IMPACT OF BEST MANAGEMENT PRACTICES ON WATER QUALITY IN PENNSYLVANIA

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UNITS OF MEASUREMENT AND CONVERSION FACTORS

Metric units are used throughout this study. Conversions to common English units are presented below.

UNIT	ABBREVIATION	EQUIVALENT
metric ton (same as Megagram)	MT	2205 pounds (lb)
hectare	ha	2.471 acre (ac)
centimeter	cm	2.54 inch (in)
kilogram per hectare	kg/ha	0.892 lb/ac
Megagram per hectare	Mg/ha	0.446 tons/acre (t/ac)

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BACKGROUND

Agricultural nonpoint source pollution plays a major role when considering the water quality assessment for any region. Agrochemicals are indispensable in current agriculture for economically sound production, but their improper use may lead to serious water quality problems.

The low fertility soils and high pest pressure in the humid eastern states require appropriate management of fertilizers and pesticides relative to the type of crop production and land management system. Nitrogen (N) and Phosphorus (P) are the major contributors to the eutrophication of water bodies, and nitrogen may also result in high nitrate levels in groundwater. Corn belt and other humid areas are the prime locations where nitrate and pesticide loadings into groundwater have been documented. One method of reducing soil erosion, and consequently controlling nutrient losses from cropland, is the use of agricultural Best Management Practices (BMPs).

Emphasis on high productivity has resulted in greater use of fertilizers and pesticides. Use of nitrogen fertilizer in the U.S. has increased from 2.4 million metric tons in 1960 to about 11.3 metric tons in 1980 (Ritter and Manger, 1985). Agriculture, according to Environmental Protection Agency (EPA), is the primary polluter of 64 percent of the nations lakes, (Erwin, 1988). Groundwater has been documented as the prime source of drinking water in rural America (more than 97%), (Solley et al. 1983). Therefore, the quality of groundwater is directly related to human health. Although sources of groundwater contamination are many, studies suggest that agriculture's relative contribution may be significant (Lee and Nielson, 1987). EPA has also initiated a groundwater survey based on the recent findings of groundwater contamination in different parts of the country including Iowa (Hallberg, 1984), Florida (Jones and Back, 1984), California (Cohen, 1986), and many other similar incidents in other parts of the country.

Nitrogen (N) and phosphorus (P) are the major contributors to the accelerated eutrophication of water bodies, and nitrogen may also result in high nitrate levels in groundwater. One method of reducing soil erosion, consequently controlling nutrient losses from cropland, is the use of Best Management Practices (BMPs).

Agricultural Best Management Practices (BMPs) play a major role in manipulating the water and chemical movement on the land surface as well as through the soil profile into the groundwater system. National concern about the quality of surface water in the mid 1960's led researchers to develop conservation tillage systems. These systems have been proven to reduce the surface loading of sediment and chemicals from agricultural lands (Bailey and Wadell, 1979). Langdale et al., (1979) reported that conservation tillage can reduce runoff by as much as 63 percent. This reduction is generally attributed to increases in surface coverage of plant residue which may retard surface runoff and allow more time for infiltration (Steichen and Russell, 1982; Laflen and Colvin, 1981). Kenimar et al. (1987) showed that a decrease in residue cover for both conventional and no-till farming increased runoff and sediment losses.

Conservation tillage, no-till, contour farming, and erosion control structures such as diversions and terraces have been the focus of research for pollution control in recent years. Kanwar, et al. (1987) conducted a field experiment on a Clarion Webster silt loam soil on a 2% slope near Ames, Iowa to determine the effects of tillage and multiple N applications on nitrate leaching. During the first year there was no significant difference between conventional and no-till systems with respect to their impact on nitrate concentrations in drainage water. However, in 1986, average nitrate concentrations in drainage from conventionally tilled plots were greater than those of no-till plots. Multiple N applications (applied at a reduced rate over the growing season) reduced nitrate concentrations in subsurface drainage compared to a single, higher rate application. Wendt and Burwell (1985) compared runoff and soil losses from natural rainfall among conventional, reduced, and no-till corn (silage and grain) with and without winter cover. Their results showed that average annual runoff was about 20% less for reduced tillage than for conventional or no-till methods for grain. Winter cover significantly reduced both soil and water losses for no-till corn (silage) compared to the equivalent treatment without winter cover. Angle et al. (1984) conducted a study to evaluate the impact of conventional and no-till farming on nutrient and sediment loss in runoff in the Piedmont physiographic region of Maryland. Their results indicated a definite reduction in surface loading of N, P, and sediment from a no-till watershed compared to conventional.

Although much research has been conducted to evaluate the impact of different BMPs on surface loading of agrochemicals (Baker and Johnson, 1983), groundwater loading of these chemicals has received little attention. Lack of comprehensive and reliable data has made it difficult to establish a direct relationship between human activities and groundwater contamination. Difficulty of measurement, the expensive nature of groundwater research, and the short-sightednesss of the researchers may be listed as prime reasons for the lack of data. Whatever the cause may be, groundwater contamination especially by nonpoint sources can no longer be ignored. Moreover, the hydraulic connectivity between surface and groundwater in many areas necessitates the examination of the impact of human activities on both surface water and groundwater quality.

Modeling efforts and applications for evaluating the impact of BMPs on water quality have also been concentrated on surface water quality.

Donigian (1982) classified water quality models into 3 classes: runoff models, receiving water models, and groundwater models. However, a fourth category of water quality model, a surface-groundwater model, should be identified and used for assessing the surface and ground water loading of agrochemicals. Examples of such models with dual (surface and ground water loading) prediction capabilities are CREAMS (Knisel, 1980), PRZM (Carsel et al., 1984) and GLEAMS (Leonard et al., 1986). Shoemaker and Magette (1987) presented a thorough review of the capabilities and uses of some of these available models.

CREAMS (Knisel, 1980) has been widely used for evaluating the impact of different BMPs on hydrology, erosion, and chemicals from agricultural lands. DelVecchio and Knisel (1982) used the CREAMS model to estimate the effect of seven different management systems on pollution reduction in the southeastern Coastal Plain physiographic region. They concluded that differences between management systems are important in selecting Best Management Practice (BMP) for pollution reduction and resource management. Shirmohammadi et al. (1987) examined the applicability of the GLEAMS model in evaluating the groundwater loading of pesticides in the Coastal Plain physiographic region of Maryland. Their results showed a close correlation between model predictions and the average measured pesticide concentrations in groundwater. Although water quality models have been in use for the last decade, the examination of the impact of different BMPs on both surface water and groundwater has been lacking.

The objective of this report is to examine the impact of different BMPs common to the conditions of Pennsylvania on surface and groundwater quality. To achieve the stated objective the CREAMS model was selected as an appropriate model for examining different BMPs.

CREAMS MODEL BACKGROUND

CREAMS (Knisel, 1980) is a 3 component model. The hydrology component has 2 options (daily and breakpoint). The breakpoint option is an infiltration based approach and has the advantage of examining storm effects on runoff and percolation. The daily option is advantageous with respect to data requirements (daily rainfall) and is appropriate for long term simulations. The erosion component is thorough and capable of simulating the soil loss from different watershed configurations. It considers overland, channel, impoundment, or any combination of these scenarios. The chemistry component of CREAMS has 2 submodels: Nutrient and Pesticide submodels. The nutrient submodel considers processes such as nutrient uptake, mineralization, denitrification, sediment attached N and P, loading of N and P to surface runoff, and leaching of N below the root zone. The chemistry component uses hydrology and erosion pass files as part of the input for simulation. CREAMS does not recognize manure but equivalent N and P from manure, or commercial fertilizer can be used as input. The pesticide component considers the linear adsorption isotherm for partitioning the absorbed and solution phases of the pesticides. The pesticide component in CREAMS is not as comprehensive as in GLEAMS (Leonard et al., 1986).

This study uses the CREAMS model to examine the impact of different BMPs on hydrology, erosion, and nitrogen and phosphorus loss in surface and ground water for field conditions representative of three regions in Pennsylvania. The pesticide submodel was not used in this study. While model input (described below) are intended to represent field conditions in specific areas, cautionn should be used in interpretation of model results. This analysis was intended to make relative comparisons between different BMPs. Results of CREAMS model runs presented in this study are valid only for comparison among these BMPs. Model output should not be used to estimate absolute nutrient runoff loadings for Pennsylvania watersheds.

DESCRIPTION OF SITES

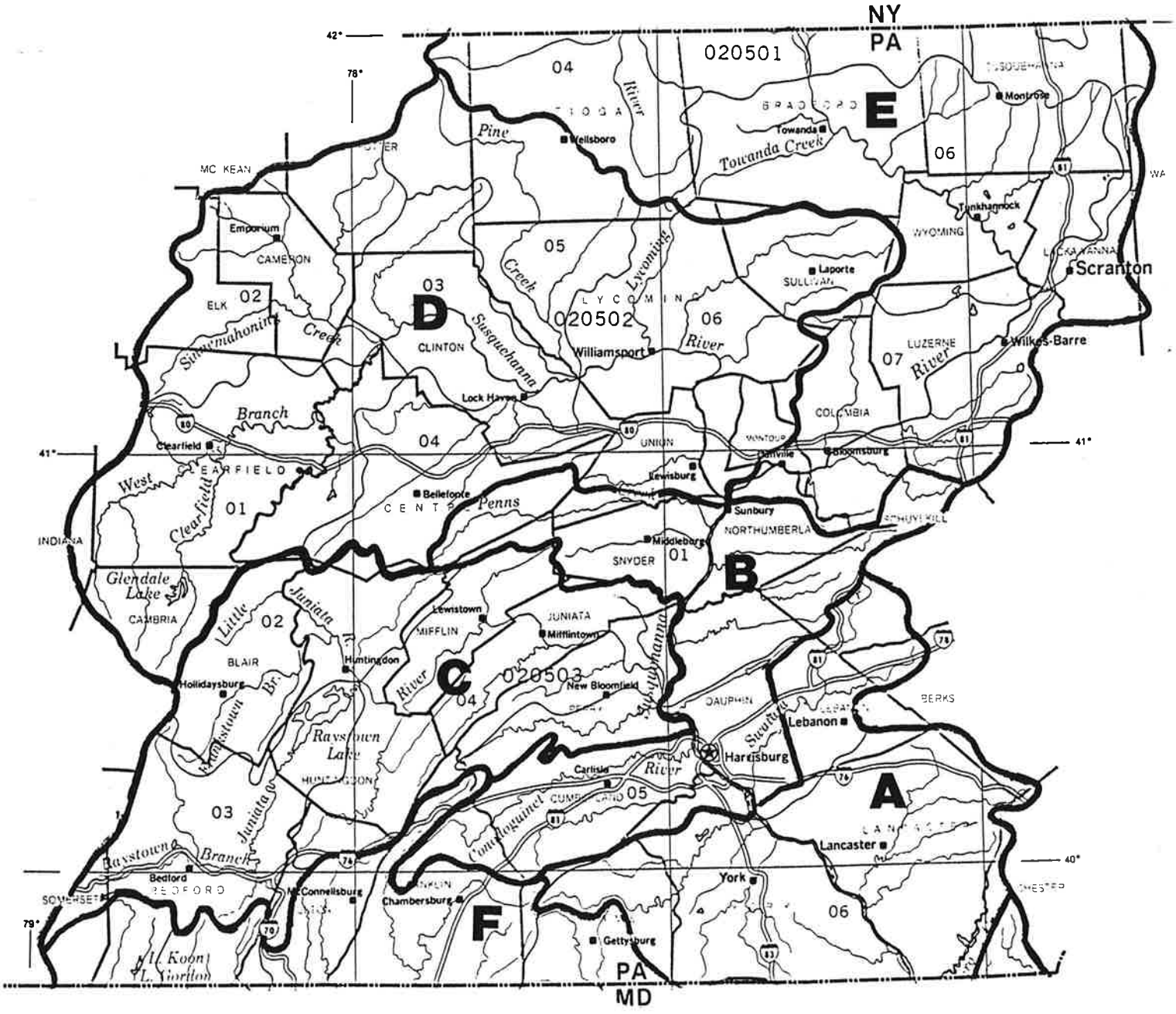
Two major criteria were used in selecting the hypothetical sub-basin conditions in this study. First, the selected sub-basin was to be representative of the whole region with respect to sub-basin size, slopes, drainage patterns, soil characteristics, land use, cropping systems and yields, and farm management strategies. The second criteria was the availability of climatic, soils, crop, and management data for the selected sub-basin. Representative fields in three sub-basins, A, E, and C, of the Susquehanna River basin (see Map 1) with areas of 2.0, 2.2, and 2.44 hectares, respectively, were selected. Sub-basin A represents the lower Susquehanna, where the dominant cropland soils are the Chester, Leck Kill and Penn series (Table 1). Sub-basin E represents the North branch of the Susquehanna and the dominant soil is Volusia (Table 1). Sub-basin C represents the western lower Susquehanna and the dominant soil is the Berks Series (Table 1). Sub-basins A, E and C reflect the conditions above the fall line in the Piedmont, Appalachian, and Blue Ridge Mountain physiographic regions, respectively.

Rainfall, temperature, and solar radiation data (1949-1978) were obtained from National Weather Service data base. Data for topographic features, soils, and typical cropping and fertilizer management plans were supplied by the Pennsylvania Bureau of Soil and Water Conservation.

MANAGEMENT PRACTICES AND CROPPING SYSTEMS

Different best management practices (BMPs) were examined in the study sites. A total of 10 BMPs were considered for each sub-basin (Table 1). The crop rotation sequence was different for each sub-basin. Sub-basin A was in 7 year rotation (2 yrs of corn grain, 2 yrs of corn silage, 1 yr of soybeans, and 2 yrs of alfalfa hay). Another 7 year rotation with 3 years of corn silage and 4 years of hay (mixture of Birdsfoot and Broome grass) was considered for sub-basin E. An 8 year rotation sequence with 2 years of corn grain, 2 years of corn silage, and 4 years of hay was selected for sub-basin C. Rotation sequences for the purpose of simulation were selected based on the common practice by farmers in Pennsylvania.

Chesapeake Bay Sub-Basins in Pennsylvania



A - Lower Susquehanna

B - Middle Susquehanna

C - Juniata

D - West Branch Susquehanna

E - North Branch Susquehanna

F - Potomac

MAP 1

TABLE 1: Characteristics of Representative Fields

Sub-basin	Field Area (ha)	Slope (%)	Soil Type	Surface Configuration	Rotation (yr)
A	2.0	8	silt loam	convex-concave	7*
E	2.2	10.5	sandy clay loam	convex-uniform	7**
C	2.44	12	silt loam	convex-concave	8***

* Corn Grain (2 years), Corn Silage (2 years), Soybeans (1 yr), Alfalfa Hay (2 years)
**Corn Silage (3 years), Hay (4 years)
***Corn Grain (2 years), Corn Silage (2 years), Hay (4 years)

Special attention should be given to the type of crop rotation. These rotations retard erosion more than other rotation sequences such as continuous corn.

TABLE 2: Management Practices Used for Simulation Purposes in Sub-basins A, E. and C. BMP# is the number used in Figures to refer to that practice.

Sub-basin	BMP #	Abbr.	Management Practices
A & C	1	CT	* Conventional Till
	3	NT	* No-Till
	5	CT-CN	* Conventional Till-Contoured
	7	NT-CN	* No-Till-Contoured
	9	CT-TR	Conventional Till-Terraces
	2	CT-NMP	* Conventional Till-Nutrient Management Plan
	4	NT-NMP	* No-Till-Nutrient Management Plan
	6	CT-CN-NMP	* Conventional Till-Contoured-Nutrient Management Plan
	8	NT-CN-NMP	* No-Till-Contoured-Nutrient Mgmt. Plan
	10	CT-TR-NMP	Conventional Till-Terr.-Nutrient Mgmt. Plan
E	9	CT-ST	Convent. Till-Strip Crop-Diversion-Grassed Waterway
	10	CT-ST-NMP	Convent. Till-Strip Crop-Diversion-Grassed Waterway-Nutrient Mgmt. Plan

* Practices marked by single star were also practiced in sub-basin E.

FERTILIZATION PLAN

Fertilizer and manure were read into the model as elemental N and P. The CREAMS model does not recognize manure and has no mechanism to convert it into elemental N and P. Fifty percent of the total manure N was considered to be available and was input into the model as split applications at designated dates. Fertilizer and manure application rates and schedules used in the model are described in Tables I - III.

TABLE I. Sub-basin A:

1.) Without Nutrient Management Plan:

a.) Commercial Fertilzer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn*	4/25	20 cm incorporation	56.0	24.0
	5/07	7.2 cm "	22.4	24.0
	6/15	surface applied	56.0	0
Soybeans	4/25	12.7 cm incorporation	22.4	20.0
Alfalfa**	4/07	7.6 cm "	22.4	29.0

* 3 fertilizer applications for each year of corn
** one time application for 1st year alfalfa only

b.) Manure (dairy) Application

With 10-4-8 analysis, at 41.4 Mg/ha (18 t/ac) per year rate, equal surface applications rates of 6.89 Mg/ha (3 t/ac) at six dates were assumed.

Crop	Dates	Manure Applied* (Mg/ha)	N	P
		-------- each date	---kg/ha---	----------
Corn & soybeans	11/1,12/1,1/1,2/1 3/1,4/1	6.89	16.8	5.86
Alfalfa	5/21,6/21,7/21, 8/26,9/1,10/21	6.89	16.8	5.86

* Surface applied unless otherwise indicated

2.) With Nutrient Management Plan (NMP)

The NMP is based on the total nutrient needs to sustain crop yield, as recommended in the agronomy guides.

a.) Commercial Fertilizer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn	5/7	7.6 cm incorporation	--	14.7
Soybeans	--			
Alfalfa*	4/7	7.6 cm "	22.4	29.3

* one time application for 1st year alfalfa only

b.) Manure (dairy) Application

With 10-4-8 analysis, at 41.4 Mg/ha (18 t/ac) per year rate, three applications (50%, 30%, 20%) of N were used to represent the availability of N in the model.

Crop	Dates	Manure Applied* (Mg/ha)	N	P
		-------- each date ----------	(---kg/ha---)	
Corn*	4/23	41.4	50.83	35.17
	6/11	--	30	0
	7/11	--	20	0
Soybeans	11/1	41.4	50.83	35.17
	12/18	--	30	0
	1/8	--	20	0
Alfalfa	6/9,7/14,8/24	13.8	33.6	11.73

* manure on corn incorporated 20.3 cm

TABLE II. Sub-basin E:

1.) Without Nutrient Management Plan:

a.) Commercial Fertilizer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn*	5/1	5 cm incorporation	84.0	26.8
	5/15	5 cm "	50.4	22.0
Hay(yr 1)	4/20	surface applied	67.0	12.2
Hay (yr 2-4)	6/4	surface applied	0	39.0

* 2 fertilizer applications for each year of corn

b.) Manure (dairy) Application

With 10-4-8 analysis, at 23.0 Mg/ha (18 t/ac) per year rate, manure was surface applied to both corn silage and hay.

Crop	Dates	Manure Applied* (Mg/ha)	N	P
		-------- each date	--(kg/ha)--	----------
Corn	11/1,12/1,1/1,2/1 3/1,4/1	3.83	9.33	3.42
Hay	5/21,6/21,7/21,8/26 9/1,10/21	3.83	9.33	3.42

* Surface applied unless otherwise indicated

2.) With Nutrient Management Plan (NMP)

a.) Commercial Fertilizer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn	5/14	5 cm incorporation	22.4	19.53
Hay(yr 1)	4/4	20 cm "	0	21.97
	4/20	5 cm "	22.4	29.30
Hay	4/20	top dress	0	39.07

b.) Manure (dairy) Application

With 10-4-8 analysis, at 52.9 Mg/ha (23 t/ac) per year rate, three applications (50%, 30%, 20%) on corn only were used to represent the availability of N in the model.

