Appendix B
Environmental Parameters

Environmental Policy Integrated Climate Model

Environmental indicators contained in REAP production activities were generated using the EPIC model. EPIC is a crop biophysical simulation model that is used to estimate the effect of management practices on crop yields, soil quality, and various environmental emissions at the field level. EPIC uses information on soils, weather, and management practices, including specific fertilizer rates, and produces information on crop yields, erosion, and chemical losses—including nitrogen losses—to the environment.

Management practices used in the EPIC management files are consistent with agronomic practices for the 45 regions as reported in the USDA ARMS, which has absorbed the CPS.

We generated crop yields and the array of environmental indicators associated with each crop production activity represented in REAP by running EPIC in four sequential steps. The first step is to condition the soil while the next three are used to calculate short-term yield, average rate of emission, and long-term yield (app. table B.1).

The first or conditioning step allows EPIC to rectify any inconsistencies in the soil profile imported from the SOILS5 database. This first step involves running EPIC for a period of 5 years with the soil erosion module turned off. The output of this step has the added advantage of making the soils profile at the beginning of the second step consistent with a field that has been subjected to the management practices being simulated. This is important because any particular soil profile used does not necessarily come from a field where the system being simulated has been used.

In step two, we calculate the short-term yield. EPIC is run for a period of 7 years, again with its soil erosion module turned off and short-term yield calculated as average yield during this period. By turning the erosion off, any variation in yield will be due strictly to variation in weather.

In step three, we calculate the environmental indicators by running EPIC for 60 years, this time with soil erosion turned on. Total emissions for each environmental indicator are tabulated and divided by the length of the simulation to obtain the annual rate of emission. Running the systems for 60 years eliminates any dependence of the emissions from the sequence of weather for any particular time period and provides a consistent base for comparing systems. By eliminating the dependence of the systems on a specific weather pattern, we did not need to coordinate weather patterns among the various weather sites. In this step, all systems are run through two full weather cycles. At the same time, each management regime is run through at least five full management cycles.

In step four, we calculate the long-term yields. EPIC is run as described in step two, except that EPIC uses the soil profile generated from the previous 60-year simulations. The difference between shortrun and longrun yield represents the change in soil productivity associated with each management system.

While EPIC was designed for use over a wide range of soil and climatic conditions, we found that crop yields were highly variable. For some regions and some crops, EPIC's yield projections matched USDA yield data, but in others, its yield projections were over or under yields reported for those areas. More importantly, EPIC's estimated yields alter the ranking of the regions with respect to crop yield.

It could be argued that since yield has little effect on erosion that the errors in EPIC’s yield estimates are not that important. However, yield is a critical factor determining plant nutrient uptake and, consequently, nitrogen emissions to the environment. Yield, especially the relative yield between crops and regions are important for determining the economic relationships as well. We found it necessary, therefore, to calibrate EPIC so that its simulated yields matched the reported yields.

In order to calibrate EPIC, we conduct sensitivity analysis over EPIC parameters for a large number of production systems in a consistent fashion. A variety of factors can be used to calibrate the EPIC parameters; the two most common factors are crop yield and soil profile. We selected crop yield because data on yield is readily available down to the county level; yield affects many of the environmental relationships pertaining to chemical emissions of interest; and we lacked the expertise to calibrate EPIC parameters to changes in soil profile.

Outside information needed to calibrate the systems includes yields, weather, growing degree days, and soils. Yields were obtained by aggregating USDA's NASS county yield data up to the REAP region. Weather information was obtained by aggregating rainfall and temperature data for NOAA weather districts to REAP regions. Growing degree days were obtained from a USDA database put together by EPIC developers called "Potential Heat Unit." Soils information was obtained from the SOILS5 database and selected by using a distance function procedure that took into account a set of soil characteristics related to soil quality and productivity.

