CHAPTER 22

SWAT INPUT DATA: .SOL

The soils data used by SWAT can be divided into two groups, physical characteristics and chemical characteristics. The physical properties of the soil govern the movement of water and air through the profile and have a major impact on the cycling of water within the HRU. Inputs for chemical characteristics are used to set initial levels of the different chemicals in the soil. While the physical properties are required, information on chemical properties is optional. The soil input (.sol) file defines the physical properties for all layers in the soil.

Following is a brief description of the variables in the soil input file. They are listed in the order they appear within the file. The soil input file will hold data for up to 25 layers.

Variable name	Definition
TITLE/TEXT	The first line of the .sol file is reserved for user comments. The comments may take up to 80 spaces. The title line is not processed by the model and may be left blank. Optional.
SNAM	Soil name. The soil name is printed in HRU summary tables. Optional.
HYDGRP	Soil hydrologic group (A, B, C, or D). Required only for the SWAT ArcView interface. The U.S. Natural Resource Conservation Service (NRCS) classifies soils into four hydrologic groups based on infiltration characteristics of the soils. NRCS Soil Survey Staff (1996) defines a hydrologic group as a group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that impact the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to seasonally high water table, saturated hydraulic conductivity, and depth to a very slowly permeable layer. The definitions for the different classes are: A Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of sands or gravel that are deep and well to excessively drained. These soils have a high rate of water transmission (low runoff potential). B Soils having moderate infiltration rates when thoroughly wetted, chiefly moderately deep to deep, moderately well to well drained, with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Variable name	Definition
HYDGRP, cont.	C Soils having slow infiltration rates when thoroughly wetted, chiefly with a layer that impedes the downward movement of water or of moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission (high runoff potential).
	D Soils having very slow infiltration rates when thoroughly wetted, chiefly clay soils with a high swelling potential; soils with a high permanent water table; soils with a clay pan or clay layer at or near the surface; and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.
	Guidelines used by USDA Soil Survey to categorize soils into Hydrologic Groups are summarized in Table 22-1.

Table 22-1: Hydrologic Group Rating Criteria

	Hydrologic Soil Groups			
Criteria[*]	**A**	**B**	**C**	**D**
Final constant infiltration rate (mm/hr)	7.6-11.4	3.8-7.6	1.3-3.8	0-1.3
Mean permeability: surface layer (mm/hr)	> 254.0	84.0-254.0	8.4-84.0	< 8.4
Mean permeability: most restrictive layer below the surface layer to a depth of 1.0 m (mm/hr)	> 254.0	84.0-254.0	8.4-84.0	< 8.4
Shrink-swell potential: most restrictive layer[**]	Low	Low	Moderate	High, Very High
Depth to bedrock or cemented pan (mm)	> 1016	> 508	> 508	< 508
DUAL HYDROLOGIC GROUPS	**A/D**	**B/D**	**C/D**	
Mean depth to water table (m)	< 0.61	< 0.61	< 0.61	

[*] These criteria are guidelines only. They are based on the theory that the minimum permeability occurs within the uppermost 50 cm. If the minimum permeability occurs between a depth of 50 to 100 cm, then the Hydrologic Soil Group is increased one group. For example, C to B. If the minimum permeability occurs below a depth of 100 cm, the Hydrologic Soil Group is based on the permeability above 100 cm, using the rules previously given.

[**] Shrink-swell potential is assigned to a profile using the following guidelines:

Low: All soils with sand, loamy sand, sandy loam, loam or silt loam horizons that are at least 50 cm thick from the surface without a clay horizon within 100 cm of the surface.

Medium: All soils with clay loam horizons within 50 cm of the surface or soils with clay horizons from 50 to 100 cm beneath the surface.

High: All soils with clay horizons within 50 cm of the surface. Lower the shrink-swell potential one class when kaolinite clay is dominant.

Variable name	Definition
SOL_ZMX	Maximum rooting depth of soil profile (mm). If no depth is specified, the model assumes the roots can develop throughout the entire depth of the soil profile. Required
ANION_EXCL	Fraction of porosity (void space) from which anions are excluded. Most soil minerals are negatively charged at normal pH and the net interaction with anions such as nitrate is a repulsion from particle surfaces. This repulsion is termed negative adsorption or anion exclusion. Anions are excluded from the area immediately adjacent to mineral surfaces due to preferential attraction of cations to these sites. This process has a direct impact on the transport of anions through the soil for it effectively excludes anions from the slowest moving portion of the soil water volume found closest to the charged particle surfaces (Jury et al, 1991). In effect, the net pathway of the anion through the soil is shorter than it would be if all the soil water had to be used (Thomas and McMahon, 1972). If no value for ANION_EXCL is entered, the model will set ANION_EXCL = 0.50. Optional.
SOL_CRK	Potential or maximum crack volume of the soil profile expressed as a fraction of the total soil volume. To accurately predict surface runoff and infiltration in areas dominated by Vertisols, the temporal change in soil volume must be quantified. Bronswijk (1989, 1990) outlines methods used to determine the maximum crack volume. Optional.
TEXTURE	Texture of soil layer. This data is not processed by the model and the line may be left blank. Optional.