Crop	Dates	Manure Applied* (Mg/ha) ------- each date	N	P
			--kg/ha--	
Corn*	5/1	52.0	64.40	44.93
	6/12	--	38.6	0
	7/12	--	25.8	0

* manure on corn incorporated 20.3 cm

TABLE III. Sub-basin C:

1.) Without Nutrient Management Plan:

a.) Commercial Fertilizer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn*	5/10	10.2 cm incorporation	84.0	36.6
	5/15	surface applied	22.4	29.3
Hay(yr 1)	4/01	10.2 cm incorporation	67.0	12.2
Hay(yr 2)	4/07	surface applied	0	18.1

* 2 fertilizer applications for each year of corn

b.) Manure (dairy) Application

With 10-4-8 analysis, at 34.5 Mg/ha (15 t/ac) per year rate, equal surface applications rates of 6.9 Mg/ha (3.0 t/ac) at five dates were assumed.

Crop	Dates	Manure Applied* (Mg/ha) -------- each date	N	P
			---kg/ha---	
Corn &	10/25,12/1,1/15 3/1,4/20	6.89	16.8	5.86
Hay	5/21,6/21,7/21, 8/26,9/1,10/21	6.89	16.8	5.86

* Surface applied unless otherwise indicated

2.) With Nutrient Management Plan (NMP)

The NMP is based on the total nutrient needs to sustain crop yield, as recommended in the agronomy guides.

a.) Commercial Fertilizer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn(g)	5/15	10.2 cm incorporation	5.6	0
Corn(sil)	5/15	10.2 cm incorporation	28.0	0
Hay*	4/05	10.2 cm incorporation	22.4	29.3

* one time application for 1st year hay only

b.) Manure (dairy) Application

With 10-4-8 analysis, at 34.5 Mg/ha (15 t/ac) per year rate, three applications (50%, 30%, 20%) of N were used to represent the availability of N in the model on corn grain and silage. Three equal applications were applied during hay years.

Crop	Dates	Manure Applied* (Mg/ha)	N	P
		-------- each date	---kg/ha--	
Corn*	4/24	34.5	42.0	29.3
	6/11	--	25.2	0
	7/11	--	16.8	0
Hay(yr 1)	6/15,7/20,8/30	11.5	28.0	9.77
Hay(yr 2)	6/5,7/10,8/15	11.5	28.0	9.77

* manure on corn incorporated 20.3 cm

RESULTS AND DISCUSSION

Simulation results of the CREAMS model demonstrate the impact of different agricultural Best Management Practices (Table 2) on hydrology, soil loss, and nitrogen and phosphorus loss in surface runoff and percolation below the root zone for each of the study fields. In this study nitrogen in percolation water is assumed to be transported to the groundwater. Results are organized in the following categories for clarity:

- Surface and ground water loading of nutrients (N and P) as affected by different BMPs
- Comparison of pollutant loadings between fields
- Percent reduction or increase in soil loss, P-surface, N-surface, and N-leachate
- Yearly variation of the ratio of runoff to percolation for all BMPs
- Yearly variation of N and P loss in surface processes and N-leachate
- Impact of dry (low rainfall) and wet year (high rainfall) conditions on hydrologic and pollutant loadings

Surface and ground water loading of nutrients (N and P) as affected by different BMPs

Figures 1, 2, and 3 show the nutrient (N and P) loadings to surface water and groundwater under different BMPs for fields in sub-basins A, E and C, respectively. Results are based on 30 year (1949-1978) averages and BMPs are numbered from 1 through 10 with even numbers representing the BMPs with the nutrient management plan (NMP). The data clearly indicate that nutrient management (NMP) is a very effective practice for reducing N and P loading to surface runoff. These data also indicate that under the same BMP, addition of nutrient management reduces the groundwater loading of nitrogen (N) more than 50%. The NMP is shown to be effective in reducing surface and groundwater loadings of nutrients for both conventional and no-till practices with or without erosion control structures. Of course, practices such as contouring, terracing and strip-cropping with diversion and grassed waterways reduce surface loading while increasing nutrient loading in the leaching component. BMP's 3 (conventional/contour tillage) and 9 (strip cropping for sub-basin E; terraces for sub-basins A and C) resulted in increased loading of N and P to groundwater while decreasing both N and P loadings to surface water.

Comparison of pollutant loadings between fields

Figures 4, 5, 6 and 7 present sediment loss, surface P losses, surface N losses and N in leachate, respectively, for all three sub-basins. Results indicate that surface loading of sediment, P and N are higher for the field in sub-basin E than the fields in sub-basins A and C. N in leachate (groundwater loading of N) is lowest for the sub-basin E field. This may

be attributed to the sandy clay loam soil with low conductance, which is typical of sub-basin E, in contrast to the more conductive silt loam soil of sub-basins A and C. Study fields in sub-basins A and C had similar surface loading characteristics that varied slightly with the type of BMP used. Higher groundwater loading of N (N-leachate) for field C than field A. This may be due to greater percolation in the sub-basin field C caused by the 10 inch (25 cm) thick top loamy profile characteristics of the Berks soil series.

Percent reduction or increase in soil loss, P-surface, N-surface, and N-leachate

Tables 3, 4, and 5 present the percent reductions or increases in soil loss, P in surface runoff, N in surface runoff, and N in leachate resulting from the use of different BMPs compared with conventional up and down hill practice for fields in sub-basins A, E,and C, respectively. The data clearly indicate that all of the BMPs reduce soil loss for all of the study fields when compared with the conventional up and down hill practice. Soil loss reductions ranged from 30.1% (CT-CN) to 78% (NT-CN), 28.9% (CT-CN) to 90.4% (CT-ST-DV), 32.20% (CT-CN) to 72.1% (NT-CN), for fields in sub-basins A, E, and C, respectively (Tables 3-5). Similarly, all of the BMPs resulted in significant reductions in N and P loadings to surface runoff in the study sites. The highest reductions were obtained for BMPs with the NMP option for all fields (Tables 3-5). Erosion control practices (contouring, strip cropping and terracing) generally reduced the surface runoff and pollutant constituents (soil loss, P and N) in the quantity of it . However, these practices also caused a slight increase in N-leachate unless NMP was used in conjunction with those practices (Figure 8). Strip cropping did not increase N-leachate over conventional tillage and in the case without NMP actually reduced N-leachate by 1.1%. Although economic feasibility and site specific analysis is required for selecting any BMP, results in tables 3, 4 and 5 indicate that no-till with NMP (NT-NMP) is the optimum practice with respect to impact on reducing soil loss, N and P in surface runoff, and N in ground water. One should note that strip cropping with diversion and grassed waterway with NMP when applied to the field in sub-basin E (Table 4) produced higher reductions than no-till with NMP (NT-NMP). However, the cost of constructing a grassed waterway and diversion may not justify that option. Figure 8 also indicates that N- leachate was highest for the field in sub-basin E when compared to the other fields for all BMPs.

Yearly variation of the ratio of runoff to percolation for all BMPs

Figures 9, 10, and 11 show the yearly variation in the ratios of runoff to percolation as affected by different BMPs for fields in sub-basins A, E, and C, respectively. Ratios are generally the lowest for the conventional tillage with terraces (CT-TR) practice for both fields in sub-basins A (Figure 9) and C (Figure 11) for the entire simulation period. However, no-till with contouring (NT-CN) resulted in the lowest ratios for field E (Figure 10). The conventional tillage up and down hill practice resulted the highest ratios for entire period and for all the study sites. Results also indicate the fluctuating nature of the responses from one year to the next due to the variations in the climatological data.

TABLE 3: Percent increase or reduction (-) in soil loss, N-Surface and N-Leachate for different BMPS when compared with conventional tillage for Sub-basin A.

BMP	Soil Loss	N Surface	P Surface	N Leach
CT-NMP	0.00	-27.36	-52.14	-37.49
CN	-30.11	-35.12	-37.53	6.07
CN-NMP	-30.11	-50.39	-66.23	-34.63
NT	-73.86	-54.03	-54.16	7.94
NT-NMP	-73.86	-69.58	-83.57	-33.70
NT-CN	-78.13	-57.25	-57.01	8.71
NT-CN-NMP	-78.13	-72.58	-86.10	-33.23
CT-TR	-72.16	-54.84	-70.91	8.26
CT-TR-NMP	-72.16	-69.52	-82.99	-33.47

TABLE 4. Percent increase or reduction (-) in soil loss, N-Surface and N-Leachate for different BMPS when compared with conventional tillage for Sub-basin E.

BMP	Soil Loss	N Surface	P Surface	N Leach
CT-NMP	0.00	-19.77	-13.89	-54.72
CN	-28.93	-24.64	-26.00	6.77
CN-NMP	-28.93	-42.72	-39.48	-51.66
NT	-74.08	-51.72	-57.77	8.08
NT-NMP	-74.08	-70.12	-71.55	-50.78
NT-CN	-79.47	-57.67	-64.28	9.17
NT-CN-NMP	-79.47	-75.78	-77.95	-50.17
CT-ST	-90.42	-64.05	-77.24	- 1.14
CT-ST-NMP	-90.42	-81.95	-89.35	-47.69

TABLE 5. Percent increase or reduction (-) in soil loss, N-Surface and N-Leachate for different BMPS when compared with conventional tillage for Sub-basin C.

BMP	Soil Loss	N Surface	P Surface	N Leach
CT-NMP	0.00	-37.17	-38.85	-29.78
CN	-32.04	-36.67	-35.22	10.82
CN-NMP	-32.04	-58.12	-57.60	-23.83
NT	-69.26	-50.31	-53.59	16.41
NT-NMP	-69.26	-72.59	-77.07	-20.90
NT-CN	-72.11	-52.22	-55.95	16.96
NT-CN-NMP	-72.11	-74.37	-79.20	-20.56
CT-TR	-71.73	-54.27	-58.00	12.75
CT-TR-NMP	-71.73	-75.29	-79.83	-22.58

Yearly variation of N and P loss in surface processes and N leachate

Figures 12, 13 and 14 show the yearly variations of nitrogen in surface processes (runoff and sediment) for the worst and best case scenarios for each of the fields. In regard to N loadings to the surface, the data indicate that conventional tillage (CT) practice is the worst case for all fields. No-till with contour and NMP (NT-CN-NMP) represents the best practice with respect to the surface loadings of N in sub-basin A croplands (Figure 12). In sub-basin E, the CT-ST-NMP (conventional, strip cropping with diversion, grassed waterway, and NMP) is the practice with lowest N-surface loadings (Figure 13). Conventional tillage with terraces and NMP (CT-TR-NMP) is the best BMP with respect to N-surface loading for field in sub-basin C (Figure 14). The model output reveals a similar impact of relationships and surface loadings of P (Figures 15, 16 and 17).

The best practice with respect to surface loadings of N may be the worst practice with respect to N loadings to the groundwater. Figures 18, 19 and 20 illustrate nitrogen loss in percolation for fields in sub-basins A, E, and C respectively. The no-till-contoured practice without NMP (NT-CN) practice results in the highest loss of N in percolation for all of the study sites. On the other hand, the lowest quantities of N in percolation are lost with conventional tillage with NMP (CT-NMP).

Results presented above (Figures 12-20) clearly indicate that selecting any BMP with respect to either surface or ground water quality may be in error if the quality of both resources are of concern.

Impact of dry (low rainfall) and wet year (high rainfall) conditions on hydrologic and pollutant loadings.

Tables 6 and 7 compare the hydrologic and water quality responses of the three study site sub-basins (A, E and C) between dry and wet years for worst case and best case management scenarios, respectively. Worst and best case management scenarios were selected using 30 year average surface loadings for each BMP. However, a dry year or wet year under a worst case or best case scenario is only a single year out of 30 years and may not be an optimum year with respect to loadings. Data from these tables indicate higher hydrologic and water quality responses for wet years than dry years for both cases for all fields except C. In field C hydrologic responses were higher for the wet year than the dry year while sediment, N and P loadings to surface processes were lower for the wet year than the dry year for both cases. However, N-leachate was higher for the wet year than the dry year for both cases. This may be attributed to the timing of rainfall events with respect to fertilizer applications and crop cover index. Crop cover was first year hay and second year hay for the dry year (1969) and the wet year (1970), respectively. The second year hay generally creates good crop coverage and root system which tends to increase infiltration and reduce runoff. Erosion is also reduced since the crop protects the soil from detachment. Nitrogen and phosphorus fixation also increase by good crop establishment and therefore, less of these constituents are available for loss.

TABLE 6: Comparison of hydrologic and water quality responses for dry and wet years for worst case scenario* (conventional tillage) with respect to surface loadings for fields in sub-basins A, E, C.

Parameter	Sub-basin A		Sub-basin E		Sub-basin C	
	1965	1975	1969	1972	1969	1970
Rainfall, cm	73.4	160.1	68.4	108.1	65.0	133.8
Runoff, cm	4.7	20.7	5.6	20.5	3.5	9.5
Percolation,cm	4.7	52.8	3.5	28.2	2.3	23.8
Sediment, Mg/ha	1.3	9.1	0.4	106.7	3.1	0.5
N-surf, kg/ha	19.0	35.5	18.8	196.0	23.8	11.0
N-leach,kg/ha	10.6	150.3	50.3	75.8	38.6	216.2
P-surf, kg/ha	8.8	16.4	1.0	80.3	7.2	1.3

* worst case scenario was selected by comparing the 30 year averages of surface loading with respect to each BMP for each sub-basin.

A: 1965 corn silage
1975 alfalfa

E: 1969 hay
1972 corn silage

C: 1969 hay 1st year
1970 hay 2nd year

TABLE 7: Comparison of hydrologic and water quality responses for dry and wet years for best case scenario* with respect to surface loadings for sub-basin A (NT-CN-NMP), sub-basin E (CT-ST-NMP), and sub-basin C (CT-TR-NMP).

Parameter	Sub-basin A		Sub-basin E		Sub-basin C	
	1965	1975	1969	1972	1969	1970
Rainfall, cm	73.4	160.1	68.4	108.1	65.0	133.8
Runoff, cm	3.0	15.0	4.7	15.3	1.9	5.2
Percolation,cm	7.2	58.7	4.0	29.6	3.0	28.1
Sediment, Mg/ha	.04	3.3	.04	6.4	0.7	0.0
N-surf, kg/ha	3.9	12.9	9.8	20.5	5.7	3.5
N-leach,kg/ha	2.8	132.6	23.7	65.7	30.9	182.1
P-surf, kg/ha	0.2	4.9	0.2	5.7	1.2	0.2

* best case scenario was selected by comparing the 30 year averages of surface loadings with respect to each BMP for each sub-basin.

Tables A1-A12 (Appendix A), Tables B1-B12 (Appendix B) and Tables C1-C12 (Appendix C) show the yearly, long term (30 yr.) averages, and long term (30 yr.) totals of hydrology and loadings of fields A, E, and C, respectively. These data may be used for further examination of BMPs for each field on a yearly basis.

SUMMARY AND CONCLUSIONS

CREAMS (Chemical, Runoff, Erosion from Agricultural Management Systems) was used to simulate long term relative effects of different agricultural Best Management Practices (BMPs) on hydrology (runoff/percolation), soil loss, and nitrogen (N) loadings to surface water and groundwater. Three hypothetical sub-basins, each representative of different physiographic regions with distinct soils and geologic characteristics were selected for the simulation purposes. Different tillage practices with and without erosion control structures were selected for the purposes of this study. The impact of the nutrient management plan on surface and groundwater quality was also evaluated for the conditions of this study. Thorough review of the available simulation results suggest the following conclusions:

1. The conventional tillage practice results in highest soil loss, N and P loadings to surface runoff.

2. No-till with contours (NT-CN) was found to yield highest nitrogen loadings to groundwater.

3. The nutrient management practice (NMP) is a very effective practice for reducing N loadings and concentrations to both surface water and ground water.

4. No-till with NMP may be selected as an optimum BMP with respect to reducing soil loss, N-runoff, and N- leachate, considering the lower dollar input required for establishing this BMP compared with the cost of structural BMPs.

5. Strip cropping with diversion and grassed waterway reduces sediment and sediment bound N and P significantly.

6. Wet years generally have higher hydrologic and water quality responses than dry years but the crop cover and timing of rainfall events also have significant effects.

REFERENCES CITED

Angle, J.S., G. McClung, M.S. McIntosh, P.M. Thomas, and D.C. Wolf. 1984. Nutrient losses in runoff from conventional and no- till corn watersheds. J. Environmental Quality, 13(3): 431-435.

Bailey, G.W. and T.E. Wadell. 1979. Best management practices for agriculture and silviculture: An integrated overview, p. 35- 546, In: Best management practices for agriculture and silviculture, R.C. Loehr, D.A. Haith, M.F. Walter and C.S. Morton. Ann Arbor Science Publishers Inc., Ann Arbor, MI.

Baker, J.L., and H.P. Johnson. 1983. Evaluating the effectiveness of BMPs from field studies. In F. Schaller and G. Bailey [eds] Agricultural Management and Water Quality. Iowa State University Press, Ames. pp. 281-304.

Carsel, R.F., C.N. Smith, L.A. Mulkey, J.D. Dean, and P.P. Jowise. 1984. User's Manual for the Pesticide Root Zone Model (PRZM): Release 1. U.S. Environmental Protection Agency, Athens, GA. EPA-EPA-600/3-84-109.

Cohen, D.B. 1986. Groundwater contamination by toxic substances: A California assessment. In W.Y. Garner, R.C. Honeycutt, and H.N. Nigg [eds], Evaluation of Pesticides in Groundwater. Am. Chem. Soc., Washington D.C., pp. 499-529.

DelVecchio, J.R. and W.G. Knisel. 1982. Application of a field- scale nonpoint pollution model. Proceedings of Specialty Conference on Environmentally sound water and soil management held in Orlando, Florida, July 20-23. Published by ASAE. pp. 227-236.

Donigian, A.S. 1982. Water quality modeling relation to watershed hydrology. In V.P. Singh [ed], Modeling components of hydrologic cycle. Water Resources Publications, Littleton, Colo. pp. 343-382.

Erwin, W. 1988. Regulating Water Quality: A farmer's perspective. J. of Soil and Water Conservation, 43(1):65-66.

Hallberg, G. 1984. Agricultural Chemicals and groundwater quality in Iowa. Iowa State University, Coop. Ext. Serv., Ames.

Jones, R.L., and R.C. Back. 1984. Monitoring aldicarb residues in Florida soil and water. Environ. Toxicol. and Chem., 3:9-20.

Kanwar, R.S., J.L. Baker and J.M. Laflen. 1985a. Effect of tillage systems and methods of fertilizer application on nitrate movement through the soil profile. TRANSACTIONS of the ASAE 28:1802-1807.

Kenimer, A.L., S. Mostaghimi, R.W. Young, T.A. Dillaha and V.O. Shanholtz. 1987. Effects of residue cover on pesticide losses from conventional and no-till systems. ASAE Paper No. 87-2541, American Society of Agricultural Engineers, St. Joseph, MI 49085.

Knisel, W.G. (Editor). 1980. CREAMS: A field-scale model for Chemical, Runoff, and Erosion from Agricultural Management Systems. Conservation Service Report 26, U.S. Department of Agriculture, Washington, D.C.

Laflen, J.M. and T.S. Colvin. 1981. Effect of crop residue on soil loss from continuous row cropping. TRANSACTIONS of ASAE 24(3):605-609.

Langdale, G.W., A.P. Bonnett, R.A. Leonard, and W.G. Fleming. 1979. Reduction of soil erosion by no-till system in southern Piedmont. TRANSACTIONS of ASAE 22:82-87.

Lee, L.K. and E.G. Nielson. 1987. The extent and costs of groundwater contamination by agriculture. J. of Soil and Water Conservation, 42(4),243-248.

Leonard, R.A., W.G. Knisel, and D.A. Still. 1986. GLEAMS: Groundwater Loading Effects of Agricultural Management Systems. ASAE Paper No. 86-2511, American Society of Agricultural Engineers, St. Joseph, MI 49085.

Pionke, H.B., and J.B. Urban. 1985. Effect of agricultural land use on groundwater quality in a small Pennsylvania watershed. Groundwater 23: 68-80.

Ritter, W.F. and K.A. Manger. 1985. Effect of irrigation efficiencies on nitrogen leaching losses. J. of Irrigation and Drainage Engineering, ASCE, 3(3).