EPIC parameters used in the calibration were WA, HI, and nitrogen demand (ba1, ba2, and ba3). WA is a growth parameter and controls the efficiency by which the plant converts sunlight into biomass. HI is the harvest index and specifies the ratio of above ground to below ground biomass. Nitrogen demand parameters (ba1, ba2, and ba3) control plant demand for nitrogen throughout the growing season. These parameters affect the sensitivity of yield to available nitrogen and play a critical role in determining nitrogen uptake and nitrogen loss.

The yield target used to calibrate EPIC parameters was the 7-year average yield for 1987-1995 for each REAP region. The 7-year average yields were calculated by aggregating NASS county yield data up to REAP regions. Because EPIC does not account for all factors, primarily disease and insects, which affect yields, EPIC should overestimate yield relative to reported yield. Consequently, we adjusted the target yield by setting it 10 percent above each crop's average yield.

The EPIC parameters were calibrated in two steps. In the first step, WA and HI were adjusted up or down until the simulated yield came within 10 percent of the target yield. The parameters were varied in sequence, first WA and then HI, until the simulated yield fell within the desired range.

In the second step, nitrogen demand was shifted up or down until the nitrogen-yield response was consistent with fertilizer application rates reported in the CPS and profit-maximizing behavior in an uncertain environment. To do this, we assumed that the nitrogen-yield relationship can be represented with a nondifferentiable plateau response model. The von Liebig and quadratic-plateau response models have this characteristic. A study by Cerrato and Blackmer (1990) found that these two functions best represented the nitrogen-yield response relationship based on data from experimental plots in Iowa. A study by Babcock (1992) demonstrated that given these types of response functions, farmers should apply the same amount of fertilizer every year based on yield potential. This, in turn, implies that the nitrogen-yield response function obtained from an average yield over a specific time period should be discontinuous at the optimal fertilizer application rate. We then shifted the nitrogen demand function until the discontinuity in the simulated nitrogen-yield response was centered over the nitrogen application rate.

Soil Selection

Reliability of the EPIC simulation of crop yield and environmental indicators depends not only on the management practices used, but also on weather and soils. Both soils and weather play important roles in crop growth, nutrient uptake, erosion, chemical losses to air, run off, and leaching. Therefore, it is important that the soils and weather sites selected be as representative of conditions as possible in each REAP region.

Representative soils were chosen for each REAP model region by using factors that reflect the susceptibility of the soil to erosion, surface runoff, and leaching. These soils were used in the EPIC crop simulations for each region. Soils were selected for each of 45 REAP regions. Soils can be separated by HEL and NHEL soils, or combined (app. tables B.2 and B.3). From the NRI, a subset of polygons was selected on the basis of REAP crops grown. The hydrologic groups, erodibility factors, slope lengths, and steepness were obtained from NRI and SOILS5 data. These variables summarize the inherent characteristics of the soil and land pertaining to water erosion, surface runoff, and leaching. Soils for each REAP region were selected by considering proximity to the centroid of these variables for each region and by acreage.

Soil Selection Factors

Environmental losses of soil and chemicals in crop production can be divided into surface and subsurface categories. Chemicals can move from the field in solution with the runoff water and on soil particles eroded from the field. Chemicals can leach through the soil into subsurface flows and groundwater. Surface runoff and sheet and rill erosion generally increase with slope length and steepness and are further affected by precipitation, the soil hydrological group, inherent erodibility of the soil, and physical cropping system attributes. The erodibility of soil, depending in part on the proportions of silt, sand, and clay, increases with the value of the USLE K factor. Hydrologic groups reflect runoff potential and are negatively related to the infiltration and leaching potential of soils. As runoff potential declines, the rate of infiltration increases along with the amount of precipitation absorbed into the soil and the potential for chemical leaching. Thus, the slope length and steepness, USLE erodibility factor (K factor), and hydrological group are included in the soil selection. Background information and data conversions and calculations of averages and distance from the centroids for each region are summarized below.

Representative Soil Delineation by Erodibility

Soils are chosen to be representative of the individual REAP regions. The separation of highly erodible and nonhighly erodible soils is desirable for some analyses. Thus, a single soil is chosen to be representative of each REAP region as well as separate soils representing highly erodible and nonhighly erodible land. The highly erodible designation by NRCS is reserved for soil inherently susceptible to erosion, considering rainfall, soil characteristics, and slope length and steepness (Magleby et al., 1995).