Variable name	Definition
SOL_Z(layer #)	Depth from soil surface to bottom of layer (mm). Required.
SOL_BD(layer #)	Moist bulk density (Mg/m^3 or g/cm^3). The soil bulk density expresses the ratio of the mass of solid particles to the total volume of the soil, $\rho_b = M_S / V_T$. In moist bulk density determinations, the mass of the soil is the oven dry weight and the total volume of the soil is determined when the soil is at or near field capacity. Bulk density values should fall between 1.1 and 1.9 Mg/m^3. Required.
SOL_AWC(layer #)	Available water capacity of the soil layer (mm H_2O/mm soil). The plant available water, also referred to as the available water capacity, is calculated by subtracting the fraction of water present at permanent wilting point from that present at field capacity, $AWC = FC - WP$ where AWC is the plant available water content, FC is the water content at field capacity, and WP is the water content at permanent wilting point. Available water capacity is estimated by determining the amount of water released between in situ field capacity (the soil water content at soil matric potential of -0.033 MPa) and the permanent wilting point (the soil water content at soil matric potential of -1.5 MPa). Required.
SOL_K(layer #)	Saturated hydraulic conductivity (mm/hr). The saturated hydraulic conductivity, K_{sat}, relates soil water flow rate (flux density) to the hydraulic gradient and is a measure of the ease of water movement through the soil. K_{sat} is the reciprocal of the resistance of the soil matrix to water flow. Required.
SOL_CBN(layer #)	Organic carbon content (% soil weight). When defining by soil weight, the soil is the portion of the sample that passes through a 2 mm sieve. Required.

Variable name	Definition
SOL_CLAY(layer #)	Clay content (% soil weight). The percent of soil particles which are < 0.002 mm in equivalent diameter. Required.
SOL_SILT(layer #)	Silt content (% soil weight). The percentage of soil particles which have an equivalent diameter between 0.05 and 0.002 mm. Required.
SOL_SAND(layer #)	Sand content (% soil weight). The percentage of soil particles which have a diameter between 2.0 and 0.05 mm. Required.
SOL_ROCK(layer #)	Rock fragment content (% total weight). The percent of the sample which has a particle diameter > 2 mm, i.e. the percent of the sample which does not pass through a 2 mm sieve. Required.
SOL_ALB(top layer)	Moist soil albedo. The ratio of the amount of solar radiation reflected by a body to the amount incident upon it, expressed as a fraction. The value for albedo should be reported when the soil is at or near field capacity. Required.
USLE_K(top layer)	USLE equation soil erodibility (K) factor (units: 0.013 (metric ton m2 hr)/(m3-metric ton cm)). Some soils erode more easily than others even when all other factors are the same. This difference is termed soil erodibility and is caused by the properties of the soil itself. Wischmeier and Smith (1978) define the soil erodibility factor as the soil loss rate per erosion index unit for a specified soil as measured on a unit plot. A unit plot is 22.1-m (72.6-ft) long, with a uniform length-wise slope of

Variable name	Definition
USLE_K, cont.	9-percent, in continuous fallow, tilled up and down the slope. Continuous fallow is defined as land that has been tilled and kept free of vegetation for more than 2 years. The units for the USLE soil erodibility factor in MUSLE are numerically equivalent to the traditional English units of 0.01 (ton acre hr)/(acre ft-ton inch).
	Wischmeier and Smith (1978) noted that a soil type usually becomes less erodible with decrease in silt fraction, regardless of whether the corresponding increase is in the sand fraction or clay fraction.
	Direct measurement of the erodibility factor is time consuming and costly. Wischmeier et al. (1971) developed a general equation to calculate the soil erodibility factor when the silt and very fine sand content makes up less than 70% of the soil particle size distribution.

$$K_{USLE} = \frac{0.00021 \cdot M^{1.14} \cdot (12 - OM) + 3.25 \cdot (c_{soilstr} - 2) + 2.5 \cdot (c_{perm} - 3)}{100}$$

where KUSLE is the soil erodibility factor, M is the particle-size parameter, OM is the percent organic matter (%), csoilstr is the soil structure code used in soil classification, and cperm is the profile permeability class.