Shirmohammadi, Adel, W.L. Magette, R.B. Brinsfield, and K. Staver. Groundwater loading of agrochemicals in the Coastal Plain Region. ASAE Paper No. 87-2632, American Society of Agricultural Engineers, St. Joseph, MI 49085.

Shoemaker, L.L. and W.L. Magette. 1987. Groundwater models for assessing agricultural best management practices. ASAE Paper No. 87-2021, American Society of Agricultural Engineers, St. Joseph, MI 45085.

Solley, W.B., E.B. Chase, and W.B. Mann, IV. 1983. Estimated uses of water in the United States in 1980. Circ. 1001. U.S. Geological Survey, Washington, D.C.

Steichen, J.M. and L.W. Russel. 1982. Conservation tillage effects on water conservation and runoff. National Technical Information No. PB83-139865.

Wendt, R.C. and R.E. Burwell. 1985. Runoff and soil losses for conventional, reduced, and no-till corn. J. of Soil and Water Conservation, 40(5):450-454.

Figure 1

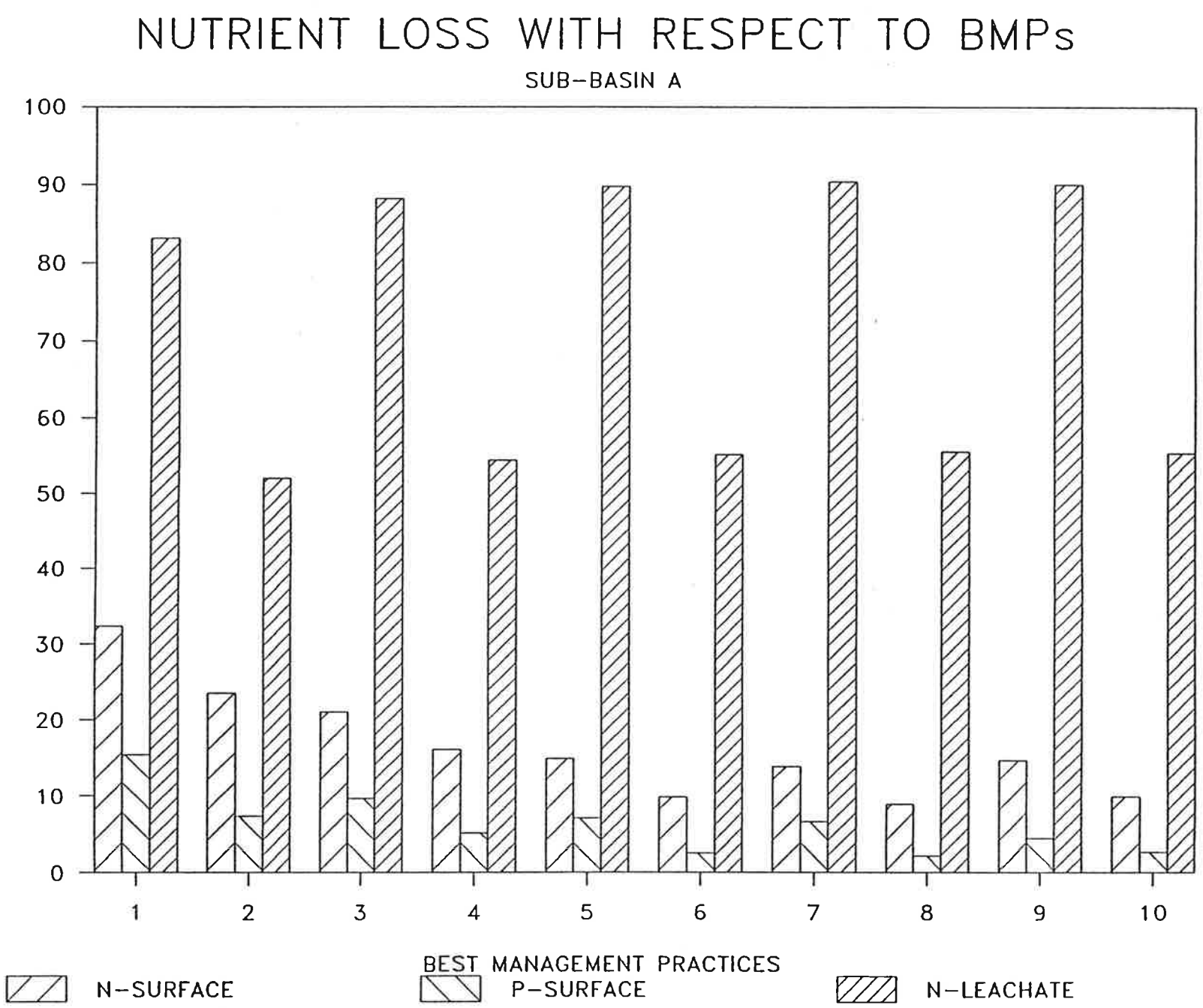

NUTRIENT LOSS WITH RESPECT TO BMPs
SUB-BASIN A
CHEMICAL LOADING (KG/HA)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
N-SURFACE
P-SURFACE
N-LEACHATE

Figure 2

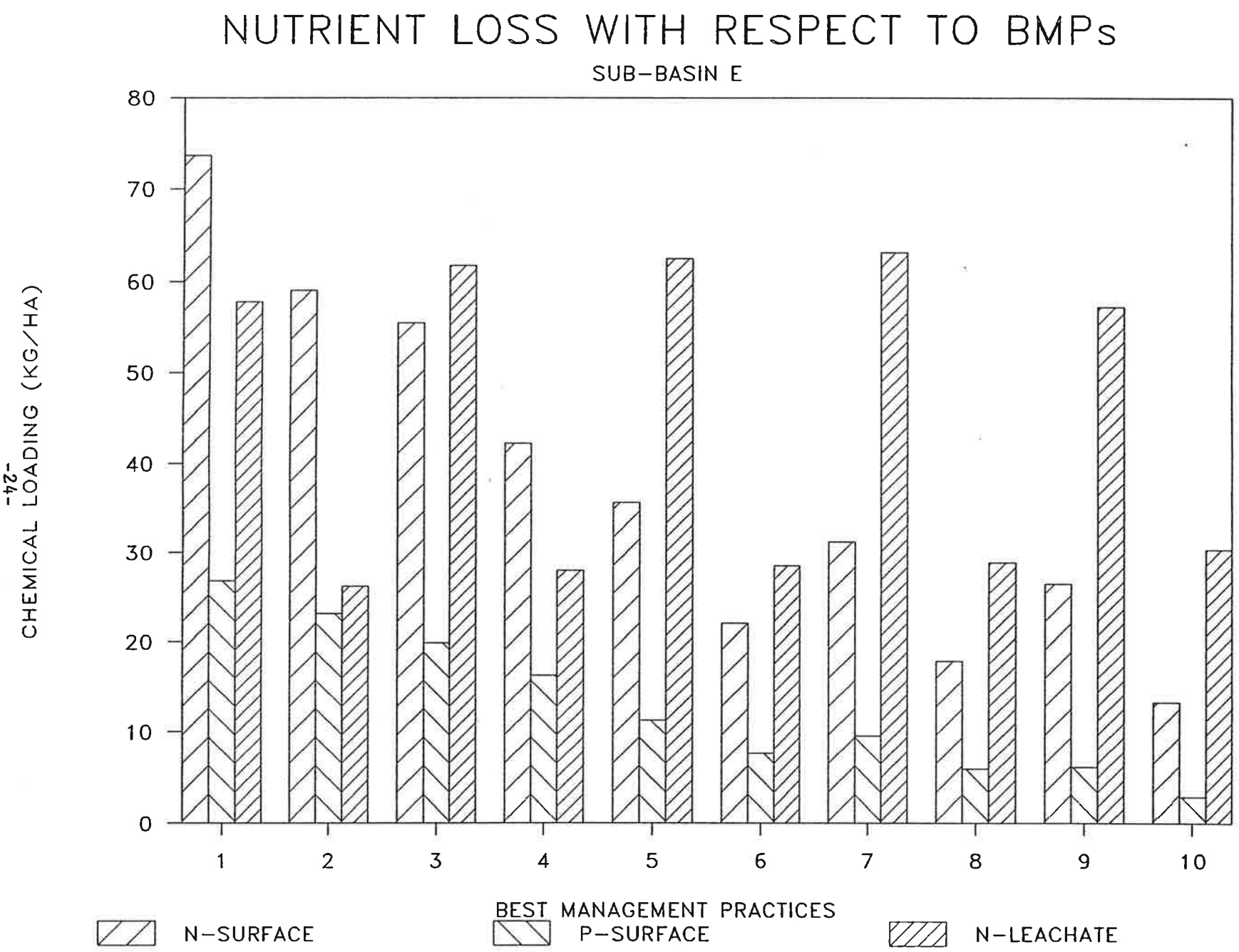

NUTRIENT LOSS WITH RESPECT TO BMPs
SUB-BASIN E
CHEMICAL LOADING (KG/HA)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
N-SURFACE
P-SURFACE
N-LEACHATE

Figure 3

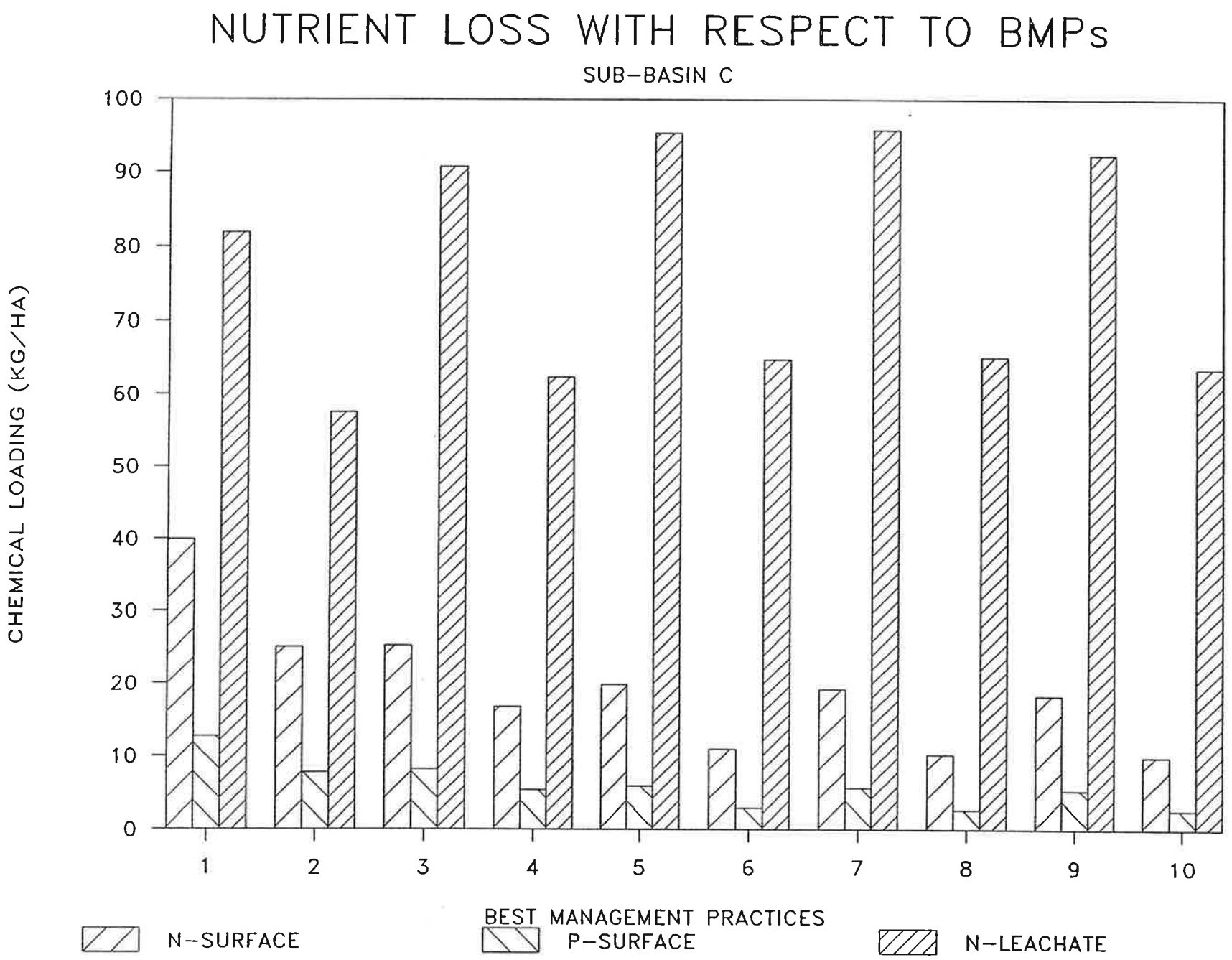

NUTRIENT LOSS WITH RESPECT TO BMPs
SUB-BASIN C
CHEMICAL LOADING (KG/HA)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
N-SURFACE
P-SURFACE
N-LEACHATE

Figure 4

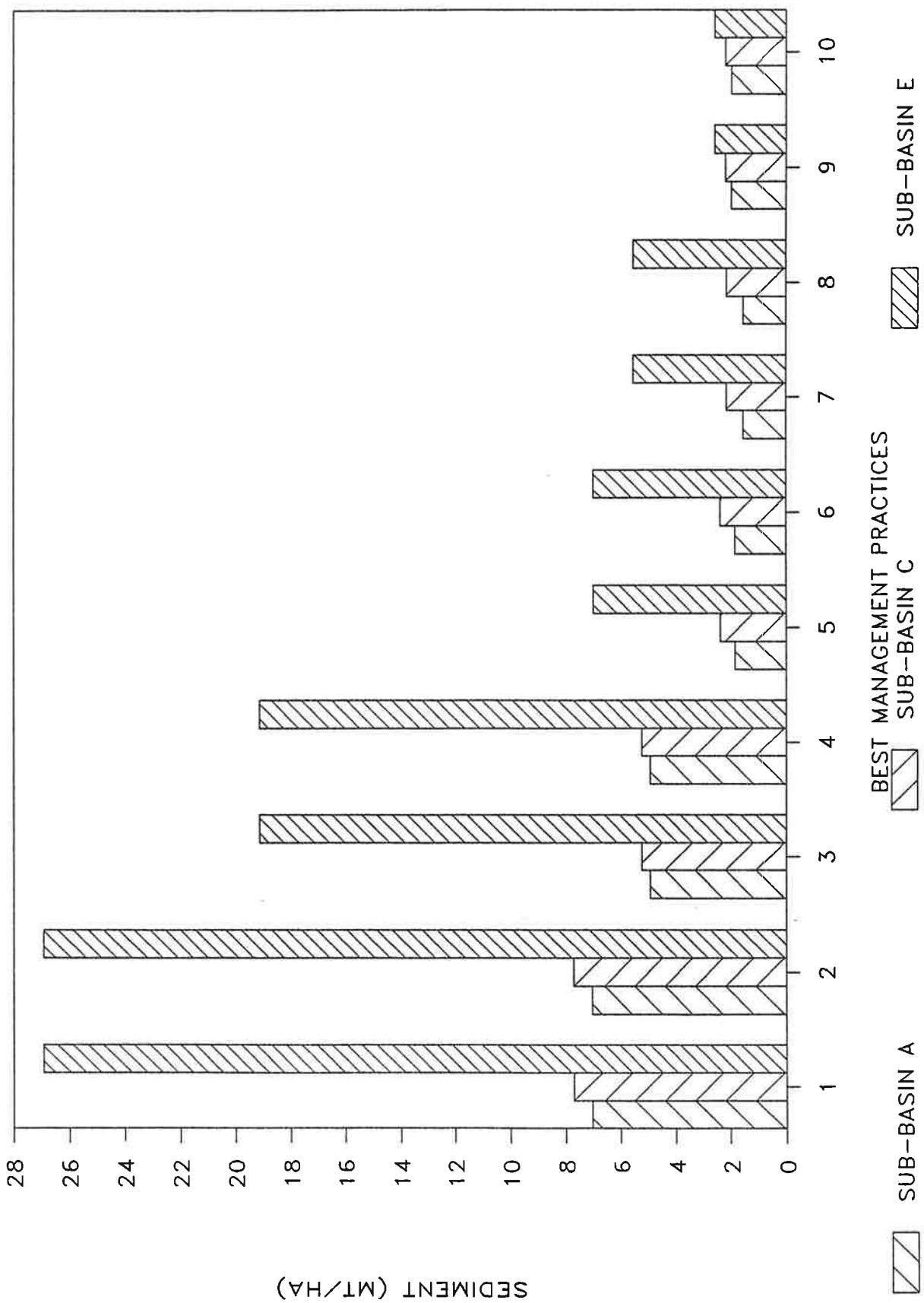

SEDIMENT LOSS IN EACH SUB-BASIN
FOR ALL BMPs
SEDIMENT (MT/HA)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
SUB-BASIN A
SUB-BASIN C
SUB-BASIN E

Figure 5

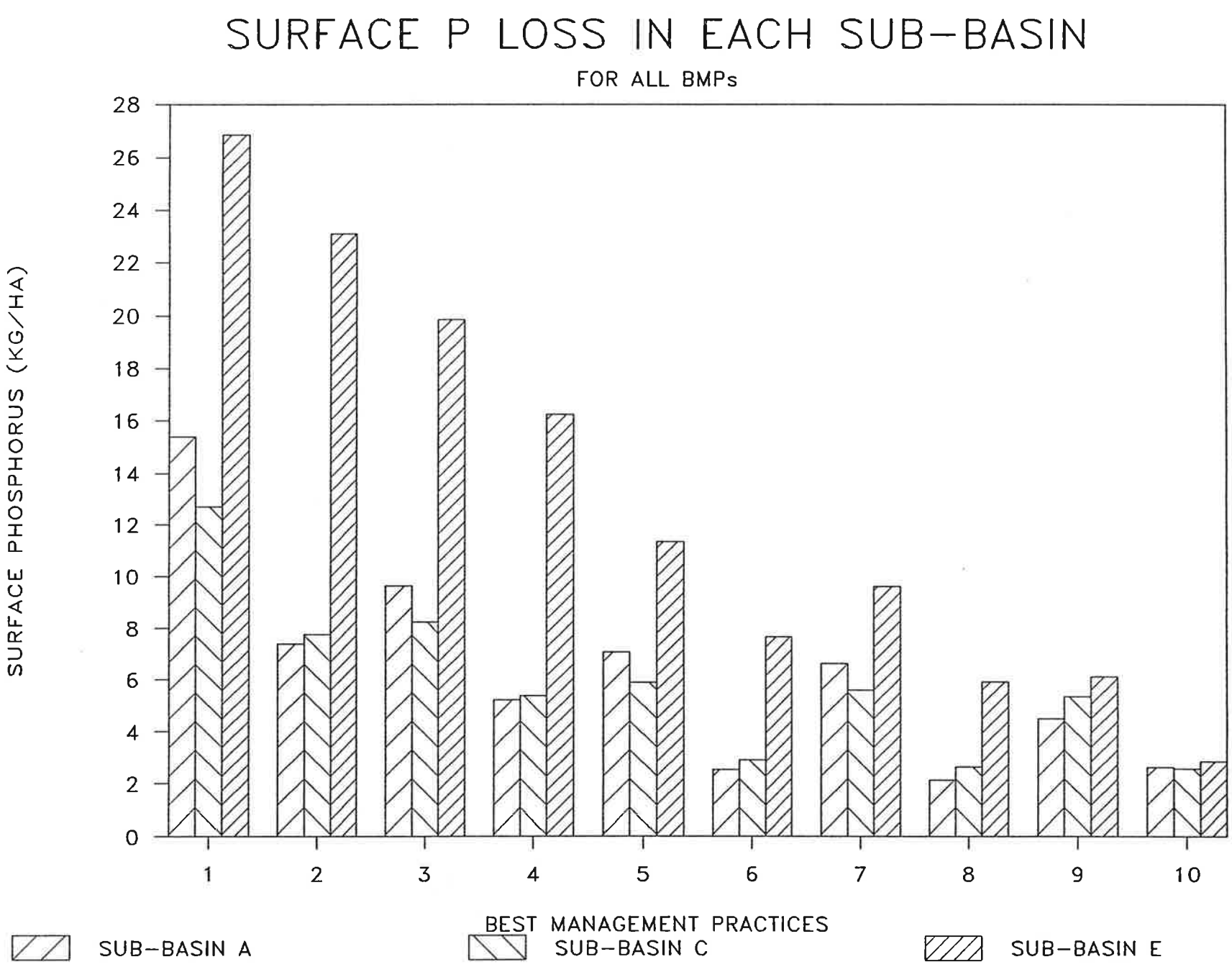

SURFACE P LOSS IN EACH SUB-BASIN
FOR ALL BMPs
SURFACE PHOSPHORUS (KG/HA)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
SUB-BASIN A
SUB-BASIN C
SUB-BASIN E