The choice of soils begins with choosing the relevant cropland. Crop acreage where any one of REAP crops was grown within 4 years was selected from the 1992 NRI. The relevant SOILS5 records were merged with the NRI polygons in the REAP crop acreage. From this data set, the hydrologic group, erodibility, slope length, and steepness were extracted for the NRI data points. These data were converted to variables ranging from 0 to 1, and averages were calculated for each model region for HEL, NHEL, and combined soils by using the NRI polygon expansion factor as a weight. Observations are limited to those where the slope steepness is no greater than 30 percent. Vector distances from the means of the four variables or the centroid were calculated as deviation scores for each NRI point. Soils in each category were ranked by ascending score, with lower scores being the most desirable. Among soils with similar scores, those associated with the greatest acreage were given preference. Representative soil parameters for each region are presented in tables B.1 through B.3)

Weather Selection

Weather sites used in the EPIC simulations were originally selected based on the proximity to the geographical center of the region (app. table B.4). However, selecting a representative weather site based on its proximity to the geographical center of a REAP region can cause the weather represented by the selected weather site to be inconsistent with weather conditions where a majority of the crops are grown. In relatively homogeneous regions—such as the Corn Belt—this does not present much of a problem, but in many REAP regions, weather varies considerably and poses a problem. Consequently, before calibrating

EPIC system parameters, we reselected weather sites that were more representative, with respect to average rainfall and temperature for areas within the REAP region with crop production rather than selecting sites based on their proximity to the center of the region.

The average rainfall and temperature for the 7-year period (1987-95) used to calculate average crop yields were used as the basis for selecting representative weather sites. This information was obtained by aggregating NOAA weather districts into REAP regions based on their share of crop acreage in each REAP region. Weather sites from EPIC's database were selected based on the average rainfall and temperatures from the NOAA data (see table B.4 for locations of selected sites).

After the weather site was selected for each region, the weather generator was set so that average rainfall and temperature generated by EPIC matched the 7-year average calculated from the NOAA data. This was needed because the EPIC weather generator is designed to replicate 30-year average rainfalls and temperatures at any specific weather site. As a result, any length of time shorter than 30 years will have average temperatures and rainfall that deviate from the 30-year average. The shorter the timespan selected and the greater the variability in weather at the site means the greater the deviations associated with any one draw from the weather distribution is likely to be. Since we wanted to calibrate EPIC parameters to the 7-year average yields, we needed to set the weather generator seed so that the average temperature and rainfall during the simulation period were equal to the averages recorded for the period used in calculating crop yields.

Erosion Calibration

Surface Runoff, Leaching, and Lateral Surface Flow

Surface run off is estimated by the EPIC system as a function of soil hydrological groups, slope, crop type, and daily rainfall (EPIC Model Documentation pages 4-5, EPIC Users Manual, table II.1). Hydrologic groups reflect runoff potential of the soils. The negative relationship between surface runoff and leaching was exploited by Williams and Kissel (1991) in the development of a leaching index by using EPIC for eight sites to simulate a range of soils and climates (Kellogg et al., 1992). Thus, the hydrological group captures the various chemical and physical soil characteristics pertinent to both surface run off and leaching.

Group A—Lowest runoff potential—highest percolation or leaching potential. High infiltration rate even when wet. Deep, well-drained sand or gravel. High water transmission rate.

Group B—Moderate infiltration rate—Moderately deep soils, with moderately fine-course texture. Moderate water transmission rate.

Group C—Slow infiltration rate—Soils with a layer impeding downward flow, or soil with moderately fine to fine texture. Slow water transmission rate.

Group D—High runoff potential—lowest percolation or leaching potential. Slow infiltration rate. Clay soils with high swelling potential, permanent high water table, clay layer near surface, and shallow soils over impervious material. Very slow water transmission rate.

Water Erosion

Water erosion estimation variables capture the remaining slope and soil characteristics used for selecting the REAP representative soils.