The particle-size parameter, M, is calculated

$$M = (m_{silt} + m_{vfs}) \cdot (100 - m_c)$$

where msilt is the percent silt content (0.002-0.05 mm diameter particles), mvfs is the percent very fine sand content (0.05-0.10 mm diameter particles), and mc is the percent clay content (< 0.002 mm diameter particles).
The percent organic matter content, OM, of a layer can be calculated:

$$OM = 1.72 \cdot orgC$$

where orgC is the percent organic carbon content of the layer (%).

Variable name	Definition
USLE_K, cont.	Soil structure refers to the aggregation of primary soil particles into compound particles which are separated from adjoining aggregates by surfaces of weakness. An individual natural soil aggregate is called a ped. Field description of soil structure notes the shape and arrangement of peds, the size of peds, and the distinctness and durability of visible peds. USDA Soil Survey terminology for structure consists of separate sets of terms defining each of these three qualities. Shape and arrangement of peds are designated as type of soil structure; size of peds as class; and degree of distinctness as grade. Angular Blocky: bounded by planes intersecting at relatively sharp angles Subangular Blocky: having mixed rounded and plane faces with vertices mostly rounded The soil-structure codes for the equation are defined by the type and class of soil structure present in the layer. There are four primary types of structure, several of which are further broken down into subtypes: -Platy, with particles arranged around a plane, generally horizontal -Prismlike, with particles arranged around a verticle line and bounded by relatively flat vertical surfaces Prismatic: without rounded upper ends Columnar: with rounded caps -Blocklike or polyhedral, with particles arranged around a point and bounded by flat or rounded surfaces which are casts of the molds formed by the faces of surrounding peds -Spheroidal or polyhedral, with particles arranged around a point and bounded by curved or very irregular surfaces that are not accomodated to the adjoining aggregates Granular: relatively non-porous Crumb: very porous The size criteria for the class will vary by type of structure and are summarized in Table 22-2.

Variable name	Definition
USLE_K, cont.	Table 22-2: Size classes of soil structure

	Shape of structure			
Size Classes	**Platy**	**Prismatic and Columnar**	**Blocky**	**Granular**
Very fine	< 1 mm	< 10 mm	< 5 mm	< 1 mm
Fine	1-2 mm	10-20 mm	5-10 mm	1-2 mm
Medium	2-5 mm	20-50 mm	10-20 mm	2-5 mm
Coarse	5-10 mm	50-100 mm	20-50 mm	5-10 mm
Very coarse	> 10 mm	> 100 mm	> 50 mm	> 10 mm

The codes assigned to $c_{soilstr}$ are:

1 very fine granular
2 fine granular
3 medium or coarse granular
4 blocky, platy, prismlike or massive

Permeability is defined as the capacity of the soil to transmit water and air through the most restricted horizon (layer) when moist. The profile permeability classes are based on the lowest saturated hydraulic conductivity in the profile. The codes assigned to c_{perm} are:

1 rapid (> 150 mm/hr)
2 moderate to rapid (50-150 mm/hr)
3 moderate (15-50 mm/hr)
4 slow to moderate (5-15 mm/hr)
5 slow (1-5 mm/hr)
6 very slow (< 1 mm/hr)

Williams (1995) proposed an alternative equation:

$$K_{USLE} = f_{csand} \cdot f_{cl-si} \cdot f_{orgc} \cdot f_{hisand}$$

where f_{csand} is a factor that gives low soil erodibility factors for soils with high coarse-sand contents and high values for soils with little sand, $f_{cl\text{-}si}$ is a factor that gives low soil erodibility factors for soils with high clay to silt ratios, f_{orgc} is a factor that reduces soil erodibility for soils with high organic carbon content, and f_{hisand} is a factor that reduces soil erodibility for soils with extremely high sand contents. The factors are calculated:

$$f_{csand} = \left(0.2 + 0.3 \cdot \exp\left[-0.256 \cdot m_s \cdot \left(1 - \frac{m_{silt}}{100}\right)\right]\right)$$