Figure 6

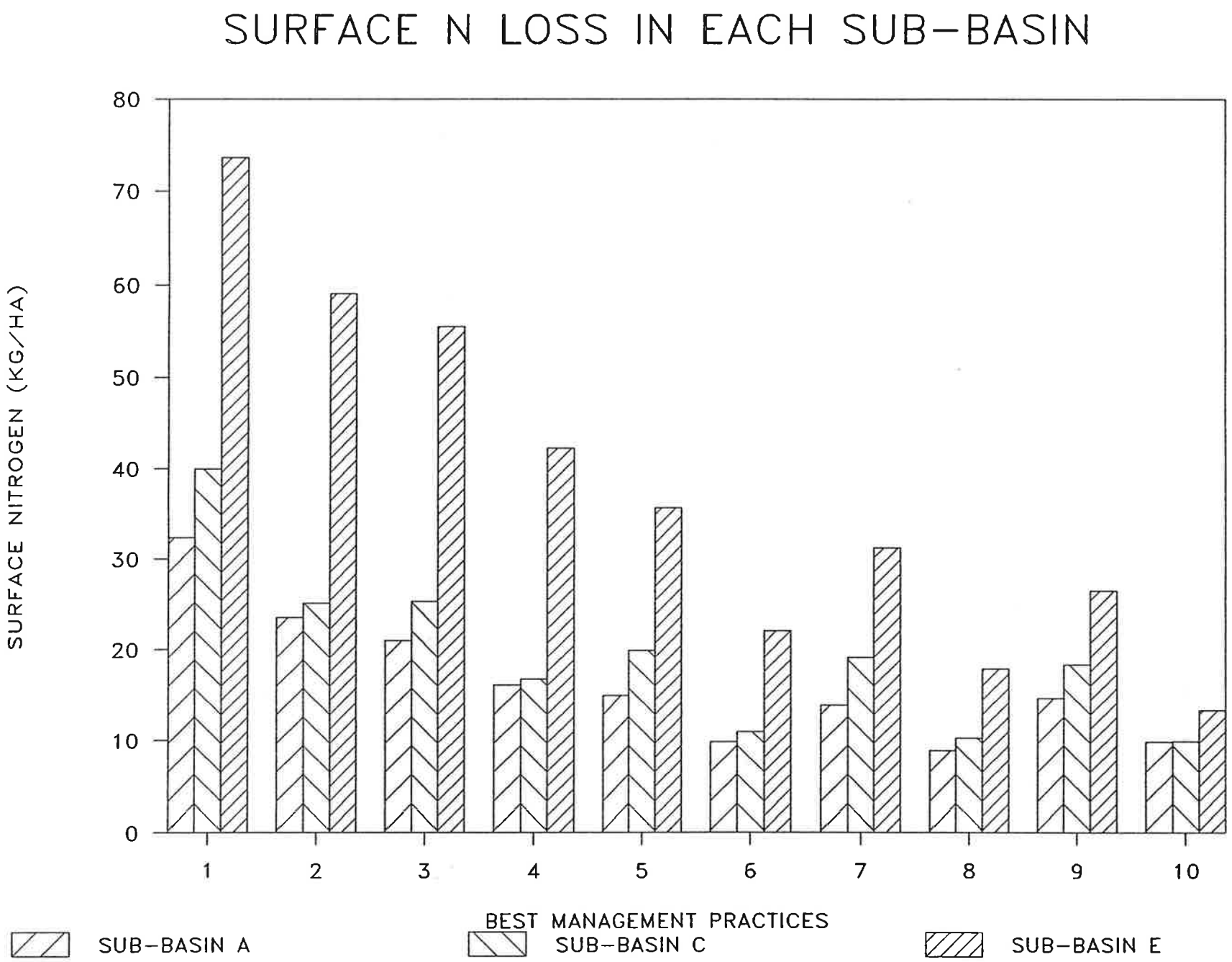

SURFACE N LOSS IN EACH SUB-BASIN
SURFACE NITROGEN (KG/HA)
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
SUB-BASIN A
SUB-BASIN C
SUB-BASIN E

Figure 7

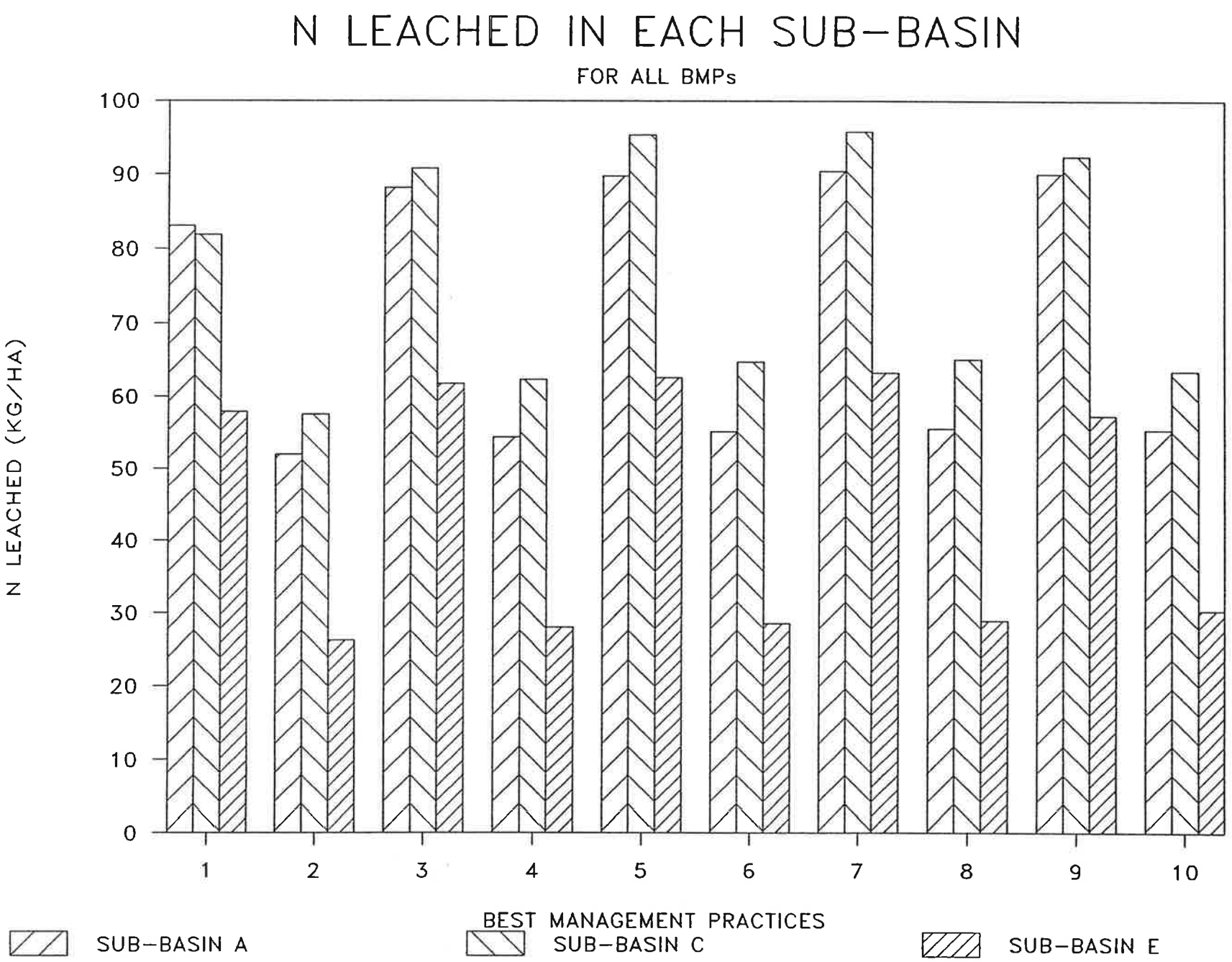

N LEACHED IN EACH SUB-BASIN
FOR ALL BMPs
N LEACHED (KG/HA)
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
SUB-BASIN A
SUB-BASIN C
SUB-BASIN E

Figure 8

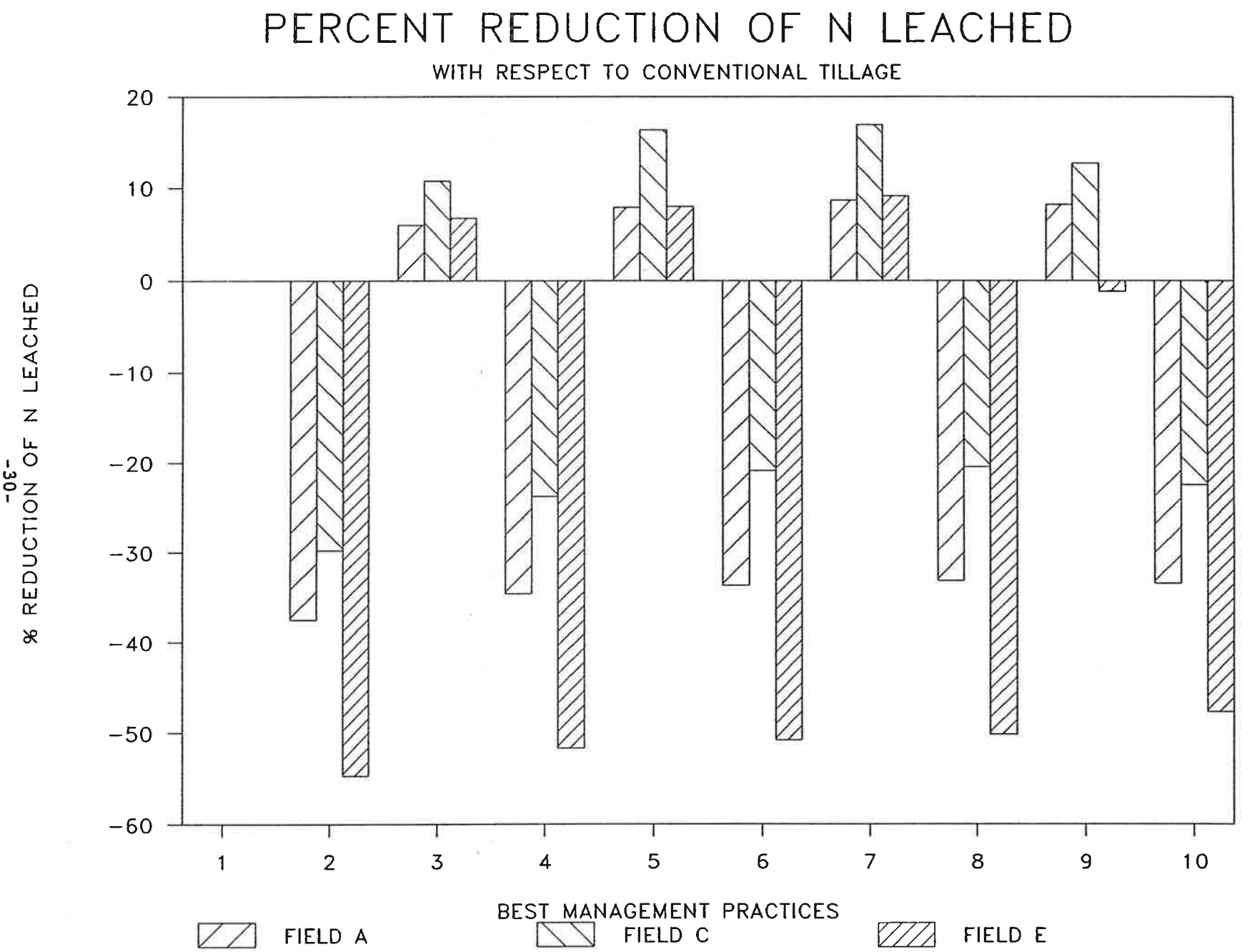

PERCENT REDUCTION OF N LEACHED
WITH RESPECT TO CONVENTIONAL TILLAGE
% REDUCTION OF N LEACHED
20
10
0
-10
-20
-30
-40
-50
-60
1
2
3
4
5
6
7
8
9
10
BEST MANAGEMENT PRACTICES
FIELD A
FIELD C
FIELD E

Figure 9

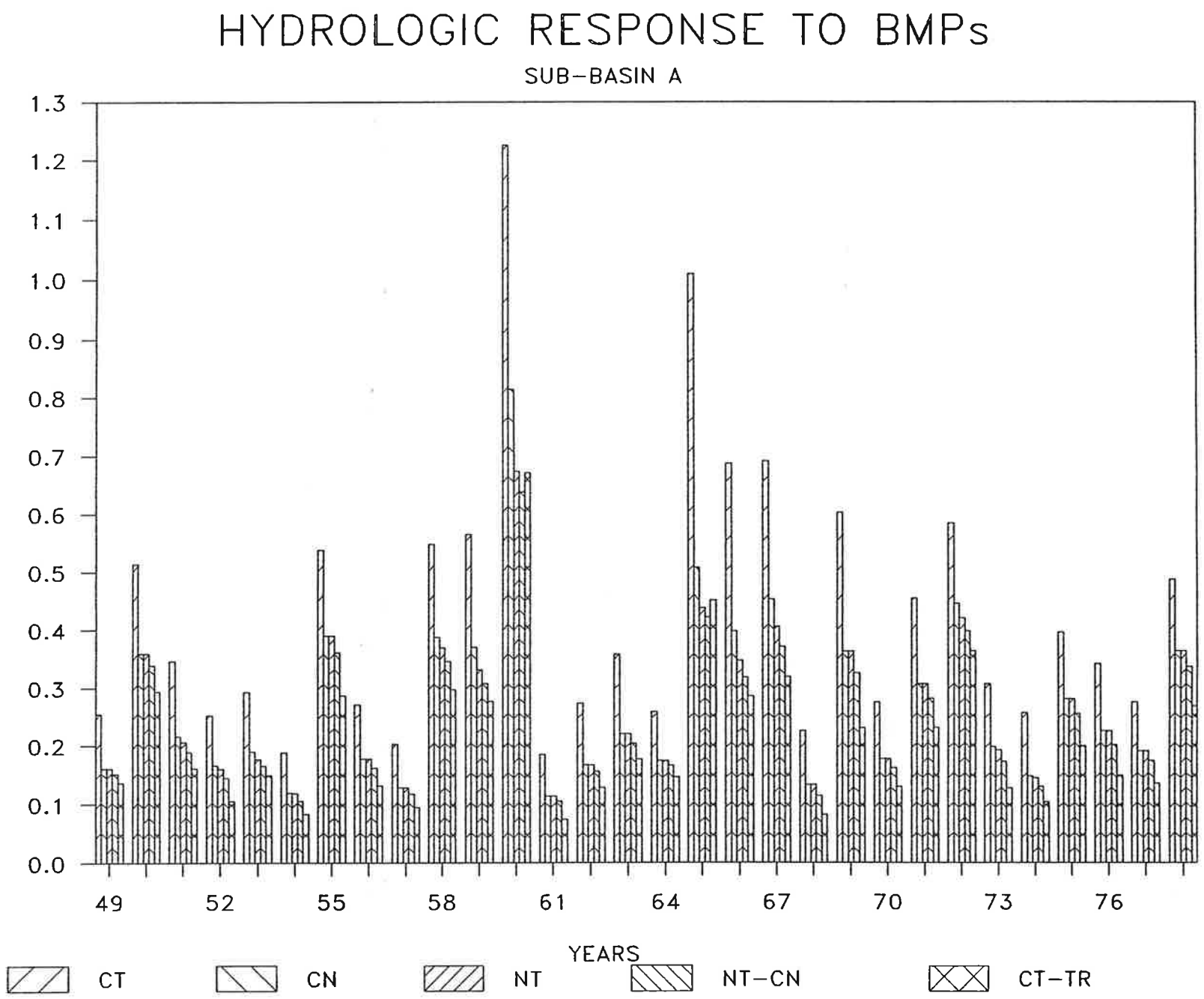

HYDROLOGIC RESPONSE TO BMPs
SUB-BASIN A
RUNOFF/PERCOLATION
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CN
NT
NT-CN
CT-TR

Figure 10

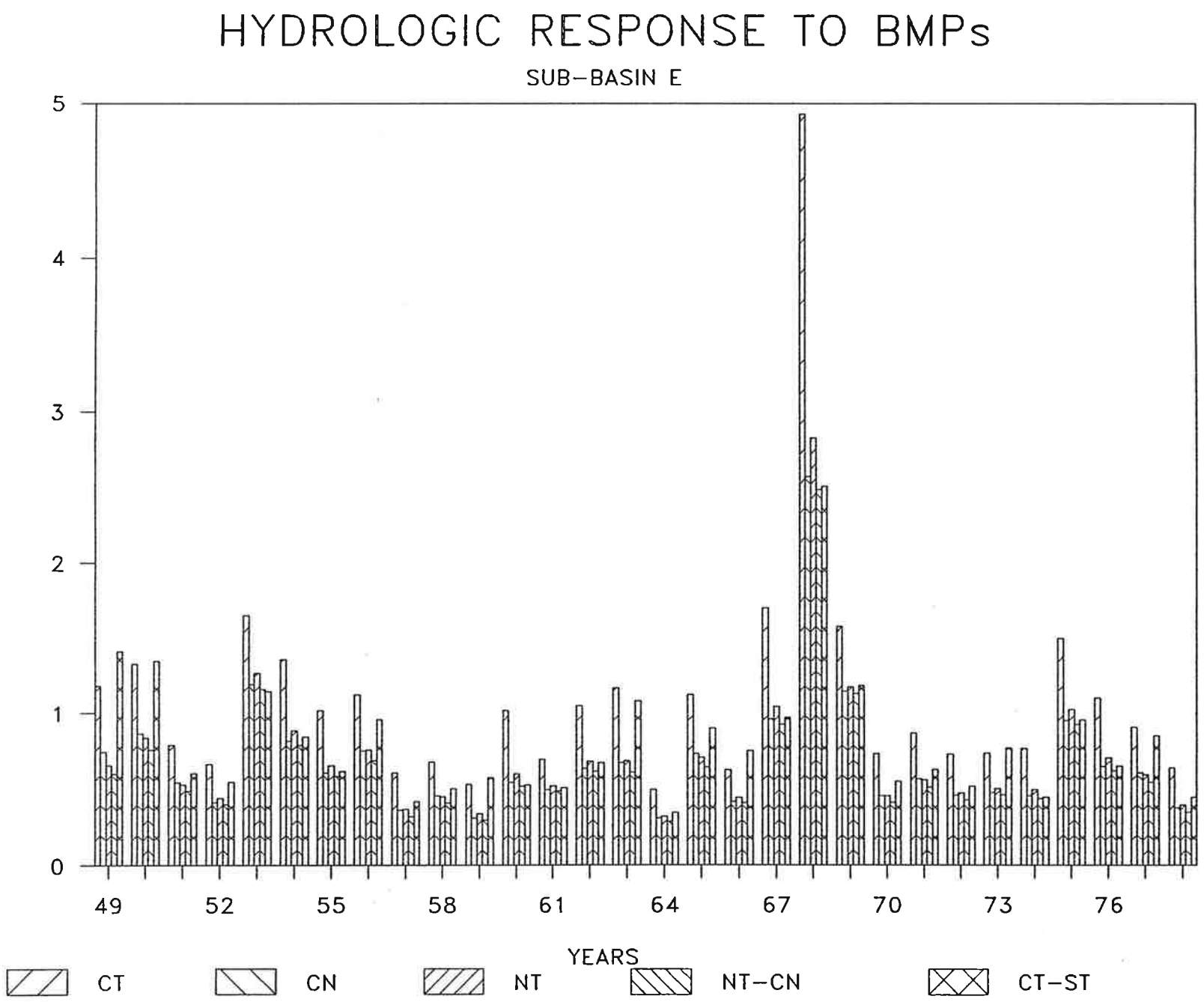

HYDROLOGIC RESPONSE TO BMPs
SUB-BASIN E
RUNOFF/PERCOLATION
0
1
2
3
4
5
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CN
NT
NT-CN
CT-ST

