Eq. #	Variable (type)	Equation	Initial value; Units
1	PRECIPITATION (exogenous)	= GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','B2')	cm/day
2	SNOW (exogenous)	=GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','D2')	cm/day
3	snow to meters (auxiliary)	= Snow/ "cm/m"	m
4	"cm/m" (constant)	=0.01	cm/m
5	"snow ha-m" (auxiliary)	=SNOW*CROPLAND HECTARES	ha-m
6	CROPLAND HECTARES (exogenous)	=GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','J2')	ha
7	cubic meters of snow (auxiliary)	= "snow ha-m"*"cubic meters per ha-m"	m^3
8	"cubic meters per ha-m" (constant)	=1000	m^3/ha-m
9	cropland snow (auxiliary)	=cubic meters of snow	m^3
10	cropland snow rate (flow)	=cropland snow	m^3
11	snowpack density (auxiliary)	=snowpack density lookup	Dmnl
12	Snowpack (stock)	=(cropland snow rate-cropland snow runoff rate)*snowpack density	0; m^3
13	cropland snow runoff rate (flow)	=(Snowpack*above 1.67 celsius)	m^3/day
14	above 1.67 celsius (auxiliary)	= IF THEN ELSE(AVERAGE TEMPERATURE> snow melting control, 1 , 0)	Dmnl
15	snow melting control (constant)	=1.67	℃
16	Surface Water (Stock)	= cropland precipitation rate+cropland snow runoff rate-cropland percolation rate- cropland surface runoff rate	0; m^3
17	cropland m of precipitation (auxiliary)	= (effective precipitation/ "cm/m")	m^3
18	"cropland ha-m" (auxiliary)	=cropland m of precipitation* CROPLAND HECTARES	ha-m
19	cubic meters of precipitation (auxiliary)	= "cropland m of precipitation"* "cubic meters per ha-m"	m^3
20	cropland precipitation (auxiliary)	=cubic meters of precipitation	m^3
21	Cropland precipitation rate (flow)	= effective precipitation	m^3
22	leaf area index lookup (auxiliary)	=cropland cover [([(0,0)-(1,0.06)],(0,0),(0.223242,0.00789474),(0.504587,0.02),(0.740061,0.0313158),(1,0.05))]	Dmnl
23	effective precipitation (auxiliary)	=IF THEN ELSE (PRECIPITATION<=0, 0 , (LAI constant 1+(LAI constant 2*(PRECIPITATION-LAI constant 1)))-leaf area index lookup)	cm
24	LAI constant 1	=0.2	cm
25	LAI constant 2	=0.8	cm

26	cropland infiltration rate (flow)	= IF THEN ELSE(Surface Water>0, Surface Water* (infiltration coefficient lookup)* infiltration stop, 0)* snow melting control	m^3/day
27	infiltration coefficient lookup (auxiliary)	= cropland groundwater ratio [([(0,0)-(1,0.7)],(0,0.66),(0.100917,0.457456),(0.269113,0.279386), (0.529052,0.122807),(1,0))]	Dmnl
28	infiltration stop (auxiliary)	=IF THEN ELSE(Cropland Groundwater>= cropland groundwater capacity, 0 , 1)	Dmnl
29	cropland groundwater ratio (auxiliary)	=IF THEN ELSE(Cropland Groundwater<= cropland groundwater capacity, Cropland Groundwater/ cropland groundwater capacity	Dmnl
30	Cropland Groundwater (stock)	=cropland infiltration rate-cropland evapotranspiration	m^3
31	cropland evapotranspiration rate (flow)	= adjusted cropland evapotranspiration	m^3/day
32	adjusted cropland evapotranspiration (auxiliary)	= hydro+maxET+wilting	m^3
33	Hydro (auxillary)	=IF THEN ELSE("ground water ratio to ET, E levels"=0.19, hydroscopic ET level, 0)	m^3
34	maxET (auxiliary)	=IF THEN ELSE("ground water ratio to ET, E levels">=0.57, cropland ET, 0)	m^3
35	Wilting (auxiliary)	= IF THEN ELSE("ground water ratio to ET, E levels"=0.24, wilting ET level , 0)	m^3
36	cropland groundwater capacity (auxiliary)	(((CROPLAND HECTARES*soil depth)* "cubic meters per ha-m" (constant))*cropland fraction of soil that is water)+cubic meters of additional water capacity from organic matter	m^3
37	"ground water ratio to ET, E levels" (auxiliary)	=cropland groundwater ratio [([(0,0)-(1,1)],(0,0.19),(0.19,0.19),(0.25,0.24),(0.56,0.24), (0.57,1),(1,1))]	Dmnl
38	hydroscopic ET level (auxiliary)	= evaporation rate*((soil moisture-hydroscopic water)/ (soil water wilting point-hydroscopic water))	m^3
39	cropland ET (auxiliary)	=cropland cubic meters ET	m^3
40	wilting ET level (auxiliary)	evaporation rate +(cropland ET- evaporation rate *((soil moisture-soil water wilting point)/ (soil water below max point-soil water wilting point))	m^3
41	soil depth (constant)	=0.3	m
41	cropland fraction of soil that is water (constant)	=0.27	Dmnl
42	cubic meters of additional water capacity from organic matter (auxiliary)	= organic matter m^3 addition*CROPLAND HECTARES	m^3
43	soil moisture (auxiliary)	=cropland groundwater ratio	Dmnl