Variable name	Definition
USLE_K, cont.	$$f_{cl-si} = \left(\frac{m_{silt}}{m_c + m_{silt}} \right)^{0.3}$$ $$f_{orgc} = \left(1 - \frac{0.0256 \cdot orgC}{orgC + \exp[3.72 - 2.95 \cdot orgC]} \right)$$ $$f_{hisand} = \left(1 - \frac{0.7 \cdot \left(1 - \frac{m_s}{100} \right)}{\left(1 - \frac{m_s}{100} \right) + \exp\left[-5.51 + 22.9 \cdot \left(1 - \frac{m_s}{100} \right) \right]} \right)$$ where m_s is the percent sand content (0.05-2.00 mm diameter particles), m_{silt} is the percent silt content (0.002-0.05 mm diameter particles), m_c is the percent clay content (< 0.002 mm diameter particles), and *orgC* is the percent organic carbon content of the layer (%). Required.
SOL_EC(layer #)	Electrical conductivity (dS/m). *Not currently active*
SOL_CAL(layer #)	Soil CaCo3 (%). (0 – 50%) *Not currently active*
SOL_PH(layer #)	Soil Ph (3-10) *Not currently active*

The format of the soil input file is:

Variable name	Line #	Position	Format	F90 Format
TITLE	1	space 1-80	character	a80
SNAM	2	space 13-28	character	a16
HYDGRP	3	space 25	character	a1
SOL_ZMX	4	space 29-35	decimal(xxxxxxxxx.xx)	f12.2
ANION_EXCL	5	space 52-56	decimal(x.xxx)	f5.3
SOL_CRK	6	space 34-38	decimal(x.xxx)	f5.3
COMMENT LINE	7	space 1-147	character	a80
SOL_Z(1)	8	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(2)	8	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(3)	8	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(4)	8	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(5)	8	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(6)	8	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(7)	8	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(8)	8	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(9)	8	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_Z(10)	8	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(1)	9	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(2)	9	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(3)	9	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(4)	9	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(5)	9	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(6)	9	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(7)	9	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(8)	9	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(9)	9	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_BD(10)	9	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(1)	10	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(2)	10	space 40-51	decimal(xxxxxxxxx.xx)	f12.2

Variable name	Line #	Position	Format	F90 Format
SOL_AWC(3)	10	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(4)	10	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(5)	10	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(6)	10	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(7)	10	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(8)	10	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(9)	10	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_AWC(10)	10	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(1)	11	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(2)	11	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(3)	11	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(4)	11	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(5)	11	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(6)	11	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(7)	11	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(8)	11	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(9)	11	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_K(10)	11	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(1)	12	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(2)	12	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(3)	12	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(4)	12	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(5)	12	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(6)	12	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(7)	12	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(8)	12	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(9)	12	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_CBN(10)	12	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(1)	13	space 28-39	decimal(xxxxxxxxx.xx)	f12.2

Variable name	Line #	Position	Format	F90 Format
SOL_CLAY(2)	13	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(3)	13	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(4)	13	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(5)	13	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(6)	13	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(7)	13	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(8)	13	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(9)	13	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_CLAY(10)	13	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(1)	14	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(2)	14	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(3)	14	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(4)	14	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(5)	14	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(6)	14	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(7)	14	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(8)	14	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(9)	14	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_SILT(10)	14	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(1)	15	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(2)	15	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(3)	15	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(4)	15	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(5)	15	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(6)	15	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(7)	15	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(8)	15	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(9)	15	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_SAND(10)	15	space 136-147	decimal(xxxxxxxxx.xx)	f12.2

Variable name	Line #	Position	Format	F90 Format
SOL_ROCK(1)	16	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(2)	16	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(3)	16	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(4)	16	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(5)	16	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(6)	16	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(7)	16	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(8)	16	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(9)	16	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_ROCK(10)	16	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_ALB(1)	17	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
USLE_K(1)	18	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(1)	19	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(2)	19	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(3)	19	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(4)	19	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(5)	19	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(6)	19	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(7)	19	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(8)	19	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(9)	19	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_EC(10)	19	space 136-147	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(1)	20	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(2)	20	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(3)	20	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(4)	20	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(5)	20	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(6)	20	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(7)	20	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(8)	20	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(9)	20	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_CAL(10)	20	space 136-147	decimal(xxxxxxxxx.xx)	f12.2

Variable name	Line #	Position	Format	F90 Format
SOL_PH(1)	21	space 28-39	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(2)	21	space 40-51	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(3)	21	space 52-63	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(4)	21	space 64-75	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(5)	21	space 76-87	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(6)	21	space 88-99	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(7)	21	space 100-111	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(8)	21	space 112-123	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(9)	21	space 124-135	decimal(xxxxxxxxx.xx)	f12.2
SOL_PH(10)	21	space 136-147	decimal(xxxxxxxxx.xx)	f12.2

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