Figure 11

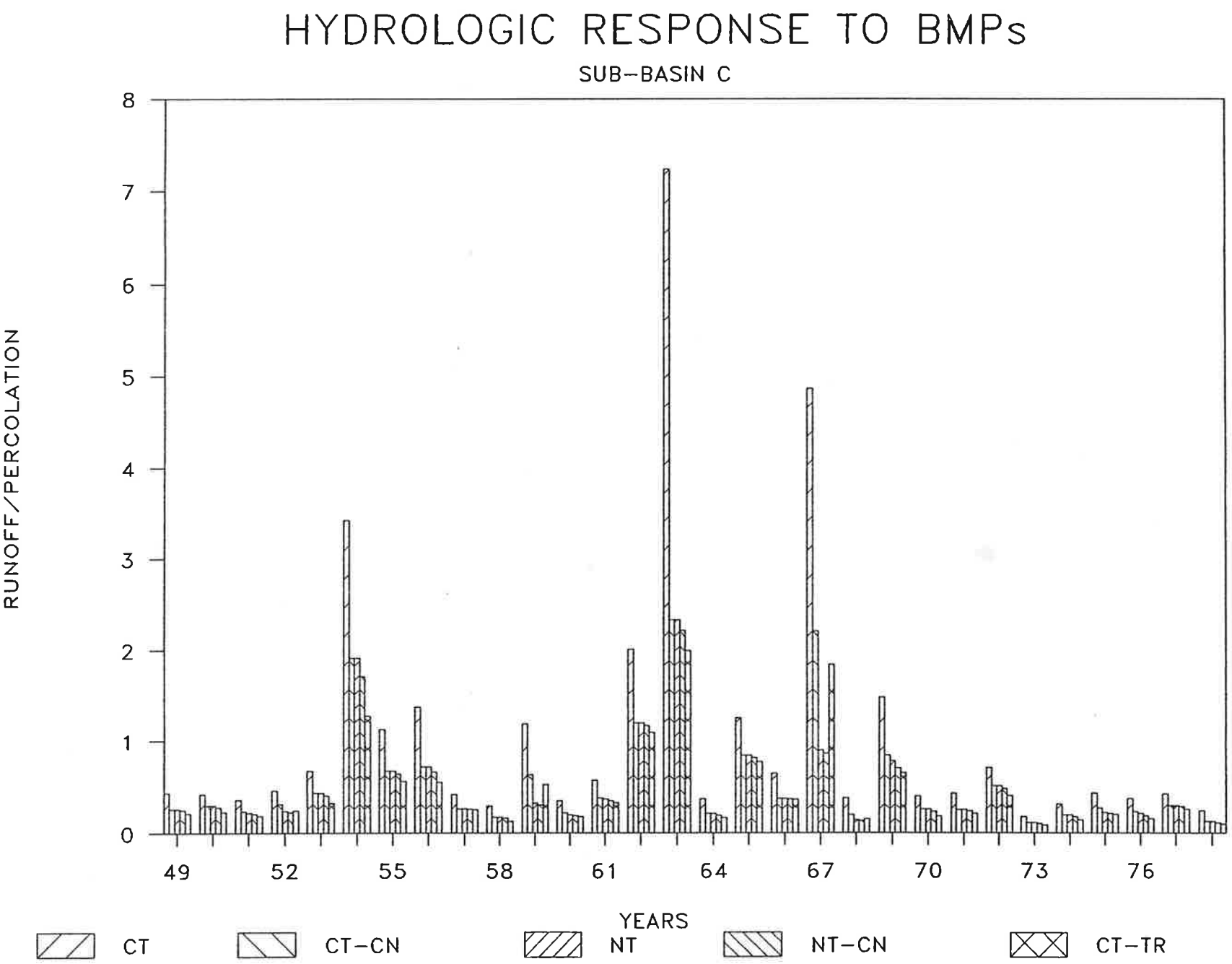

HYDROLOGIC RESPONSE TO BMPs
SUB-BASIN C
RUNOFF/PERCOLATION
0
1
2
3
4
5
6
7
8
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CT-CN
NT
NT-CN
CT-TR

Figure 12

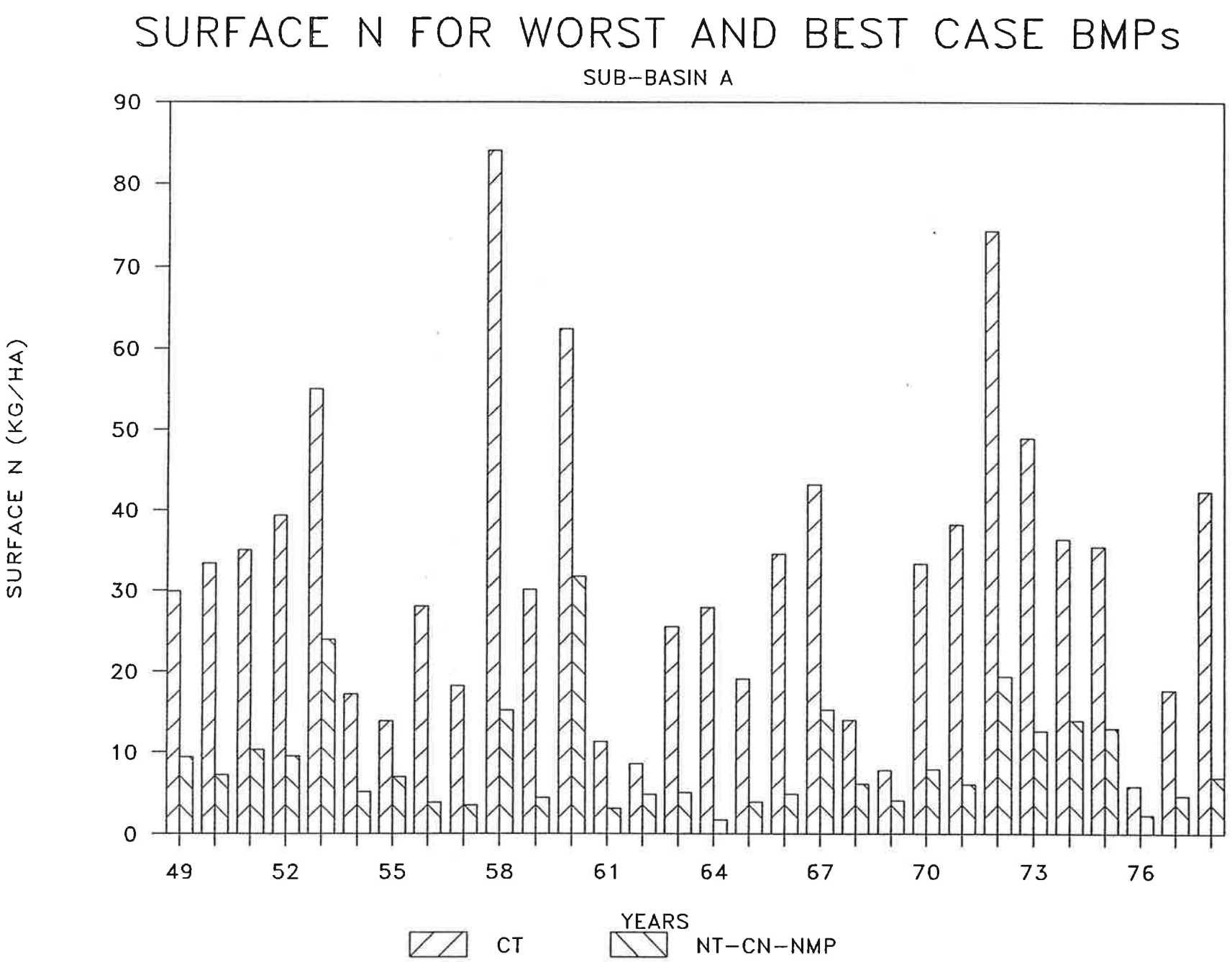

SURFACE N FOR WORST AND BEST CASE BMPs
SUB-BASIN A
SURFACE N (KG/HA)
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
NT-CN-NMP

Figure 13

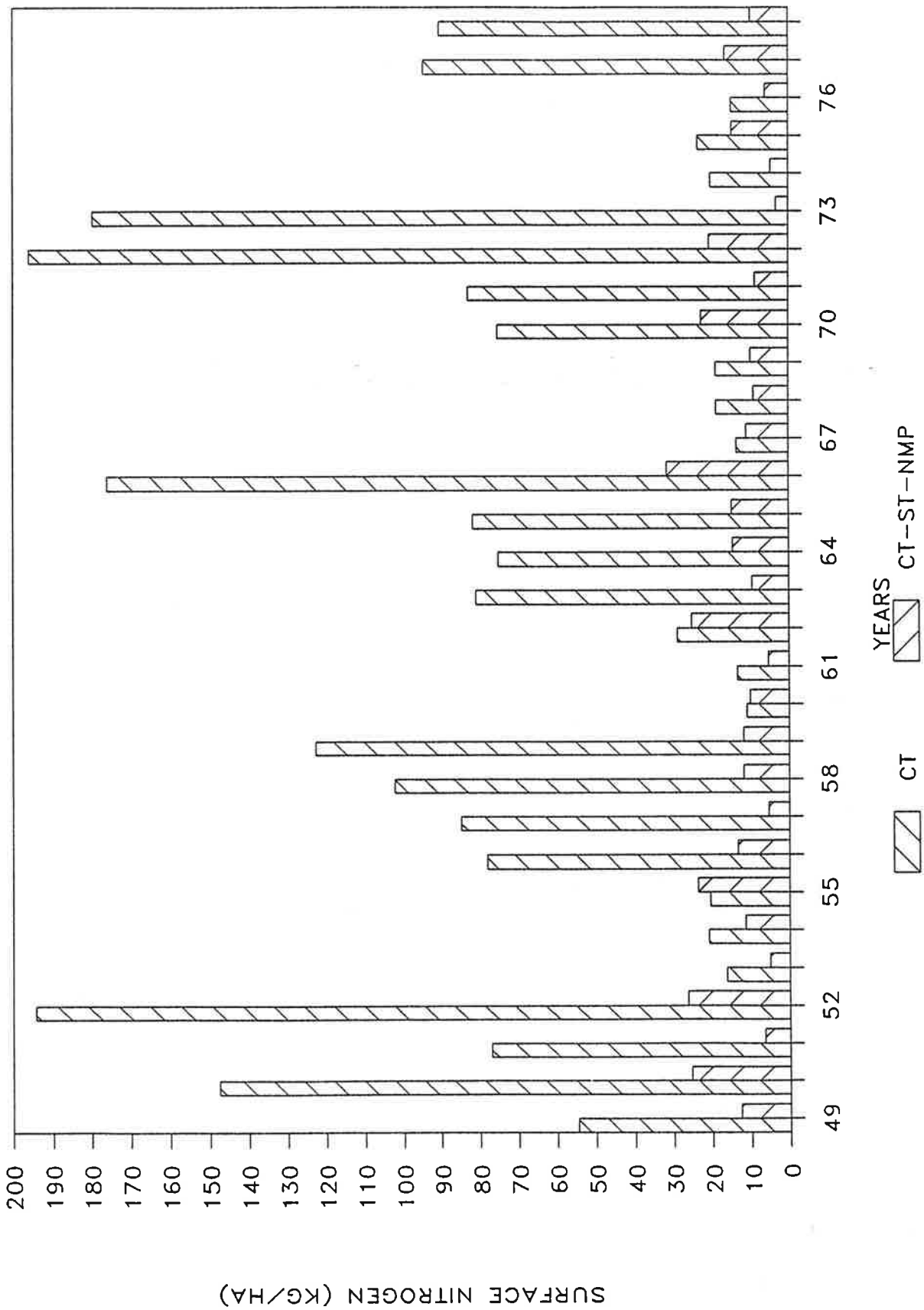

SURFACE N FOR BEST AND WORST CASE BMPs
SUB-BASIN E
SURFACE NITROGEN (KG/HA)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CT-ST-NMP

Figure 14

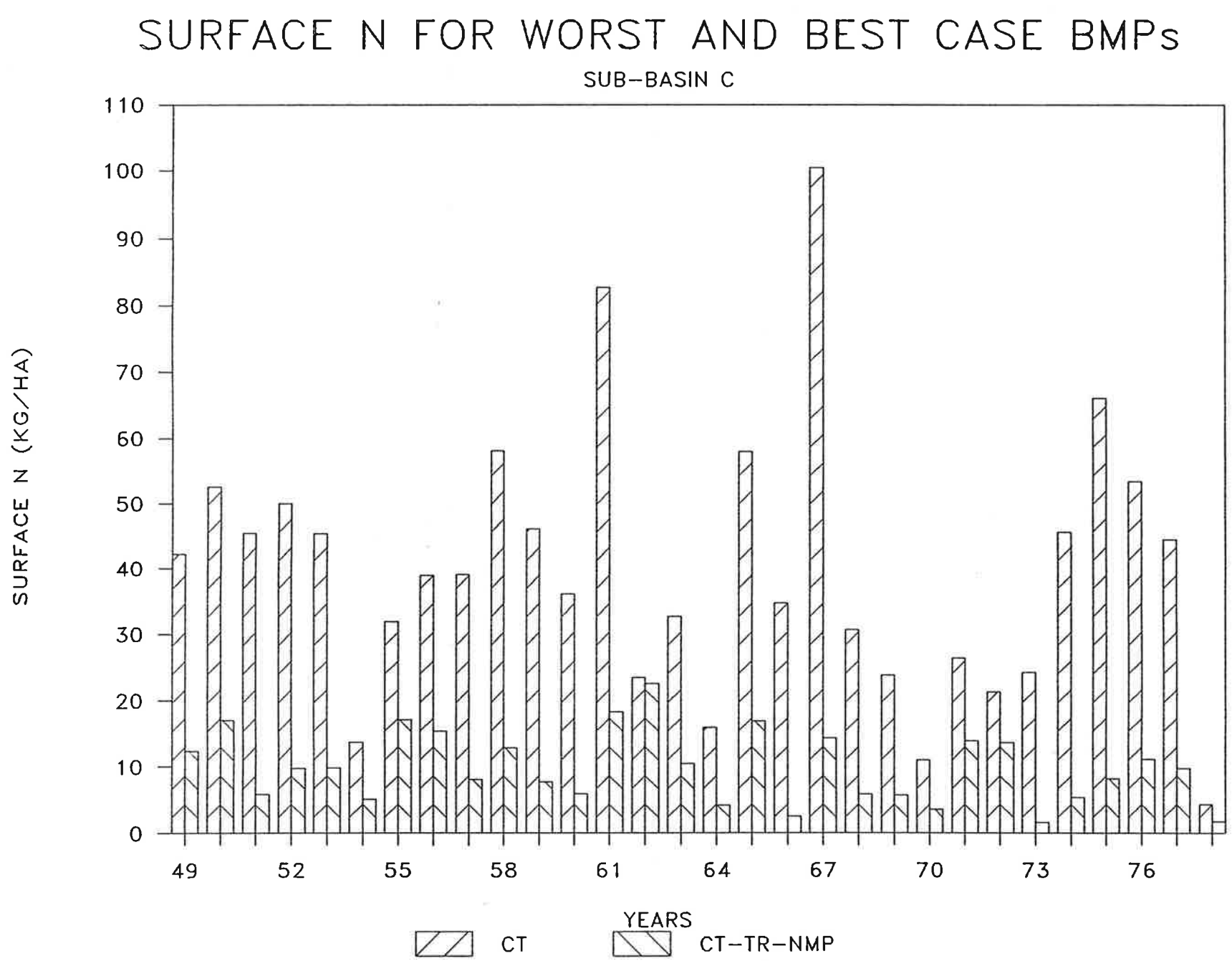

SURFACE N FOR WORST AND BEST CASE BMPs
SUB-BASIN C
SURFACE N (KG/HA)
110
100
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CT-TR-NMP

Figure 15

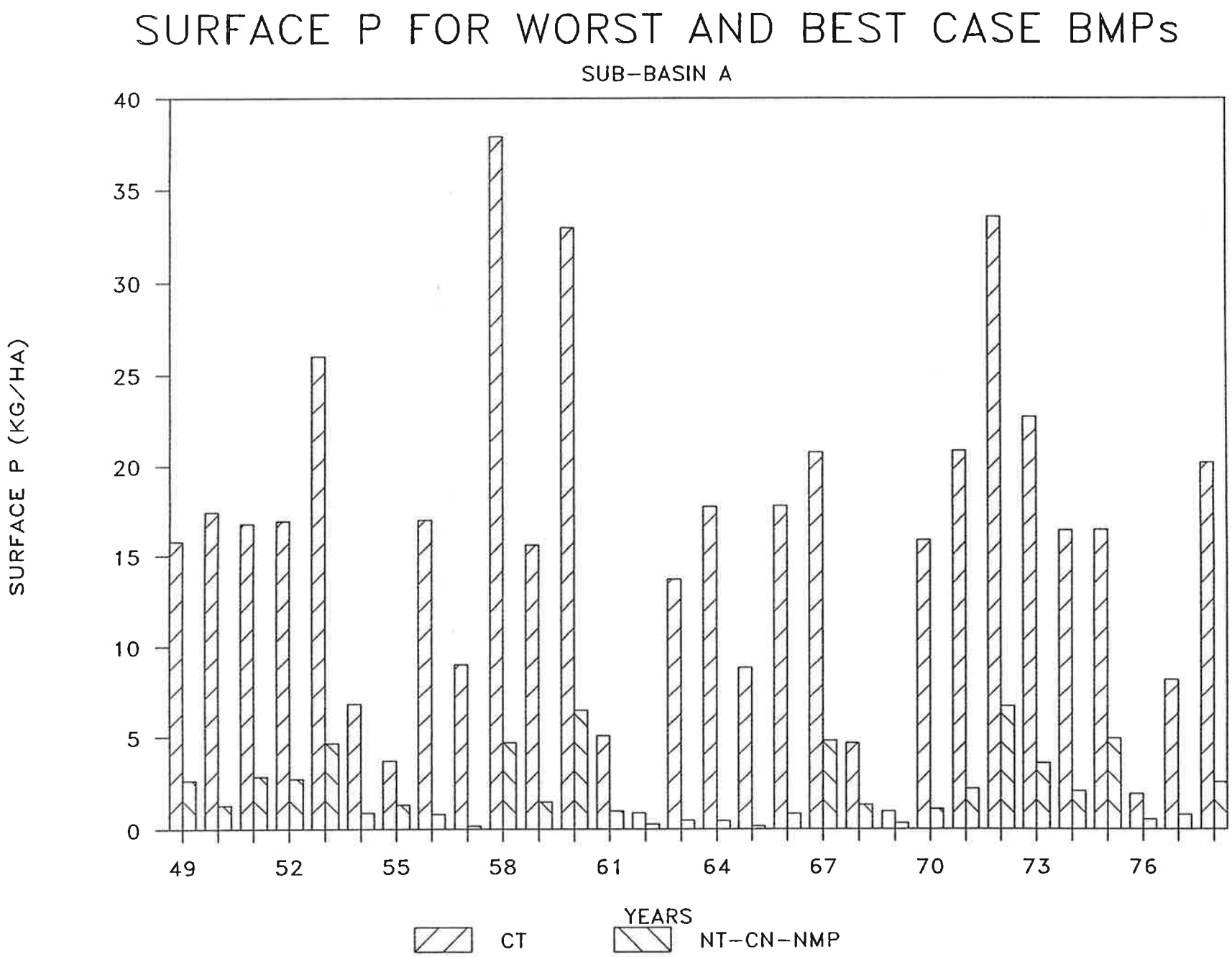

SURFACE P FOR WORST AND BEST CASE BMPs
SUB-BASIN A
SURFACE P (KG/HA)
40
35
30
25
20
15
10
5
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
NT-CN-NMP