The USLE equation is represented in EPIC as follows:

Y = (EI) (K) (CE) (PE) (LS) (ROKF)

where:

Y is the sediment yield

EI is the rainfall intensity measure

K is the soil erodibility factor

CE is the crop management factor (tillage)

PE is the erosion control factor

LS is the slope length and steepness factor

ROKF is the course fragment factor

The REAP representative soils choice factors include slope length and steepness and directly affect the USLE soil erodibility factor (K). The hydrologic group reflects the course fragment factor (ROKF). The crop management factor is determined by the REAP crop system, and rainfall parameters are incorporated in the EPIC simulation for each of the 45 regions. Thus, all USLE variables are accounted for by REAP values other than the erosion control factor (PE). The absence of PE could result in low erosion estimates, where such physical controls such as terracing are needed but have not been incorporated. However, over the years much of such land has either been taken out of tilled crop production or has undergone treatment.

Appendix table B-1—Representative soils combined erodiblility class

Farm Resource Region	Erodibility Class	Soil	SOILS5 ID	SURFACE TEXTURE	ACRES	HYDRO-LOGIC GROUP	K FACTOR	SLOPE LENGTH	SLOPE PERCENT
APN	HEL	ZANESVILLE	KY0001	SICL	165700	C	0.37	150	6.0
APO	HEL	LORING	TN0011	SIL	455400	C	0.49	110	3.0
APP	NHEL	APPLING	NC0032	SL	177700	B	0.24	200	4.0
APT	NHEL	GOLDSBORO	NC0041	FSL	162800	B	0.20	200	1.0
CBL	NHEL	ELSTON	IN0029	L	33000	B	0.28	300	1.0
CBM	NHEL	GALVA	IA0163	SICL	562200	B	0.32	200	3.0
CBN	NHEL	BARDEN	MO0032	SIL	49000	C	0.37	279	5.0
CBO	NHEL	WARDELL	MO0045	L	38700	C	0.37	250	0.1
CBR	NHEL	CANFIELD	OH0057	SIL	131300	C	0.37	200	4.0
DLN	NHEL	ROXANA	LA0067	SIL	36200	B	0.43	200	1.5
DLO	NHEL	DUNDEE	MS0057	VFSL	938000	C	0.37	150	0.8
DLP	NHEL	SAVANNAH	MS0083	L	41100	C	0.37	200	2.0
DLT	NHEL	MIDLAND	LA0017	SICL	156300	D	0.43	125	0.2
LAF	NHEL	VALLERS	MN0055	L	31900	C	0.28	120	0.5
LAK	NHEL	CHETEK	WI0120	SL	111400	B	0.24	150	3.0
LAL	NHEL	KIBBIE	MI0041	L	75900	B	0.28	200	3.0
LAM	NHEL	CLARION	IA0521	L	108100	B	0.28	125	3.0
MNB	NHEL	TETONIA	ID0217	SIL	18700	B	0.37	500	4.0
MND	NHEL	PARLEYS	UT0062	SIL	61000	B	0.32	600	2.0