44	hydroscopic water (constant)	0.19	Dmnl
45	soil water wilting point (constant)	= 0.24	Dmnl
46	evaporation rate (auxillary)	= (arbitrary meters of evaporation only per day* CROPLAND HECTARES)* “cubic meters per ha-m”	m^3
47	arbitrary feet of evaporation only per day(constant)	= 0.001000000032	m
48	cropland cubic meters ET (auxillary)	= "cropland ET ha-m"* “cubic meters per ha-m”	m^3
49	"cropland ET ha-m" (auxiliary)	=CROPLAND EVAPOTRANSPIRATION* CROPLAND HECTARES	ha-m
49	CROPLAND EVAPOTRANSPIRATI -ON (exogenous)	=GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','Z2')	m
50	soil water below max point (constant)	= 0.57	Dmnl
51	organic matter m^3 addition (auxiliary)	= Cropland Organic Matter [([(0,0)-(10,20000)],(0,0),(1,2205.73),(2,4411.46), (3,6617.19),(4,8822.92),(5,11028.6),(6,13234.4),(7,15440.1))]	m^3/ ha
52	Cropland Soil Organic Matter (stock)	=humification-cultivation	3; Dmnl
53	Humification (flow)	= plant residue per hectare lookup function	Dmnl/day
54	Cultivation (flow)	=IF THEN ELSE(AVERAGE TEMPERATURE> 50, cultivation loss of organic matter rate * Cropland Soil Organic Matter, 0)	Dmnl/day
55	plant residue per hectare lookup function (auxiliary)	= plant residue [([(0,0)(70000,7)],(0,0),(10000,1),(20000,2), (30000,3),(40000,4),(50000,5),(60000,6),(70000,7))]	Dmnl
56	cultivation loss of organic matter rate (constant)	=0	Dmnl
57	plant residue (auxillary)	= ((Cropland Residue/CROPLAND HECTARES)* Cropland Residue)*microbial activity	Dmnl
58	Cropland Residue (stock)	= plant residue rate-volatilization	kg
59	volatilization (flow)	Crop Residue*typical volatilization of residue	kg/day
60	microbial activity (auxiliary)	PULSE TRAIN(microbial degradation start, microbial duration , microbial activity repeat interval, microbial activity last pulse time)	day
62	typical volatilization of residue (constant)	=0.02	Dmnl
63	plant residue rate (flow)	= Plant Biomass*litter fraction	kg/day
64	litter fraction (constant)	=0.66	Dmnl
65	Plant Biomass (stock)	= plant harvest rate- plant residue rate-harvested grain	1000;kg
66	harvested grain (constant)	=0.3	Dmnl
67	plant harvest rate (flow)	=Cropland Biomass*cropland harvest outflow	kg/day

68	cropland harvest outflow (auxillary)	= PULSE TRAIN(cropland initial pulse time outflow, cropland duration outflow , cropland repeat interval time outflow , cropland last pulse time outflow)	day
69	Cropland Biomass (stock)	= plant growth rate-plant harvest rate	kg
70	plant growth (auxiliary)	= ((plant growth*plant available water)*CROPLAND HECTARES)*cropland grown inflow	kg/ day
71	plant grown inflow (auxiliary)	=PULSE TRAIN(cropland initial pulse time inflow, cropland duration inflow , cropland repeat interval time inflow , cropland last pulse time inflow)	day
72	Growing Degree Days (stock)	GDD inflow-GDD outflow	℃
73	plant available water (auxiliary)	= soil moisture [([(0,0)(1,1)],(0,0),(0.19,0.19), (0.24,0.36),(0.57,0.75),(1,1))]	Dmnl
74	cropland surface runoff rate(flow)	= cropland runoff *cropland runoff lookup	m^3/ day
75	cropland runoff lookup (auxiliary)	=cropland groundwater ratio [([(0,0)-(1,1)],(0,0), (0.33945,0.114035), (0.59633,0.320175),(0.733945,0.491228), (0.850153,0.688596),(1,1))]	Dmnl
76	cropland runoff (auxiliary)	= IF THEN ELSE(rain and snow proxy>0, Surface Water* cropland runoff coefficient, 0)* snow melting control	m^3
77	rain and snow proxy	=cropland snow proxy+ cropland rain proxy	1
78	cropland runoff coefficient (constant)	=0.34	Dmnl
79	cropland rain proxy	=IF THEN ELSE(cropland precipitation rate>0, 1 ,0)	1
80	cropland snow proxy	=IF THEN ELSE(cropland snow runoff rate>0, 1 , 0)	1
81	Discharge (stock)	=Cropland surface runoff rate-discharge outflow	0; m^3
82	discharge outflow (flow)	= Discharge	m^3/day
83	cropland biomass per hectare (auxiliary)	=(Cropland Biomass/CROPLAND HECTARES)	kg/ha
84	cropland cover lookup (auxiliary)	=Cropland biomass per hectare [([(0,0)-(6000,1)],(0,0),(100,0.1),(200,0.2),(300,0.3), (400,0.4),(500,0.5),(600,0.6),(700,0.7),(800,0.8), (900,0.9),(1000,1),(2000,1),(3000,1),(4000,1),(5000,1), (6000,1))]	Dmdl
85	“R-FACTOR” (exogenous)	= GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','X2')	Tons/ha
86	“K-factor” (constant)	=0.49	Tons/ha
87	“LS-factor” (constant)	=.573	Tons/ha
88	“p-factor” (constant)	=0.75	Tons/ha
89	“c-factor” (auxiliary)	= cropland cover lookup	Dmnl
90	Erosion (auxiliary)	=(“K-factor”* “R-FACTOR”)* “LS-factor” * “c-factor” * “p-factor”)	Tons/ha
91	catchment hectares	=CROPLAND HECTARES	ha
92	catchment km^2	=catchment hectares* “ha/km^2”	km^2