Figure 16

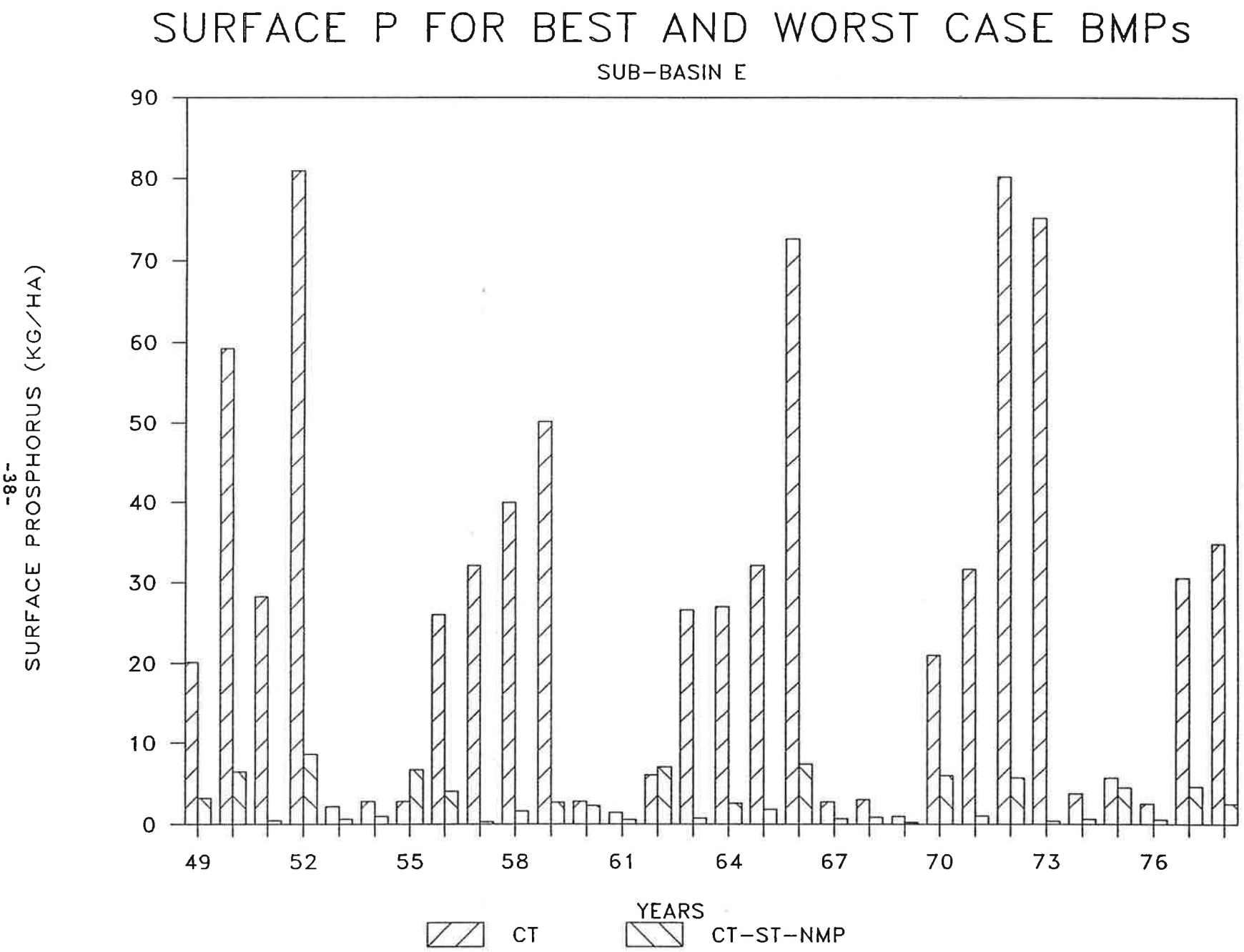

SURFACE P FOR BEST AND WORST CASE BMPs
SUB-BASIN E
SURFACE PROSPHORUS (KG/HA)
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CT-ST-NMP

Figure 17

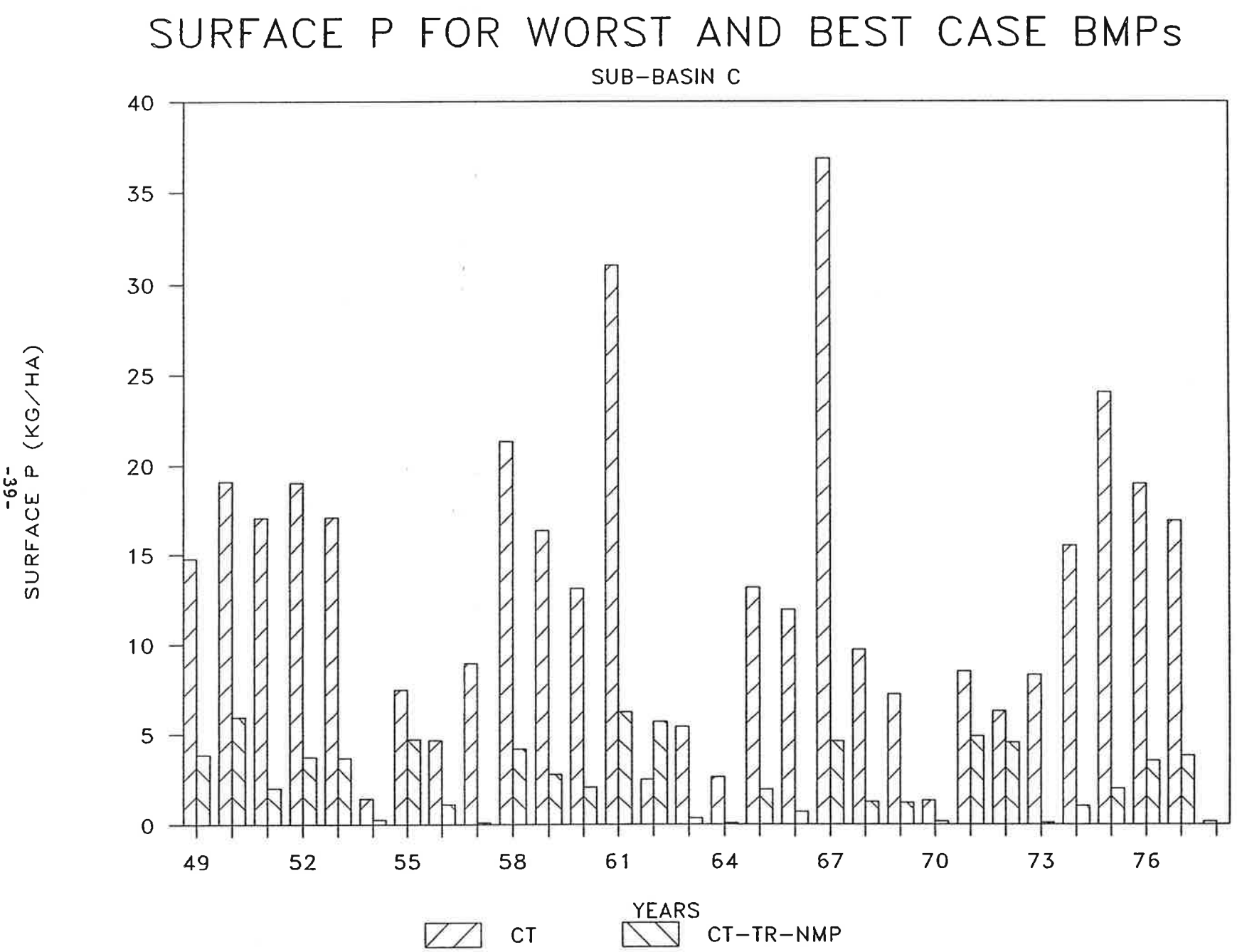

SURFACE P FOR WORST AND BEST CASE BMPs
SUB-BASIN C
SURFACE P (KG/HA)
40
35
30
25
20
15
10
5
0
49
52
55
58
61
64
67
70
73
76
YEARS
CT
CT-TR-NMP

Figure 18

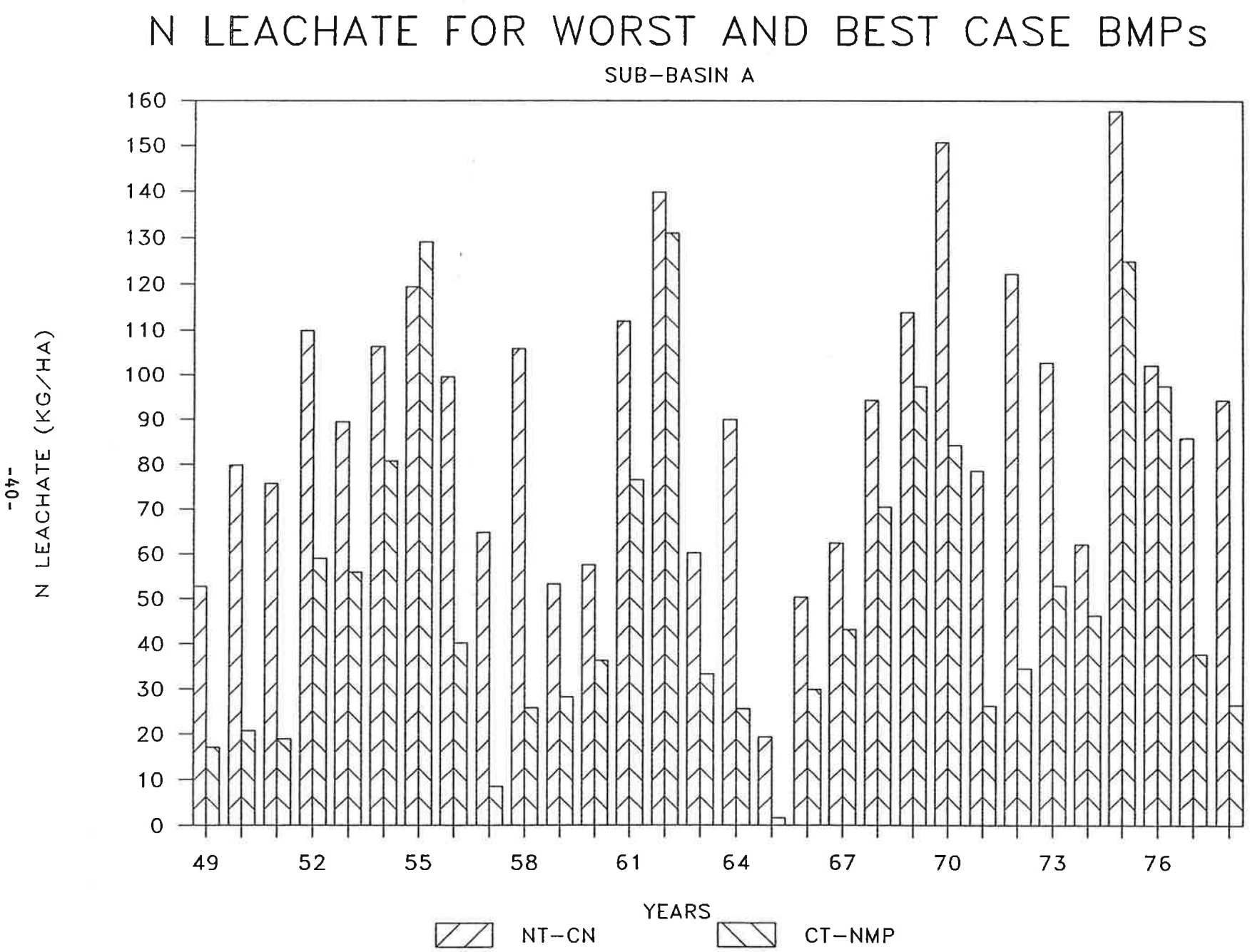

N LEACHATE FOR WORST AND BEST CASE BMPs
SUB-BASIN A
N LEACHATE (KG/HA)
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
NT-CN
CT-NMP

Figure 19

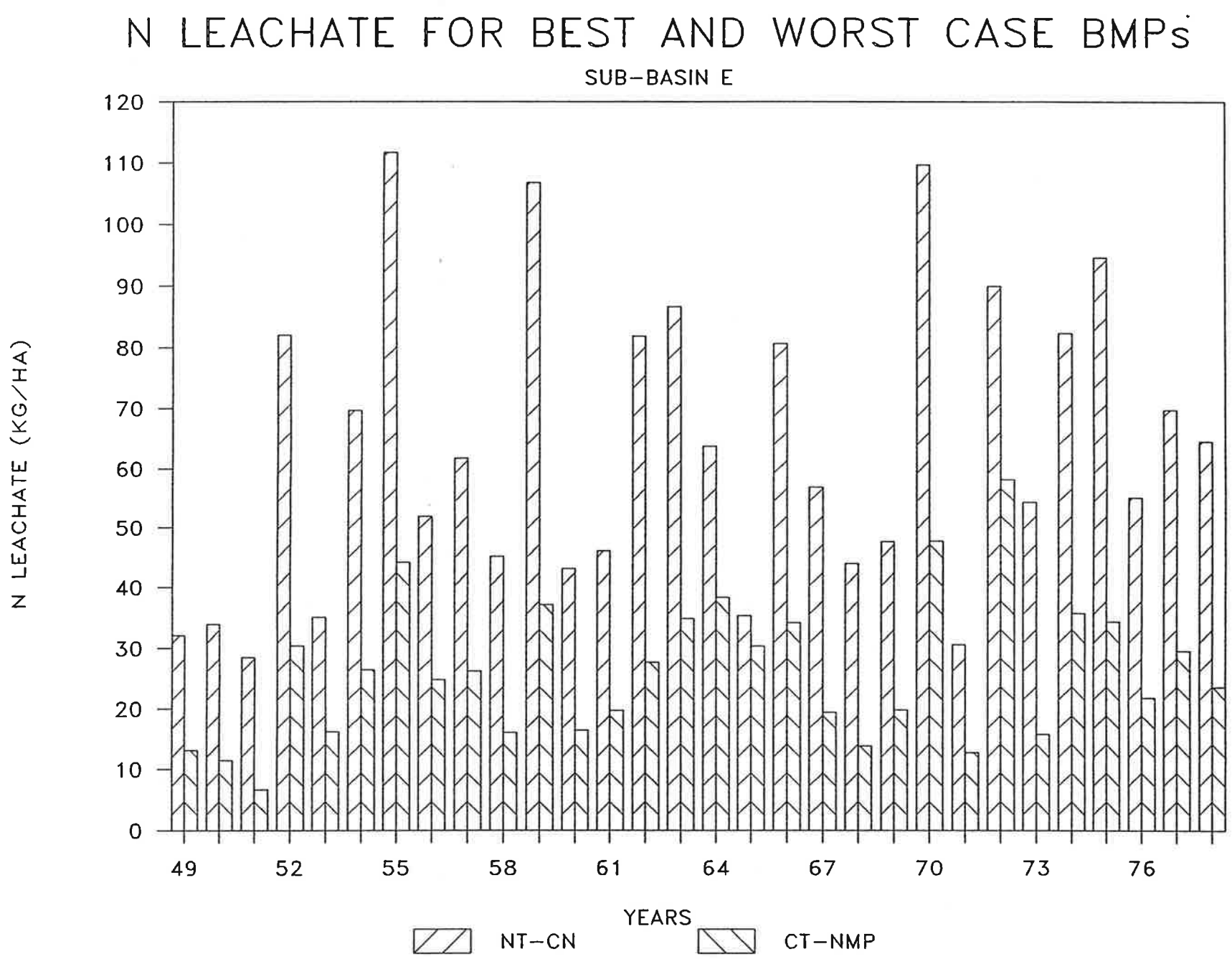
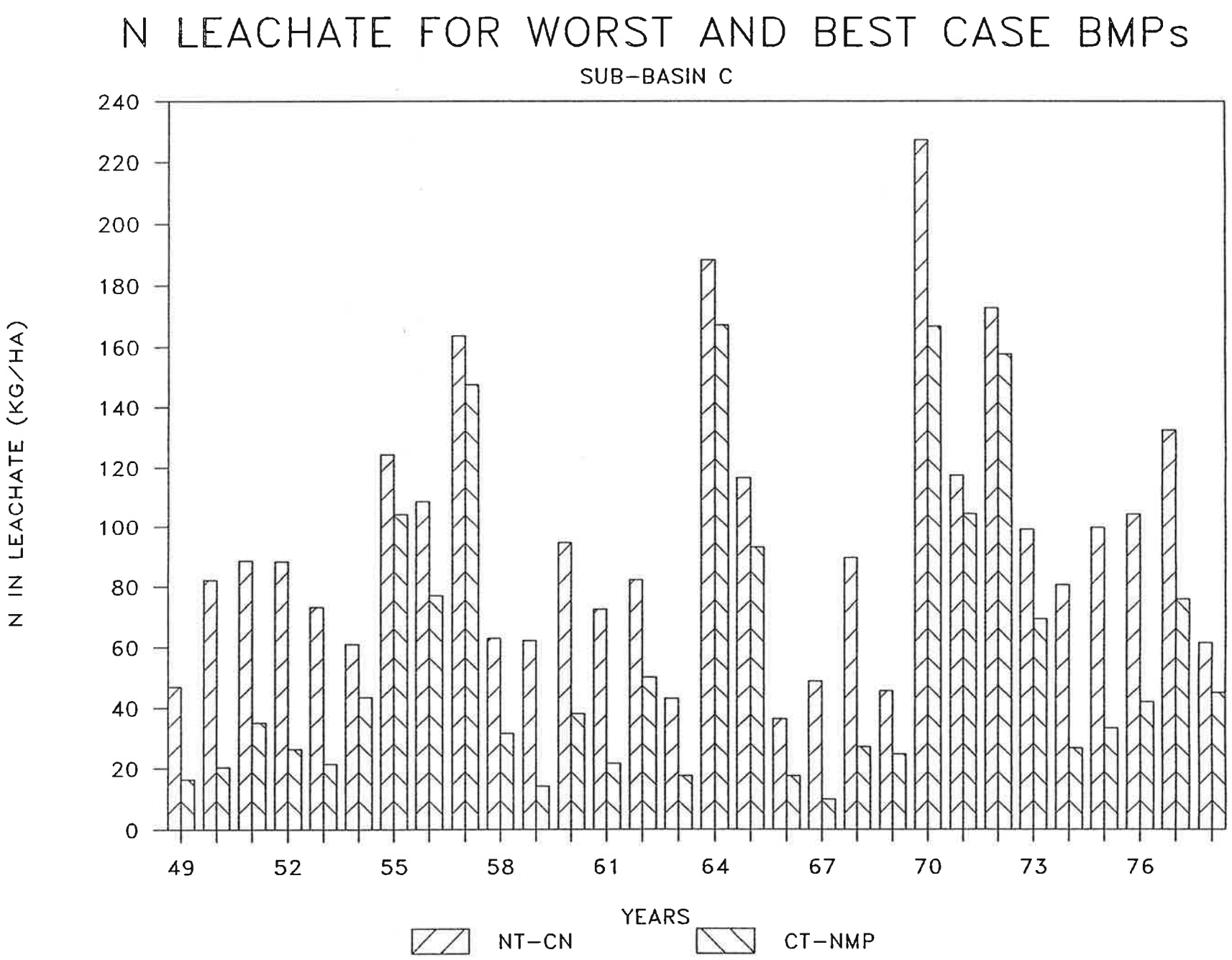

N LEACHATE FOR BEST AND WORST CASE BMPs
SUB-BASIN E
N LEACHATE (KG/HA)
120
110
100
90
80
70
60
50
40
30
20
10
0
49
52
55
58
61
64
67
70
73
76
YEARS
NT-CN
CT-NMP