Appendix table B-1—Representative soils combined erodiblility class— continued

MNE	NHEL	NUNN	CO0038	CL	15300	C	0.28	250	4.0
MNF	HEL	SCOBEY	MT0124	CL	792100	C	0.37	300	3.0
MNG	HEL	NORKA	CO0071	SIL	197800	B	0.32	400	3.0
MNH	HEL	CLOVIS	NM0969	FSL	107800	B	0.28	250	0.7
NPF	NHEL	BARNES	ND0119	L	3486600	B	0.28	250	3.0
NPG	HEL	HUGGINS	SD0093	SIL	6600	C	0.32	310	3.0
NPH	NHEL	HARNEY	KS0047	SIL	3101300	B	0.32	220	2.0
NPM	NHEL	MOODY	SD0343	SICL	696300	B	0.32	200	4.0
NTL	NHEL	APPLETON	NY0145	SIL	60000	C	0.32	235	4.0
NTN	HEL	GILPIN	PA0007	SIL	229100	C	0.32	150	10.0
NTR	HEL	WELLSBORO	PA0027	L	134700	C	0.28	160	6.0
NTS	HEL	GLENELG	MD0021	L	181900	B	0.32	220	6.0
NTT	NHEL	SASSAFRAS	MD0039	SL	243600	B	0.28	160	1.0
PAA	NHEL	WOODBURN	OR0325	SIL	81600	C	0.32	350	2.0
PAB	NHEL	WALLA WALLA	WA0026	SIL	349700	B	0.43	400	7.0
PAC	NHEL	TWISSELMAN	CA0699	C	122600	C	0.32	850	2.0
PAD	NHEL	FURY	ID0568	SIL	64500	C	0.32	800	1.0
PAE	NHEL	CLAYTON	WA0302	FSL	13700	B	0.28	350	5.0
SEN	NHEL	CHENNEBY	AL0026	SICL	33600	C	0.32	45	2.0
SEP	NHEL	TIFTON	GA0001	SL	1249100	B	0.17	150	3.0
SET	NHEL	DOTHAN	AL0010	LS	30000	B	0.15	200	1.0
SPH	NHEL	ROWENA	TX0159	CL	492900	C	0.32	240	1.0
SPI	HEL	DUVAL	TX0208	VFSL	113800	B	0.32	300	1.0

Appendix table B-1—Representative soils combined erodiblility class— continued

SPJ	NHEL	AUSTIN	TX0144	SIC	84100	C	0.32	200	2.0
SPM	NHEL	DENNIS	OK0004	SIL	96200	C	0.43	100	1.0
SPT	NHEL	LAKE CHARLES	TX0020	C	611200	D	0.32	200	0.2

Appendix table B-2—HEL Representative soils

Region	Erodibility	SOIL	SOILS5	MUSYM	State	SCH_TOT	Acres	S.text	H.Gr.	K Fact	S.Length	Slope	USLE92
APN	NHEL	BELKNAP	IL0004	Bn	KY	0.150455	131200	SIL	C	0.37	200	2	3.306
APO	NHEL	COLLINS	MS0030	8	KY	0.035029	205100	SIL	C	0.43	120	1	6.61
APP	NHEL	APPLING	NC0032	ApB	VA	0.092878	177700	FSL	B	0.24	200	3	3.335
APS	NHEL	HAGERSTOWN	MD0004	HcC	WV	0.142632	25800	SIL	C	0.32	175	4	1.44
APT	NHEL	GOLDSBORO	NC0041	GoA	NC	0.130436	162800	FSL	B	0.2	200	1	3.6175
CBL	NHEL	ELBURN	IL0136	198	IL	0.130818	26200	SIL	B	0.28	350	1	2.96
CBM	NHEL	GALVA	IA0163	GaA	IA	0.096073	562200	SICL	B	0.32	210	2	2.41
CBN	NHEL	STENDAL	IN0058	St	OH	0.120973	65400	SIL	C	0.37	200	2	2.545
CBO	NHEL	COMMERCE	LA0041	42	MO	0.065068	127500	SICL	C	0.37	250	0.2	3.63
CBR	NHEL	CANFIELD	OH0057	CdB	OH	0.038391	131300	SIL	C	0.37	200	2	2.27
DLN	NHEL	BARLING	AR0029	2	AR	0.118307	6400	SIL	C	0.37	150	1	0.19
DLO	NHEL	SHARKEY	LA0050	Sb	MS	0.165205	1990100	SICL	D	0.37	165	0.5	4.58
DLP	NHEL	SAVANNAH	MS0083	SaA	MS	0.074307	41100	SIL	C	0.37	200	1	4.583
DLT	NHEL	CROWLEY	LA0044	CrA	LA	0.073238	423800	SIL	D	0.49	125	0.3	3.105
LAF	NHEL	BEARDEN	ND0296	67A	MN	0.089325	428700	SIL	C	0.28	100	0.5	0.488
LAK	NHEL	ROSHOLT	WI0226	RoB	WI	0.061142	185600	SL	B	0.24	200	3	0.19
LAL	NHEL	FOX	WI0026	FoB	MI	0.046413	176400	SL	B	0.24	200	2	0.975
LAM	NHEL	CLARION	IA0074	ClB	MN	0.057651	480500	L	B	0.24	100	2	2.078
MNB	NHEL	REXBURG	ID0083	700A	ID	0.156065	84000	SIL	B	0.43	600	3	6.62
MND	NHEL	WITT	NM1122	R0B	CO	0.167687	95000	L	B	0.37	500	2	0.07
MNE	NHEL	AMSTERDAM	MT0499	11	MT	0.187658	85700	SIL	B	0.32	250	3	0.015
MNF	NHEL	WILLIAMS	ND0258	69	MT	0.152982	492400	L	B	0.43	250	3	1.98
MNG	NHEL	WELD	CO0054	WeB	CO	0.178504	220100	SIL	C	0.32	400	3	1.325

