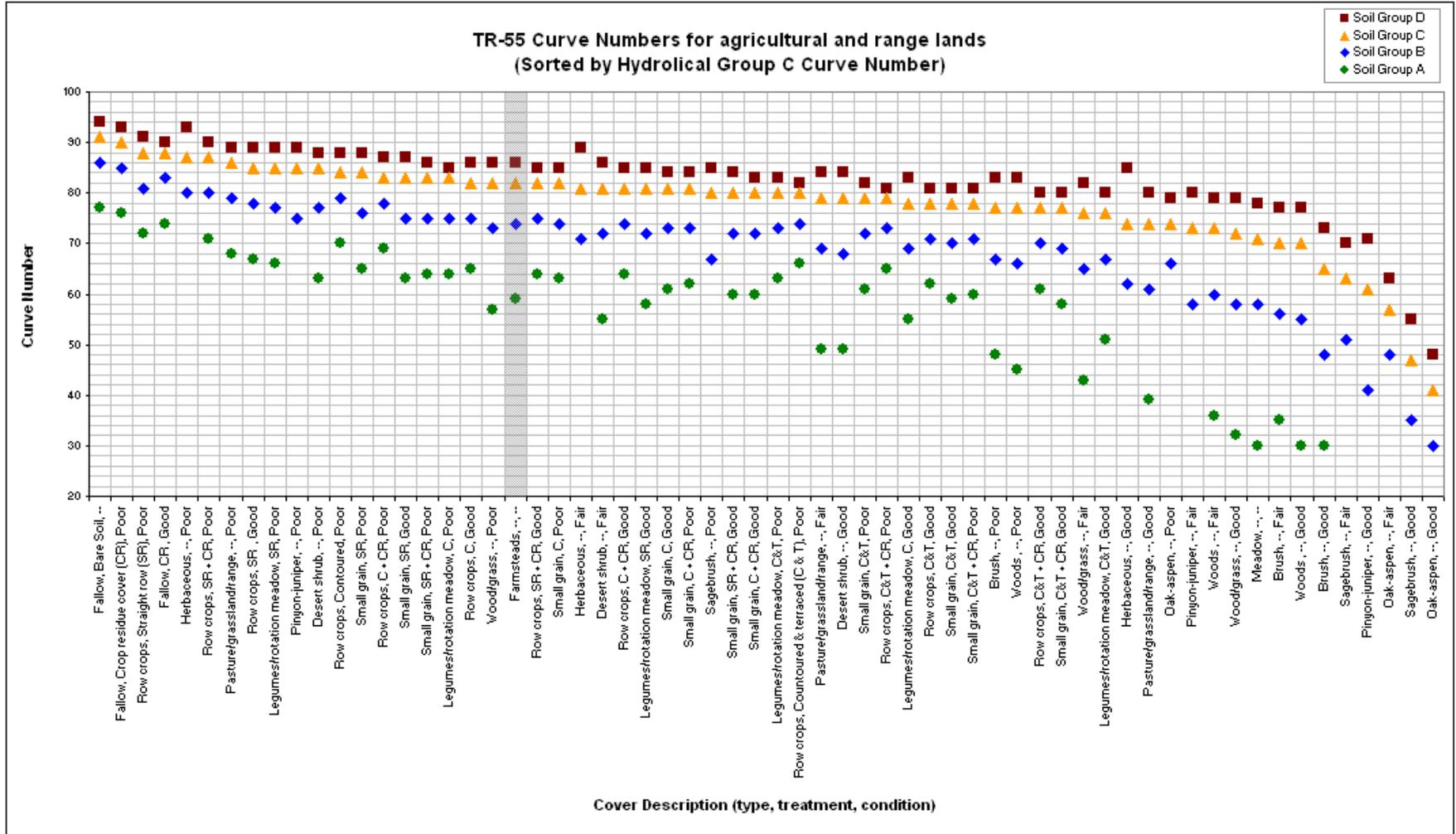


Figure 1. TR-55 (USDA, 1986) Farmstead curve number used for scenario development relative to other available cover types, soil treatments, and conditions.

Table 5. Soils of Cumberland County, New Jersey Ranked by Area^{a,b}.