Figure 20


N LEACHATE FOR WORST AND BEST CASE BMPs
SUB-BASIN C
N IN LEACHATE (KG/HA)
240
220
200
180
160
140
120
100
80
60
40
20
0
49
52
55
58
61
64
67
70
73
76
YEARS
NT-CN
CT-NMP

APPENDIX A

TABLES A1-A-12 For Sub-Basin A

(Yearly Variations and 30 Year Averages Plus Totals)

Table A1:
Pennsylvania Sub-basin A
Conventional tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	4.99	4.37	19.63	29.94	15.80	19.50	11.33	10.44	4.47	46.07
1950	102.79	12.14	3.05	23.60	33.42	17.44	24.21	13.51	9.21	3.93	71.38
1951	111.06	9.41	5.94	27.17	35.02	16.76	19.35	10.09	15.67	6.67	63.37
1952	133.98	10.43	10.76	41.38	39.35	16.92	11.97	5.20	27.38	11.72	102.89
1953	116.19	10.97	12.82	37.51	55.02	26.03	22.86	12.28	32.16	13.75	78.46
1954	88.79	4.57	2.26	24.37	17.12	6.80	10.00	3.77	7.12	3.03	103.02
1955	107.53	15.29	2.26	28.46	13.86	3.67	7.42	0.92	6.44	2.75	123.16
1956	113.53	8.21	1.03	30.38	28.06	16.98	24.06	15.28	4.00	1.70	93.62
1957	78.80	4.91	0.56	24.29	18.22	8.98	15.81	7.96	2.41	1.02	60.59
1958	131.53	17.95	33.85	32.79	84.03	37.88	24.20	12.27	59.83	25.61	94.77
1959	108.50	9.70	6.01	17.15	30.18	15.58	13.99	8.68	16.19	6.90	41.84
1960	113.28	15.79	18.25	12.88	62.48	32.99	25.28	17.06	37.20	15.93	42.43
1961	102.46	6.11	1.73	33.13	11.27	5.06	4.77	2.30	6.50	2.76	110.98
1962	90.35	6.19	0.25	22.74	8.52	0.90	7.34	0.40	1.18	0.50	133.83
1963	83.26	6.08	0.63	17.04	25.48	13.68	22.73	12.52	2.75	1.16	56.02
1964	91.47	7.27	1.48	28.17	27.85	17.70	22.46	15.41	5.39	2.29	84.27
1965	73.43	4.73	1.30	4.68	19.04	8.83	14.93	7.08	4.11	1.75	10.59
1966	95.62	7.29	4.44	10.61	34.55	17.78	21.64	12.27	12.91	5.51	38.78
1967	107.59	11.97	14.35	17.32	43.19	20.74	10.93	6.91	32.26	13.83	51.07
1968	90.22	3.72	2.15	16.56	13.95	4.68	7.42	1.90	6.53	2.78	93.33
1969	93.87	6.11	0.34	10.13	7.72	0.97	6.23	0.34	1.49	0.63	103.15
1970	107.12	8.37	3.43	30.48	33.35	15.84	24.48	12.05	8.87	3.79	145.25
1971	121.41	14.34	7.06	31.51	38.18	20.81	18.29	12.30	19.89	8.51	70.90
1972	130.38	21.18	28.33	36.24	74.38	33.58	23.48	11.78	50.90	21.80	107.00
1973	126.08	11.24	12.13	36.65	48.94	22.70	18.38	9.64	30.56	13.06	92.62
1974	110.18	5.82	5.81	22.72	36.35	16.39	19.87	9.36	16.48	7.03	54.26
1975	160.13	20.87	9.06	52.80	35.46	16.40	10.58	5.77	24.88	10.63	150.30
1976	129.93	9.51	0.87	27.89	5.81	1.89	2.85	0.63	2.96	1.26	98.62
1977	102.05	8.33	0.94	30.31	17.61	8.14	14.24	6.70	3.37	1.44	82.83
1978	125.99	17.99	15.87	36.93	42.30	20.13	10.79	6.63	31.51	13.50	89.70
Average	107.82	10.05	7.04	26.18	32.36	15.40	16.00	8.41	16.35	6.99	83.17

Table A2:
Pennsylvania Sub-basin A
Conventional tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	4.99	4.37	19.63	15.75	4.61	5.31	0.14	10.44	4.47	17.15
1950	102.79	12.14	3.05	23.60	15.96	4.35	6.75	0.42	9.21	3.93	20.80
1951	111.06	9.41	5.94	27.17	20.98	6.93	5.31	0.26	15.67	6.67	18.94
1952	133.98	10.43	10.76	41.38	32.98	12.39	5.60	0.67	27.38	11.72	59.00
1953	116.19	10.97	12.82	37.51	56.90	14.08	24.74	0.33	32.16	13.75	55.96
1954	88.79	4.57	2.26	24.37	12.17	3.17	5.05	0.14	7.12	3.03	80.72
1955	107.53	15.29	2.26	28.46	13.83	3.35	7.39	0.60	6.44	2.75	129.18
1956	113.53	8.21	1.03	30.38	8.13	1.99	4.13	0.29	4.00	1.70	40.19
1957	78.80	4.91	0.56	24.29	7.93	1.17	5.52	0.15	2.41	1.02	8.53
1958	131.53	17.95	33.85	32.79	67.18	26.19	7.35	0.58	59.83	25.61	25.69
1959	108.50	9.70	6.01	17.15	18.61	7.31	2.42	0.41	16.19	6.90	28.19
1960	113.28	15.79	18.25	12.88	66.62	16.51	29.42	0.58	37.20	15.93	36.35
1961	102.46	6.11	1.73	33.13	8.94	3.26	2.44	0.50	6.50	2.76	76.52
1962	90.35	6.19	0.25	22.74	8.42	0.75	7.24	0.25	1.18	0.50	131.04
1963	83.26	6.08	0.63	17.04	9.93	1.32	7.18	0.16	2.75	1.16	33.25
1964	91.47	7.27	1.48	28.17	7.02	2.54	1.63	0.25	5.39	2.29	25.56
1965	73.43	4.73	1.30	4.68	9.37	1.88	5.26	0.13	4.11	1.75	1.62
1966	95.62	7.29	4.44	10.61	18.54	5.89	5.63	0.38	12.91	5.51	29.76
1967	107.59	11.97	14.35	17.32	40.83	14.25	8.57	0.42	32.26	13.83	43.05
1968	90.22	3.72	2.15	16.56	11.45	2.91	4.92	0.13	6.53	2.78	70.44
1969	93.87	6.11	0.34	10.13	7.56	0.87	6.07	0.24	1.49	0.63	97.37
1970	107.12	8.37	3.43	30.48	17.67	4.07	8.80	0.28	8.87	3.79	84.25
1971	121.41	14.34	7.06	31.51	22.39	9.00	2.50	0.49	19.89	8.51	26.17
1972	130.38	21.18	28.33	36.24	57.96	22.47	7.06	0.67	50.90	21.80	34.44
1973	126.08	11.24	12.13	36.65	38.17	13.68	7.61	0.62	30.56	13.06	52.94
1974	110.18	5.82	5.81	22.72	31.66	7.19	15.18	0.16	16.48	7.03	46.20
1975	160.13	20.87	9.06	52.80	29.27	11.59	4.39	0.96	24.88	10.63	124.95
1976	129.93	9.51	0.87	27.89	5.53	1.61	2.57	0.35	2.96	1.26	97.41
1977	102.05	8.33	0.94	30.31	9.26	1.68	5.89	0.24	3.37	1.44	37.59
1978	125.99	17.99	15.87	36.93	34.15	14.13	2.64	0.63	31.51	13.50	26.36
Average	107.82	10.05	7.04	26.18	23.50	7.37	7.15	0.38	16.35	6.99	51.99

Table A3:
Pennsylvania Sub-basin A
Contour tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.41	3.12	21.25	19.14	9.56	11.32	6.21	7.82	3.35	52.46
1950	102.79	9.47	2.15	26.34	21.55	10.62	14.84	7.76	6.71	2.86	79.27
1951	111.06	6.49	3.94	30.11	21.79	9.39	11.14	4.84	10.65	4.55	70.71
1952	133.98	7.36	6.70	44.40	25.11	10.62	6.92	2.87	18.19	7.75	106.97
1953	116.19	7.69	7.08	40.58	31.20	13.85	12.55	5.88	18.65	7.97	85.87
1954	88.79	3.06	1.21	25.93	10.37	4.02	6.26	2.26	4.11	1.76	106.15
1955	107.53	12.18	1.34	31.28	9.08	2.38	4.96	0.62	4.12	1.76	118.41
1956	113.53	5.77	0.52	32.69	15.95	9.62	13.75	8.69	2.20	0.93	99.01
1957	78.80	3.31	0.25	25.94	10.31	5.00	9.11	4.49	1.20	0.51	64.28
1958	131.53	14.16	21.68	36.58	55.62	24.07	14.25	6.36	41.37	17.71	102.44
1959	108.50	7.25	4.19	19.60	19.54	9.72	8.28	4.93	11.26	4.79	46.40
1960	113.28	12.70	14.84	15.60	45.24	22.77	15.10	9.86	30.14	12.91	49.55
1961	102.46	3.96	0.85	34.95	6.34	2.82	2.77	1.32	3.57	1.50	115.63
1962	90.35	4.12	0.16	24.71	5.39	0.56	4.61	0.24	0.78	0.32	137.99
1963	83.26	4.12	0.27	18.76	14.27	7.58	12.97	7.04	1.30	0.54	60.12
1964	91.47	5.26	0.90	30.23	16.10	10.06	12.74	8.64	3.36	1.42	89.69
1965	73.43	3.07	0.61	6.05	10.49	4.22	8.30	3.29	2.19	0.93	15.57
1966	95.62	4.98	2.53	12.52	19.84	9.96	12.03	6.64	7.81	3.32	45.03
1967	107.59	9.11	10.11	20.13	29.23	13.60	6.25	3.77	22.98	9.83	55.17
1968	90.22	2.25	1.28	17.04	8.55	2.76	4.56	1.07	3.99	1.69	93.71
1969	93.87	4.18	0.20	11.53	4.72	0.60	3.74	0.19	0.98	0.41	112.50
1970	107.12	5.82	2.94	32.99	21.99	9.97	14.67	6.85	7.32	3.12	150.74
1971	121.41	10.71	4.91	35.04	25.16	13.30	11.05	7.27	14.11	6.03	77.63
1972	130.38	17.73	24.46	39.83	58.48	25.68	14.59	6.89	43.89	18.79	116.15
1973	126.08	7.89	7.98	39.89	31.64	14.33	10.84	5.45	20.80	8.88	99.30
1974	110.18	3.64	4.06	24.72	23.21	10.12	11.69	5.20	11.52	4.92	58.89
1975	160.13	16.08	5.98	57.51	23.62	10.66	6.53	3.37	17.09	7.29	157.03
1976	129.93	6.85	0.43	30.41	3.32	1.04	1.78	0.38	1.54	0.66	101.10
1977	102.05	6.19	0.61	32.47	10.20	4.76	7.91	3.79	2.29	0.97	85.49
1978	125.99	14.64	12.35	40.30	32.06	14.87	7.00	4.13	25.06	10.74	93.43
Average	107.82	7.45	4.92	28.65	20.99	9.62	9.42	4.68	11.57	4.94	88.22

Table A4:
Pennsylvania Sub-basin A
Contour tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.41	3.12	21.25	11.30	3.44	3.48	0.09	7.82	3.35	18.91
1950	102.79	9.47	2.15	26.34	11.55	3.18	4.84	0.32	6.71	2.86	22.65
1951	111.06	6.49	3.94	30.11	14.81	4.75	4.16	0.20	10.65	4.55	20.74
1952	133.98	7.36	6.70	44.40	21.71	8.19	3.52	0.44	18.19	7.75	62.02
1953	116.19	7.69	7.08	40.58	31.99	8.21	13.34	0.24	18.65	7.97	62.45
1954	88.79	3.06	1.21	25.93	7.45	1.86	3.34	0.10	4.11	1.76	83.30
1955	107.53	12.18	1.34	31.28	9.06	2.19	4.94	0.43	4.12	1.76	122.49
1956	113.53	5.77	0.52	32.69	4.55	1.10	2.35	0.17	2.20	0.93	38.42
1957	78.80	3.31	0.25	25.94	4.51	0.60	3.31	0.09	1.20	0.51	10.06
1958	131.53	14.16	21.68	36.58	46.72	18.18	5.35	0.47	41.37	17.71	27.43
1959	108.50	7.25	4.19	19.60	12.99	5.08	1.73	0.29	11.26	4.79	29.86
1960	113.28	12.70	14.84	15.60	47.72	13.36	17.58	0.45	30.14	12.91	44.12
1961	102.46	3.96	0.85	34.95	4.99	1.79	1.42	0.29	3.57	1.50	81.08
1962	90.35	4.12	0.16	24.71	5.32	0.46	4.54	0.14	0.78	0.32	135.45
1963	83.26	4.12	0.27	18.76	5.50	0.66	4.20	0.12	1.30	0.54	34.20
1964	91.47	5.26	0.90	30.23	4.47	1.59	1.11	0.17	3.36	1.42	26.64
1965	73.43	3.07	0.61	6.05	5.86	1.01	3.67	0.08	2.19	0.93	2.33
1966	95.62	4.98	2.53	12.52	11.22	3.53	3.41	0.21	7.81	3.32	31.73
1967	107.59	9.11	10.11	20.13	27.63	10.14	4.65	0.31	22.98	9.83	46.97
1968	90.22	2.25	1.28	17.04	7.19	1.74	3.20	0.05	3.99	1.69	71.16
1969	93.87	4.18	0.20	11.53	4.65	0.57	3.67	0.16	0.98	0.41	107.64
1970	107.12	5.82	2.94	32.99	13.11	3.30	5.79	0.18	7.32	3.12	84.99
1971	121.41	10.71	4.91	35.04	15.86	6.38	1.75	0.35	14.11	6.03	27.62
1972	130.38	17.73	24.46	39.83	48.94	19.36	5.05	0.57	43.89	18.79	36.85
1973	126.08	7.89	7.98	39.89	25.90	9.23	5.10	0.35	20.80	8.88	56.65
1974	110.18	3.64	4.06	24.72	20.62	5.03	9.10	0.11	11.52	4.92	49.34
1975	160.13	16.08	5.98	57.51	20.12	7.96	3.03	0.67	17.09	7.29	131.22
1976	129.93	6.85	0.43	30.41	3.13	0.88	1.59	0.22	1.54	0.66	100.19
1977	102.05	6.19	0.61	32.47	5.50	1.14	3.21	0.17	2.29	0.97	37.09
1978	125.99	14.64	12.35	40.30	27.13	11.23	2.07	0.49	25.06	10.74	27.54
Average	107.82	7.45	4.92	28.65	16.05	5.20	4.48	0.26	11.57	4.94	54.37

Table A5:
Pennsylvania Sub-basin A
No-Till without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.41	2.33	21.25	17.47	8.84	11.32	6.21	6.15	2.63	52.46
1950	102.79	9.47	0.90	26.34	17.97	9.09	14.84	7.76	3.13	1.33	79.27
1951	111.06	6.68	2.89	32.42	18.26	7.95	11.25	4.97	7.01	2.98	74.69
1952	133.98	7.49	2.13	46.83	15.53	6.45	8.11	3.29	7.42	3.16	109.29
1953	116.19	7.89	4.08	44.86	24.29	11.10	12.78	6.18	11.51	4.92	89.05
1954	88.79	3.06	0.65	26.08	8.75	3.33	6.24	2.26	2.51	1.07	105.48
1955	107.53	12.18	0.94	31.28	7.93	1.90	4.94	0.62	2.99	1.28	118.28
1956	113.53	5.77	0.52	32.69	15.74	9.54	13.75	8.69	1.99	0.85	99.00
1957	78.80	3.31	0.09	25.94	9.57	4.68	9.11	4.49	0.46	0.19	64.28
1958	131.53	14.43	3.79	39.14	25.29	11.29	14.65	6.74	10.64	4.55	105.06
1959	108.50	7.39	1.14	22.36	12.24	6.72	8.46	5.11	3.78	1.61	53.01
1960	113.28	12.95	7.58	19.21	32.24	17.48	15.48	10.32	16.76	7.16	57.30
1961	102.46	3.96	0.40	34.95	4.70	2.13	2.76	1.32	1.94	0.81	113.65
1962	90.35	4.12	0.07	24.71	4.97	0.39	4.61	0.24	0.36	0.15	137.82
1963	83.26	4.12	0.27	18.76	14.21	7.56	12.97	7.04	1.24	0.52	60.11
1964	91.47	5.26	0.25	30.23	13.79	9.08	12.74	8.64	1.05	0.44	89.68
1965	73.43	3.12	0.07	7.12	8.69	3.50	8.33	3.35	0.36	0.15	19.00
1966	95.62	5.15	0.61	14.84	14.94	8.05	12.38	6.97	2.56	1.08	50.00
1967	107.59	9.35	5.96	23.05	22.29	10.80	6.70	4.13	15.59	6.67	61.62
1968	90.22	2.25	0.81	17.04	7.24	2.23	4.54	1.07	2.70	1.16	92.77
1969	93.87	4.18	0.11	11.53	4.29	0.42	3.73	0.19	0.56	0.23	112.30
1970	107.12	5.82	0.83	32.99	17.78	8.16	14.67	6.85	3.11	1.31	150.59
1971	121.41	10.71	1.41	35.04	16.11	9.42	11.05	7.27	5.06	2.15	77.63
1972	130.38	17.94	5.78	42.75	29.12	13.24	14.70	7.07	14.42	6.17	121.25
1973	126.08	8.13	3.27	42.26	20.97	9.95	11.44	5.88	9.53	4.07	101.63
1974	110.18	3.91	1.52	27.13	17.43	7.85	12.31	5.67	5.12	2.18	61.57
1975	160.13	16.08	3.97	57.51	18.46	8.46	6.52	3.38	11.94	5.08	156.21
1976	129.93	6.85	0.29	30.41	2.87	0.85	1.78	0.38	1.09	0.47	101.10
1977	102.05	6.19	0.58	32.47	10.17	4.75	7.91	3.79	2.26	0.96	85.49
1978	125.99	14.64	1.86	40.30	12.68	6.54	7.00	4.13	5.68	2.41	93.43
Average	107.82	7.53	1.84	29.72	14.87	7.06	9.57	4.80	5.30	2.26	89.77