Appendix table B-2—HEL Representative soils— continued

MNH	NHEL	KUMA	CO0028	25	CO	0.148546	137700	SIL	B	0.32	300	2	4.66
NPF	NHEL	BARNES	ND0119	BhA	ND	0.128394	3486600	L	B	0.28	240	2	0.52
NPG	NHEL	KEITH	NE0049	KeC	NE	0.153496	214300	L	B	0.28	200	3	0.74
NPH	NHEL	HARNEY	KS0047	HB	KS	0.100918	3101300	SIL	B	0.32	225	2	0.898
NPM	NHEL	NORA	SD0060	NoC	NE	0.164418	721900	SIL	B	0.32	225	3	2.35
NTL	NHEL	LIMA	NY0120	Lo	NY	0.179558	194700	FSL	B	0.32	200	3	1.4775
NTN	NHEL	GILPIN	PA0007	GNB	PA	0.073243	28200	SIL	C	0.32	200	5	1.02
NTR	NHEL	MARDIN	NY0060	MrB	NY	0.148794	139200	SIL	C	0.24	200	4	0.676
NTS	NHEL	HAGERSTOWN	MD0004	35B2	PA	0.146413	103900	SIL	C	0.32	250	4	2.16
PAA	NHEL	WOODBURN	OR0325	77A	OR	0.03915	81600	SIL	C	0.32	350	2	0.65
PAB	NHEL	WALLA	WA0026	31B	OR	0.069468	349700	SIL	B	0.43	450	5	3.503
PAC	NHEL	COLUMBIA	CA0188	144	CA	0.018474	22500	FSL	C	0.32	990	1	0.33
PAD	NHEL	FURY	ID0568	7A	OR	0.055534	64500	SIL	C	0.32	500	0.5	0
PAE	NHEL	NARCISSE	WA0103	NcA	WA	0.157449	8000	SIL	C	0.37	200	3	1.06
SEN	NHEL	CHENNEBY	AL0026	Lk	AL	0.139673	33600	SICL	C	0.32	45	2	4.46
SEP	NHEL	TIFTON	GA0001	TuB	GA	0.029616	1249100	SL	B	0.17	150	2	5.161
SET	NHEL	GOLDSBORO	NC0041	Gb	SC	0.083078	178200	LS	B	0.17	200	1	2.618
SPH	NHEL	OLTON	TX0129	OcA	TX	0.037056	892300	CL	C	0.32	240	0.9	2.29
SPI	NHEL	CLAREVILLE	TX0207	12B	TX	0.046369	26900	CL	C	0.32	200	1	2.78
SPJ	NHEL	HOUSTON B.	TX0093	HoB2	TX	0.14973	756500	C	D	0.32	175	2	4.57
SPM	NHEL	DENNIS	OK0004	DtB	OK	0.068226	96200	SIL	C	0.43	100	1	2.49
SPT	NHEL	L.CHARLES	TX0020	24	TX	0.043141	611200	C	D	0.32	180	0.2	1.55