93	"ha/km^2"	=0.01	ha/km^2
94	sediment delivery ratio	=SDR constant*(catchment km^2^(SDR exponent))	1
95	SDR constant	=0.42	Dmnl
96	SDR exponent	= -0.125	Dmnl
97	sediment deposition	= (total erosion*basin sediment delivery ratio)	Tons
98	total erosion	= (erosion*CROPLAND HECTARES)	Ton/catchment
99	TSS	= (sediment deposition* mg/ton)/ discharge in liters	mg/l
100	"mg/ton" (constant)	= 9.072e+008	mg/Ton
101	discharge in liters	=IF THEN ELSE(total basin liters of water>0, total basin liters of water, 1)	l
102	total basin liters of water	=basin total cubic meters of water*liters per cubic meter	l
103	liters per cubic meter (constant)	=1000	l/m^3
104	snowpack density lookup (auxiliary)	= snowpack depth[([(0,0)-(4,0.9)],(0,0),(0.3,0.05),(0.6,0.08),(0.9,0.1),(1,0.15),(2,0.17),(3,0.19),(4,0.3))]	Dmnl
105	snowpack depth (auxiliary)	=(Snowpack/cubic meters per ha-m)/CROPLAND HECTARES	m
106	basin total cubic meters of water (auxiliary)	= Discharge	m^3
107	microbial degradation start (auxiliary)	=502	day
108	microbial duration (auxiliary)	=153	day
109	microbial activity repeat interval (auxiliary)	=365	day
110	microbial activity last pulse time (auxiliary)	=24107	day
111	cropland initial pulse time outflow (auxiliary)	= 298	day
112	cropland duration outflow (auxiliary)	=189	day
113	cropland repeat interval time outflow (auxiliary)	=365	day
114	cropland last pulse time outflow (auxiliary)	=24107	day
115	cropland initial pulse time inflow (auxiliary)	=121	day
116	cropland duration inflow (auxiliary)	=177	day
117	cropland repeat interval time inflow (auxiliary)	=365	day
118	cropland last pulse time inflow (auxiliary)	=24107	day
119	GDD inflow (flow)	=growing degree units pulse events inflow	GDD/day
120	GDD outflow (flow)	=growing degree units pulse events outflow	GDD/day
121	growing degree units pulse events inflow (auxiliary)	=GROWING DEGREE UNITS*PULSE TRAIN(GDD initial pulse time inflow, GDD duration inflow ,GDD repeat interval time inflow , GDD last pulse time inflow)	GDD*day

122	growing degree units pulse events outflow (auxiliary)	=PULSE TRAIN(GDD initial pulse time outflow, GDD duration outflow ,GDD repeat interval time outflow , GDD last pulse time outflow)	GDD*day
123	GDD initial pulse time inflow	=105	day
124	GDD last pulse time inflow (auxiliary)	=24107	day
125	GDD repeat interval time inflow (auxiliary)	=365	day
126	GDD duration inflow (auxiliary)	=184	day
127	GDD initial pulse time outflow (auxiliary)	=289	day
128	GDD last pulse time outflow (auxiliary)	=24107	day
129	GDD repeat interval time outflow (auxiliary)	=365	day
130	GDD duration outflow (auxiliary)	=181	day
131	GROWING DEGREE UNITS (exogenous)	=GET XLS DATA ('HUC4.xlsx', 'Sheet2', 'A','H2')	GDD