Soil	Total Acres	% Area	Hydrologic Group	Erodibility	Slope	pH	OM	Sand	Silt	Clay
Downer	39587	13.1%	B	0.2-0.28	0-10	5.8-6.3	1.25-2	65-80	15-25	5-12
Aura	38617	12.8%	B	0.2-0.28	0-5	4-6	0.1-2	67-80	15-23	5-13.5
Hammonton	28304	9.4%	B	0.2-0.32	0-5	4.5-5.5	2	68.5-80	15-24	5-7.5
Sassafras	26062	8.6%	B	0.2-0.28	0-10	4.6-6.3	1.5-2	65-68.5	23-25	7.5-12
Berryland	23834	7.9%	B/D	0.1	0-2	4.3	3	91.5	5	3.5
Transquaking	20539	6.8%	D	0.02	0-1	-	70	7.2	47.8	45
Manahawkin	16513	5.5%	D	0.05	0-2	4.8	55	91.5	5	3.5
Evesboro	14632	4.9%	A	0.1-0.17	0-15	4.3	0.75	91.5-96	1.5-5	2.5-3.5
Appoquinimink	14194	4.7%	D	0.37	0-1	6.5	10.5	11.4	68.6	20
Matapeake	12020	4.0%	B	0.43	0-10	5	1.5	14.3	72.7	13
Woodstown	10035	3.3%	C	0.28	0-5	6.4	1.5	67	25	8
Chillum	9454	3.1%	B	0.43	0-5	5	2	13.8	69.7	16.5
Fallsington	7163	2.4%	B/D	0.05	0-2	4	85	65	23	12
Galloway	6668	2.2%	B	0.17	0-5	4.3	2	83.8	9.2	7
Mattapex	6315	2.1%	C	0.43	0-5	4.6	1.75	14.2	71.8	14
Pawcatuck	6206	2.1%	D	0.02	0-1	-	55	81.1	8.9	10
Mispillion	4429	1.5%	D	0.02	0-1	-	55	24	51	25
Fort Mott	4379	1.5%	A	0.2	0-5	4.6	1.25	83.5	9	7.5
Lakewood	3040	1.0%	A	0.1	0-5	4.3	1.5	91.5	5	3.5
Broadkill	2762	0.9%	D	0.02	0-1	6.5	30	11.4	68.6	20
Atsion	2545	0.8%	C/D	0.05	0-2	3.6	85	91.5	5	3.5
Lakehurst	2371	0.8%	A	0.05	0-5	3.6	85	91.5	5	3.5
Othello	1558	0.5%	C/D	0.05-0.37	0-2	4-5	1.5-85	13.9-30	60-70.6	10-15.5
Psamments, wet substratum	177	0.1%	A	0.2	0-5	4.3	0	91.6	6.4	2
Psamments	32	0.0%	A	0.2	0-2	4.3	0	91.6	6.4	2
Udorthents	16	0.0%	D	0.37	0-8	6.5	4	13.9	70.6	15.5
Chicone	11	0.0%	D	0.37	0-1	5.3	3	28	60	12

Notes:

^a pH, OM, Sand, Silt, and Clay are based on representative values from USDA Soil Data Mart.^b Table excludes areas for mines and water

“-” = No data.

Literature Cited

- EPA. 1998. Carsel, R.F., J.C. Imhoff, P.R. Hummel, J.M. Cheplick, and A.S. Donigian, Jr. PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0. National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA.
- EPA. 1999. Jones, R.D., J. Breithaupt, J. Carleton, L. Libelo, J. Lin, R. Matzner, and R. Parker. Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessments. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC.
- EPA. 2004. Abel, S.A. Procedure for Conducting Quality Assurance and Quality Control of Existing and New PRZM Field and Orchard Crop Standard Scenarios. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. Revised 2004.
- Haan, C.T. and B.J. Barfield. 1978. Hydrology and Sedimentology of Surface Mined Lands. Office of Continuing Education and Extension, College of Engineering, University of Kentucky, Lexington KY 40506. pp 286.
- NOAA. 2006. Climate Normals at Major Weather Observing Stations in all 50 States, Puerto Rico, and Pacific Islands. National Oceanic and Atmospheric Administration (NOAA), Environmental Satellite, Data, and Information Service. Online at: <http://www1.ncdc.noaa.gov/pub/data/ccd-data>.
- USDA. 1986. Urban Hydrology for Small Watersheds. United States Department of Agriculture, Natural Resources Conservation Service. Technical Release 55.
- USDA. 2000. Revised Universal Soil Loss Equation (RUSLE) EPA Pesticide Project. U.S. Department of Agriculture, National Resources Conservation Service (NRCS) and Agricultural Research Service (ARS).
- USDA. 2002a. 2002 Census of Agriculture. U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). Online at: <http://www.nass.usda.gov/census/census02/preliminary/2002censusdates.htm>.
- USDA. 2002b. Census of Agriculture County Profile for Cumberland County, New Jersey. United States Department of Agriculture, New Jersey Agricultural Statistics Service. Online at: <http://www.nass.usda.gov/census/census02/profiles/nj>.

USDA. 2002c. Official Series Description – WOODSTOWN Series. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). October. 2006. Online at: www2.ftw.nrcs.usda.gov/osd/dat/W/WOODSTOWN.html.

USDA. 2004. Nursery Crops 2003 Summary. United States Department of Agriculture National Agricultural Statistics Service. October. 2006. Online at: <http://usda.mannlib.cornell.edu/usda/nass/NursProd//2000s/2004/NursProd-07-26-2004.txt>.

USDA. 2006. Soil Survey Areas of Cumberland County, New Jersey. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), Soil Data Mart. October 2, 2006. Online at: <http://soildatamart.nrcs.usda.gov>.

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