Appendix table B-3—Representative soils, NHEL

Region	Erodibility	SOIL	SOILS5	MUSYM	State	SCH_TOT	Acres	S.text	H.Gr.	K Fact	S.Length	Slope	USLE92
APN	HEL	LOWELL	KY0032	LoC	KY	0.16414	218500	SIL	C	0.37	160	8	1.06
APO	HEL	LORING	TN0011	LoC3	TN	0.088049	455400	SIL	C	0.49	110	5	19
APP	HEL	CECIL	NC0018	Cf	VA	0.093005	308600	FSL	B	0.28	200	7	0.74
APS	HEL	FREDERICK	VA0059	29C2	VA	0.155668	55900	SIL	B	0.32	200	10	29.47
APT	HEL	MUNDEN	VA0162	MuA	VA	0.064154	3600	SL	B	0.2	250	2	2.78
CBL	HEL	HITT	IL0216	506C	IL	0.04111	18000	SIL	B	0.32	200	6	6.58
CBM	HEL	FAYETTE	IA0564	163C2	IA	0.146531	694600	SIL	B	0.37	180	8	24.99
CBN	HEL	COSHOCTON	OH0104	CnC	OH	0.093539	86400	SIL	C	0.37	200	10	0.32
CBO	HEL	LORING	TN0011	3C2	MO	0.166762	18800	SIL	C	0.49	100	7	34.365
CBR	HEL	WOOSTER	OH0017	WsC2	OH	0.073686	104400	SIL	C	0.37	200	8	7.24
DLN	HEL	ENDERS	AR0002	20	AR	0.096942	2500	FSL	C	0.32	100	8	0.26
DLO	HEL	LORING	TN0011	33B	MS	0.033393	284600	SIL	C	0.49	125	4	14.48
DLP	HEL	SAVANNAH	MS0083	SaC2	MS	0.03369	53300	SIL	C	0.37	150	4	0.79
DLT	HEL	MIDLAND	LA0017	McA	LA	0.088073	1800	SICL	D	0.43	135	0.2	0.04
LAF	HEL	POPPLETON	MN0131	148	MN	0.122787	20900	LFS	A	0.15	150	0.5	0.4166
LAK	HEL	ROSHOLT	WI0226	RrC2	WI	0.082225	34600	SL	B	0.24	180	7	4.14
LAL	HEL	MARLETTE	MI0083	36C	MI	0.072976	90600	L	B	0.32	200	7	0.11
LAM	HEL	VALTON	WI0127	DtC2	WI	0.030537	159200	SIL	B	0.32	175	10	6.49
MNB	HEL	TETONIA	ID0217	58	ID	0.167971	55300	SIL	B	0.37	400	6	9.39
MND	HEL	GLENDALE	AZ0130	Gf	NM	0.113567	39800	L	B	0.32	700	0.4	0.07
MNE	HEL	WINIFRED	MT0135	602WM	MT	0.145761	42300	C	C	0.32	300	4	1.76
MNF	HEL	SCOBEY	MT0124	657156	MT	0.039211	792100	CL	C	0.37	300	3	1.555
MNG	HEL	NORKA	CO0071	WBC	CO	0.147358	197800	SIL	B	0.32	400	3	7.95

Appendix table B-3—Representative soils, NHEL— continued

MNH	HEL	AMARILLO	TX0130	Ab	NM	0.101994	246600	FSL	B	0.24	300	0.8	0.61
NPF	HEL	WILLIAMS	ND0042	341C	ND	0.12297	197700	L	B	0.28	300	4	0.23
NPG	HEL	SAVO	SD0084	86B	SD	0.150627	5200	SIL	C	0.32	300	4	0.5
NPH	HEL	RICHFIELD	KS0096	RN	KS	0.057905	1580300	SIL	B	0.32	200	2	0.69
NPM	HEL	SHARPSBURG	IA0033	ShD2	NE	0.189385	350200	SICL	B	0.32	150	7	8.8
NTL	HEL	HONEOYE	NY0117	HnB	NY	0.146097	58400	SIL	B	0.32	200	7	2.63
NTN	HEL	GILPIN	PA0007	GgC2	PA	0.122794	229100	SIL	C	0.32	125	11	3.04
NTR	HEL	WELLSBORO	PA0027	32C	NY	0.060963	134700	L	C	0.28	150	9	0.68
NTS	HEL	GLENELG	MD0021	GEB2	PA	0.129692	181900	SIL	B	0.32	200	8	3.84
PAA	HEL	MANITA	OR0650	53B	OR	0.094004	800	L	C	0.32	400	7	0.78
PAB	HEL	ATHENA	OR0002	AsE2	WA	0.090662	319900	SIL	B	0.37	400	11	6.99
PAC	HEL	NACIMIENTO	CA0045	175	CA	0.08746	72500	SICL	C	0.32	100	12	2.23
PAD	HEL	HOLTVILLE	CA0279	110	CA	0.078941	27600	SIC	C	0.32	1200	0.2	0.05
PAE	HEL	BONNER	ID0232	35	WA	0.139642	10400	SIL	B	0.32	40	10	2.4
SEN	HEL	WYNNVILLE	AL0042	Tk	AL	0.157549	95500	SIL	C	0.28	80	5	12.88
SEP	HEL	CECIL	NC0018	CeB	SC	0.099457	171000	SL	B	0.28	120	5	9.9
SET	HEL	CARNEGIE	GA0027	CoC2	GA	0.217712	4900	SL	C	0.28	300	3	10.57
SPH	HEL	AMARILLO	TX0130	Aa	TX	0.082723	1767600	FSL	B	0.24	250	1.5	2.6
SPI	HEL	KNIPPA	TX0435	KnA	TX	0.121015	63600	C	C	0.32	300	1	0.93
SPJ	HEL	AUSTIN	TX0144	8	TX	0.059579	28000	SIC	C	0.32	150	3	0.41
SPM	HEL	DENNIS	OK0004	DeC	OK	0.069785	26100	SIL	C	0.43	120	3	0.11
SPT	HEL	VICTORIA	TX0224	7A1	TX	0.117146	36000	C	D	0.32	300	0.5	4.64

Appendix table B.4—Selected weather sites and their location

Model Region	State	Station	Lat	Long
APN	KY	09	36.75	86.20
APP	NC	10	35.73	81.38
APS	WV	03	39.27	80.35
CBL	OH	04	41.40	81.85
CBM	IL	10	40.47	87.67
CBN	IN	08	38.60	86.10
CBO	TN	11	35.62	85.20
CBR	OH	10	40.50	81.45
DLN	AR	01	34.55	92.62
DLO	MS	11	31.95	90.98
DLP	MS	02	31.57	90.43
DLT	MS	13	30.63	89.05
LAF	MN	31	48.57	95.63
LAK	WI	13	46.35	91.82
LAL	MI	24	47.17	88.50
LAM	WI	15	43.55	90.88
MNB	ID	16	42.32	111.30
MND	AZ	27	36.28	113.07
MNE	MT	32	48.40	115.53
MNF	MT	13	48.40	115.53
MNG	CO	01	40.12	103.17
MNH	CO	14	40.58	102.30
NPF	ND	15 & 03	46.40	97.23 & 46.38
NPG	NE	13	42.27	101.35
NPH	KS	01	39.47	98.83
NPM	NE	06	41.43	96.48
NTL	NY	12	41.85	73.62
NTN	PA	12	41.48	79.43
NTR	ME	01	44.32	69.80
NTS	NJ	02	40.25	74.28
NTT	DE	01	38.63	75.47
PAA	OR	05	44.57	123.28
PAB	OR	09	45.35	119.55
PAC	CA	17	36.73	119.82
PAD	OR	12	43.28	118.83
PAE	WA	06	48.53	117.87
SPH	TX	01	32.43	99.68
SPI	TX	09	25.92	97.47
SPJ	TX	66	33.60	96.65
SPM	OK	20	36.30	95.32
SPT	LA	04	29.88	93.42
STN	GA	06	34.52	83.53
STP	AL	02	33.57	86.75
STT	FL	14	30.42	81.65