Table A6:
Pennsylvania Sub-basin A
No-till with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.41	2.33	21.25	9.63	2.72	3.48	0.09	6.15	2.63	18.91
1950	102.79	9.47	0.90	26.34	7.97	1.65	4.84	0.32	3.13	1.33	22.65
1951	111.06	6.68	2.89	32.42	11.17	3.18	4.16	0.20	7.01	2.98	21.94
1952	133.98	7.49	2.13	46.83	11.60	3.61	4.18	0.45	7.42	3.16	63.67
1953	116.19	7.89	4.08	44.86	25.06	5.17	13.55	0.25	11.51	4.92	62.96
1954	88.79	3.06	0.65	26.08	5.85	1.17	3.34	0.10	2.51	1.07	83.17
1955	107.53	12.18	0.94	31.28	7.93	1.71	4.94	0.43	2.99	1.28	122.48
1956	113.53	5.77	0.52	32.69	4.34	1.02	2.35	0.17	1.99	0.85	38.42
1957	78.80	3.31	0.09	25.94	3.77	0.28	3.31	0.09	0.46	0.19	10.06
1958	131.53	14.43	3.79	39.14	16.01	5.03	5.37	0.48	10.64	4.55	29.01
1959	108.50	7.39	1.14	22.36	5.49	1.91	1.71	0.30	3.78	1.61	33.15
1960	113.28	12.95	7.58	19.21	34.66	7.62	17.90	0.46	16.76	7.16	48.33
1961	102.46	3.96	0.40	34.95	3.36	1.10	1.42	0.29	1.94	0.81	80.58
1962	90.35	4.12	0.07	24.71	4.90	0.29	4.54	0.14	0.36	0.15	135.40
1963	83.26	4.12	0.27	18.76	5.44	0.64	4.20	0.12	1.24	0.52	34.20
1964	91.47	5.26	0.25	30.23	2.16	0.61	1.11	0.17	1.05	0.44	26.64
1965	73.43	3.12	0.07	7.12	4.03	0.23	3.67	0.08	0.36	0.15	2.75
1966	95.62	5.15	0.61	14.84	5.97	1.31	3.41	0.23	2.56	1.08	34.63
1967	107.59	9.35	5.96	23.05	20.40	6.98	4.81	0.31	15.59	6.67	50.67
1968	90.22	2.25	0.81	17.04	5.90	1.21	3.20	0.05	2.70	1.16	71.03
1969	93.87	4.18	0.11	11.53	4.23	0.39	3.67	0.16	0.56	0.23	107.59
1970	107.12	5.82	0.83	32.99	8.90	1.49	5.79	0.18	3.11	1.31	84.98
1971	121.41	10.71	1.41	35.04	6.81	2.50	1.75	0.35	5.06	2.15	27.62
1972	130.38	17.94	5.78	42.75	19.50	6.75	5.08	0.58	14.42	6.17	38.55
1973	126.08	8.13	3.27	42.26	14.75	4.48	5.22	0.41	9.53	4.07	58.23
1974	110.18	3.91	1.52	27.13	14.56	2.29	9.44	0.11	5.12	2.18	50.84
1975	160.13	16.08	3.97	57.51	14.96	5.75	3.02	0.67	11.94	5.08	131.03
1976	129.93	6.85	0.29	30.41	2.68	0.69	1.59	0.22	1.09	0.47	100.18
1977	102.05	6.19	0.58	32.47	5.47	1.13	3.21	0.17	2.26	0.96	37.09
1978	125.99	14.64	1.86	40.30	7.75	2.90	2.07	0.49	5.68	2.41	27.54
Average	107.82	7.53	1.84	29.72	9.84	2.53	4.54	0.27	5.30	2.26	55.14

Table A7:
Pennsylvania Sub-basin A
No-till/Contour without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.25	2.24	21.38	17.22	8.74	11.28	6.20	5.94	2.54	52.74
1950	102.79	9.05	0.63	26.70	17.07	8.69	14.67	7.67	2.40	1.02	79.73
1951	111.06	6.20	2.73	32.90	17.21	7.55	11.00	4.90	6.21	2.65	75.69
1952	133.98	6.82	1.50	47.47	13.39	5.54	7.92	3.22	5.47	2.32	109.80
1953	116.19	7.48	3.77	45.28	23.01	10.53	12.61	6.08	10.40	4.45	89.57
1954	88.79	2.75	0.49	26.34	8.07	3.01	6.15	2.20	1.92	0.81	106.32
1955	107.53	11.51	0.63	31.92	6.99	1.49	4.80	0.56	2.19	0.93	119.38
1956	113.53	5.33	0.38	33.05	14.99	9.21	13.44	8.56	1.55	0.65	99.48
1957	78.80	3.05	0.04	26.18	9.24	4.52	9.00	4.42	0.24	0.10	64.71
1958	131.53	13.73	3.52	39.84	24.30	10.88	14.40	6.65	9.90	4.23	105.77
1959	108.50	7.01	0.90	22.80	11.12	6.25	8.33	5.06	2.79	1.19	53.31
1960	113.28	12.50	6.16	19.59	29.34	16.24	15.33	10.24	14.01	6.00	57.63
1961	102.46	3.62	0.36	34.77	4.33	1.93	2.57	1.20	1.76	0.73	111.87
1962	90.35	3.89	0.07	24.96	4.88	0.35	4.52	0.20	0.36	0.15	139.83
1963	83.26	3.85	0.18	18.96	13.73	7.35	12.89	6.99	0.84	0.36	60.26
1964	91.47	5.05	0.16	30.42	13.31	8.86	12.62	8.57	0.69	0.29	90.01
1965	73.43	3.02	0.04	7.17	8.54	3.45	8.30	3.35	0.24	0.10	19.34
1966	95.62	4.79	0.36	15.09	13.81	7.57	12.31	6.94	1.50	0.63	50.38
1967	107.59	8.76	3.79	23.63	17.01	8.56	6.53	4.07	10.48	4.49	62.39
1968	90.22	1.97	0.94	17.30	7.46	2.32	4.44	1.03	3.02	1.29	94.28
1969	93.87	3.86	0.09	11.88	4.09	0.37	3.63	0.18	0.46	0.19	113.79
1970	107.12	5.40	0.58	33.43	16.64	7.72	14.41	6.77	2.23	0.95	150.73
1971	121.41	10.00	1.21	35.69	15.22	9.02	10.84	7.16	4.38	1.86	78.51
1972	130.38	17.26	5.94	43.38	28.77	13.11	14.41	6.97	14.36	6.14	122.28
1973	126.08	7.43	2.64	43.08	18.79	8.95	11.18	5.72	7.61	3.23	102.67
1974	110.18	3.55	1.37	27.46	16.72	7.53	12.15	5.58	4.57	1.95	62.04
1975	160.13	14.97	3.32	58.65	16.37	7.59	6.20	3.27	10.17	4.32	157.65
1976	129.93	6.22	0.20	30.96	2.39	0.66	1.58	0.32	0.81	0.34	102.10
1977	102.05	5.74	0.36	32.97	9.09	4.25	7.62	3.63	1.47	0.62	85.81
1978	125.99	13.81	1.61	41.11	11.77	6.19	6.84	4.09	4.93	2.10	94.28
Average	107.82	7.06	1.54	30.15	14.33	6.62	9.40	4.73	4.43	1.89	90.41

Table A8:
Pennsylvania Sub-basin A
No-till/Contour with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	3.25	2.24	21.38	9.41	2.63	3.47	0.09	5.94	2.54	18.94
1950	102.79	9.05	0.63	26.70	7.17	1.31	4.77	0.29	2.40	1.02	22.80
1951	111.06	6.20	2.73	32.90	10.29	2.83	4.08	0.18	6.21	2.65	22.42
1952	133.98	6.82	1.50	47.47	9.53	2.72	4.06	0.40	5.47	2.32	64.10
1953	116.19	7.48	3.77	45.28	23.86	4.66	13.46	0.21	10.40	4.45	63.06
1954	88.79	2.75	0.49	26.34	5.18	0.88	3.26	0.07	1.92	0.81	84.00
1955	107.53	11.51	0.63	31.92	6.96	1.33	4.77	0.40	2.19	0.93	124.00
1956	113.53	5.33	0.38	33.05	3.78	0.81	2.23	0.16	1.55	0.65	38.33
1957	78.80	3.05	0.04	26.18	3.50	0.18	3.26	0.08	0.24	0.10	10.14
1958	131.53	13.73	3.52	39.84	15.19	4.69	5.29	0.46	9.90	4.23	29.13
1959	108.50	7.01	0.90	22.80	4.41	1.46	1.62	0.27	2.79	1.19	33.38
1960	113.28	12.50	6.16	19.59	31.82	6.45	17.81	0.45	14.01	6.00	48.48
1961	102.46	3.62	0.36	34.77	3.07	0.98	1.31	0.25	1.76	0.73	78.73
1962	90.35	3.89	0.07	24.96	4.82	0.28	4.46	0.13	0.36	0.15	137.41
1963	83.26	3.85	0.18	18.96	5.00	0.47	4.16	0.11	0.84	0.36	34.15
1964	91.47	5.05	0.16	30.42	1.74	0.46	1.05	0.17	0.69	0.29	26.86
1965	73.43	3.02	0.04	7.17	3.89	0.18	3.65	0.08	0.24	0.10	2.76
1966	95.62	4.79	0.36	15.09	4.83	0.83	3.33	0.20	1.50	0.63	34.83
1967	107.59	8.76	3.79	23.63	15.21	4.79	4.73	0.30	10.48	4.49	51.14
1968	90.22	1.97	0.94	17.30	6.12	1.33	3.10	0.04	3.02	1.29	72.42
1969	93.87	3.86	0.09	11.88	4.03	0.34	3.57	0.15	0.46	0.19	109.35
1970	107.12	5.40	0.58	33.43	7.90	1.10	5.67	0.15	2.23	0.95	84.27
1971	121.41	10.00	1.21	35.69	6.05	2.19	1.67	0.33	4.38	1.86	27.98
1972	130.38	17.26	5.94	43.38	19.32	6.68	4.96	0.54	14.36	6.14	38.87
1973	126.08	7.43	2.64	43.08	12.58	3.56	4.97	0.33	7.61	3.23	58.96
1974	110.18	3.55	1.37	27.46	13.91	2.05	9.34	0.10	4.57	1.95	50.83
1975	160.13	14.97	3.32	58.65	12.92	4.92	2.75	0.60	10.17	4.32	132.63
1976	129.93	6.22	0.20	30.96	2.27	0.54	1.46	0.20	0.81	0.34	101.34
1977	102.05	5.74	0.36	32.97	4.60	0.79	3.13	0.17	1.47	0.62	36.78
1978	125.99	13.81	1.61	41.11	6.88	2.55	1.95	0.45	4.93	2.10	27.82
Average	107.82	7.06	1.54	30.15	8.87	2.14	4.44	0.25	4.43	1.89	55.53

Table A9:
Pennsylvania Sub-basin A
Terraces without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	2.95	0.25	21.7	12.23	3.2	11.16	2.75	1.07	0.45	53.55
1950	102.79	8.11	1.28	27.68	18.97	5.38	14.36	3.42	4.61	1.96	81.26
1951	111.06	5.05	1.1	31.48	14.94	3.97	10.53	2.1	4.41	1.87	72.69
1952	133.98	4.88	3.25	46.86	16.49	5.59	6.23	1.22	10.26	4.37	109.12
1953	116.19	6.24	2.89	41.93	21.39	6.53	11.96	2.53	9.43	4	87.61
1954	88.79	2.21	0.72	26.73	8.67	2.11	5.99	0.97	2.68	1.14	108.15
1955	107.53	9.61	0.74	33.63	6.76	1.39	4.3	0.34	2.46	1.05	122.65
1956	113.53	4.44	0.38	33.93	14.62	4.43	12.91	3.7	1.71	0.73	100.53
1957	78.8	2.52	0.29	26.74	10.17	2.51	8.75	1.91	1.42	0.6	65.49
1958	131.53	11.61	7.37	39.19	30.8	10.25	13.5	2.86	17.3	7.39	105.42
1959	108.5	5.82	2.73	21.08	16.48	5.83	7.92	2.19	8.56	3.64	47.63
1960	113.28	11.26	5.92	16.77	29.73	10.86	14.69	4.43	15.04	6.43	50.52
1961	102.46	2.59	0.58	35.48	4.81	1.59	2.16	0.48	2.65	1.11	116.94
1962	90.35	3.27	0.07	25.53	4.63	0.26	4.27	0.11	0.36	0.15	138.49
1963	83.26	3.4	0.13	19.34	13.44	3.39	12.74	3.1	0.7	0.29	59.14
1964	91.47	4.52	0.63	30.95	14.85	4.85	12.38	3.81	2.47	1.04	90.68
1965	73.43	2.82	0.45	6.25	10.03	2.24	8.24	1.48	1.79	0.76	17
1966	95.62	3.77	1.86	13.25	17.56	5.41	11.72	2.92	5.84	2.49	46.04
1967	107.59	7.06	3.18	22.18	14.95	5.61	5.65	1.65	9.3	3.96	57.83
1968	90.22	1.36	0.13	16.67	4.96	0.73	4.24	0.43	0.72	0.3	90.63
1969	93.87	2.94	0.11	12.78	4.05	0.34	3.47	0.1	0.58	0.24	116.94
1970	107.12	4.46	0.74	34.43	16.67	4.15	13.88	2.97	2.79	1.18	150.25
1971	121.41	8.58	1.91	37.17	17.58	6.22	10.52	3.22	7.06	3	79.91
1972	130.38	15.32	8.92	42.22	32.14	11.03	13.65	3.13	18.49	7.9	120.36
1973	126.08	5.37	3.29	42.34	20.67	6.88	10.02	2.33	10.65	4.55	102.52
1974	110.18	2.65	1.08	25.73	15.58	4.04	11.28	2.22	4.3	1.82	60.44
1975	160.13	12.25	2.06	61.44	13.21	4.79	5.63	1.57	7.58	3.22	162.03
1976	129.93	4.81	0.16	32.31	1.92	0.45	1.25	0.17	0.67	0.28	104.37
1977	102.05	4.59	0.36	34.03	8.58	2.19	7.08	1.55	1.5	0.64	86.44
1978	125.99	11.61	6.07	43.37	21.37	8.33	6.41	1.93	14.96	6.4	96.55
Average	107.82	5.87	1.96	30.11	14.61	4.49	8.90	2.05	5.71	2.43	90.04

Table A10:
Pennsylvania Sub-basin A
Terraces with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	87.15	2.95	0.25	21.7	4.48	0.54	3.41	0.09	1.07	0.45	19.04
1950	102.79	8.11	1.28	27.68	9.25	2.22	4.64	0.26	4.61	1.96	23.37
1951	111.06	5.05	1.1	31.48	8.37	2	3.96	0.13	4.41	1.87	21.56
1952	133.98	4.88	3.25	46.86	13.25	4.64	2.99	0.27	10.26	4.37	63.87
1953	116.19	6.24	2.89	41.93	22.49	4.2	13.06	0.2	9.43	4	62.61
1954	88.79	2.21	0.72	26.73	5.84	1.21	3.16	0.07	2.68	1.14	85.4
1955	107.53	9.61	0.74	33.63	6.72	1.37	4.26	0.32	2.46	1.05	128.23
1956	113.53	4.44	0.38	33.93	3.76	0.87	2.05	0.14	1.71	0.73	37.92
1957	78.8	2.52	0.29	26.74	4.62	0.65	3.2	0.05	1.42	0.6	10.27
1958	131.53	11.61	7.37	39.19	22.36	7.75	5.06	0.36	17.3	7.39	28.06
1959	108.5	5.82	2.73	21.08	10.04	3.84	1.48	0.2	8.56	3.64	30.87
1960	113.28	11.26	5.92	16.77	32.39	6.83	17.35	0.4	15.04	6.43	44.47
1961	102.46	2.59	0.58	35.48	3.44	1.22	0.79	0.11	2.65	1.11	82.38
1962	90.35	3.27	0.07	25.53	4.56	0.26	4.2	0.11	0.36	0.15	135.87
1963	83.26	3.4	0.13	19.34	4.75	0.39	4.05	0.1	0.7	0.29	32.74
1964	91.47	4.52	0.63	30.95	3.44	1.19	0.97	0.15	2.47	1.04	27.43
1965	73.43	2.82	0.45	6.25	5.42	0.84	3.63	0.08	1.79	0.76	2.41
1966	95.62	3.77	1.86	13.25	8.92	2.62	3.08	0.13	5.84	2.49	32.42
1967	107.59	7.06	3.18	22.18	13.58	4.18	4.28	0.22	9.3	3.96	48.76
1968	90.22	1.36	0.13	16.67	3.71	0.32	2.99	0.02	0.72	0.3	68.42
1969	93.87	2.94	0.11	12.78	3.93	0.34	3.35	0.1	0.58	0.24	111.77
1970	107.12	4.46	0.74	34.43	8.18	1.29	5.39	0.11	2.79	1.18	81.29
1971	121.41	8.58	1.91	37.17	8.55	3.3	1.49	0.3	7.06	3	28.62
1972	130.38	15.32	8.92	42.22	23.19	8.39	4.7	0.49	18.49	7.9	38.28
1973	126.08	5.37	3.29	42.34	14.91	4.77	4.26	0.22	10.65	4.55	59.05
1974	110.18	2.65	1.08	25.73	13.18	1.89	8.88	0.07	4.3	1.82	49.52
1975	160.13	12.25	2.06	61.44	9.77	3.69	2.19	0.47	7.58	3.22	136.71
1976	129.93	4.81	0.16	32.31	1.84	0.42	1.17	0.14	0.67	0.28	104.03
1977	102.05	4.59	0.36	34.03	4.42	0.76	2.92	0.12	1.5	0.64	36
1978	125.99	11.61	6.07	43.37	16.64	6.76	1.68	0.36	14.96	6.4	28.62
Average	107.82	5.87	1.96	30.11	9.87	2.63	4.15	0.19	5.71	2.43	55.33

Table A11:
Sub-basin A
Summary of (30 year) average annual results for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional										
without NMP	10.05	7.04	26.18	32.35	15.40	16.00	8.41	16.35	6.99	83.17
with NMP	10.05	7.04	26.18	23.50	7.37	7.15	0.38	16.35	6.99	51.99
Contour										
without NMP	7.45	4.92	28.65	20.99	9.62	9.42	4.68	11.57	4.94	88.22
with NMP	7.45	4.92	28.65	16.05	5.20	4.48	0.26	11.57	4.94	54.37
No-till										
without NMP	7.53	1.84	29.72	14.87	7.06	9.57	4.80	5.30	2.26	89.77
with NMP	7.53	1.84	29.72	9.84	2.53	4.54	0.27	5.30	2.26	55.14
No-till/Contour										
without NMP	7.06	1.54	30.15	13.83	6.62	9.40	4.73	4.43	1.89	90.41
with NMP	7.06	1.54	30.15	8.87	2.14	4.44	0.25	4.43	1.89	55.53
Terraces										
without NMP	5.87	1.96	30.11	14.61	4.48	8.90	2.05	5.71	2.43	90.04
with NMP	5.87	1.96	30.11	9.86	2.62	4.15	0.19	5.71	2.43	55.33

Table A12:
Sub-basin A
Summary of 30 year totals for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional										
without NMP	301.48	211.33	785.52	970.56	325.18	480.06	115.47	490.50	209.71	2495.10
with NMP	301.48	211.33	785.52	705.07	221.14	214.57	11.43	490.50	209.71	1559.62
Contour										
without NMP	223.45	147.60	859.50	629.61	288.50	282.51	140.30	347.10	148.20	2646.60
with NMP	223.45	147.60	859.50	481.60	156.13	134.50	7.93	347.10	148.20	1631.14
No-till										
without NMP	225.81	55.10	891.49	445.99	211.75	287.07	144.01	158.92	67.74	2693.02
with NMP	225.81	55.10	891.49	295.25	75.81	136.33	8.07	158.92	67.74	1654.30
No-till/Contour										
without NMP	211.87	46.21	904.36	414.87	198.43	281.97	141.80	132.90	56.63	2712.34
with NMP	211.87	46.21	904.36	266.24	63.99	133.34	7.36	132.90	56.63	1665.91
Terraces										
without NMP	176.07	58.65	903.19	438.25	134.55	266.89	61.59	171.36	72.96	2701.18
with NMP	176.07	58.65	903.19	296.00	78.75	124.64	5.79	171.36	72.96	1659.99

APPENDIX B

TABLES B1-B12 For Sub-Basin E

(Yearly Variations and 30 Year Averages Plus Totals)

Table B1:
Pennsylvania Sub-basin E
Conventional tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	5.93	17.22	5.02	54.65	20.13	18.68	4.73	35.97	15.40	22.81
1950	100.70	16.66	62.70	12.50	147.67	59.33	31.98	9.77	115.69	49.56	26.50
1951	81.31	10.22	18.45	12.94	76.88	28.27	29.41	7.94	47.47	20.33	22.36
1952	98.19	15.24	98.36	22.98	194.22	80.93	15.69	4.45	178.53	76.48	72.23
1953	80.12	10.78	1.01	6.53	16.14	2.16	12.31	0.53	3.83	1.63	34.36
1954	87.28	13.12	1.30	9.65	20.77	2.76	15.99	0.73	4.78	2.03	62.56
1955	93.84	13.57	1.23	13.33	20.45	2.76	15.88	0.82	4.57	1.94	109.13
1956	91.45	15.37	23.36	13.73	77.85	26.04	31.94	6.38	45.91	19.66	55.65
1957	84.48	8.68	27.55	14.34	84.65	32.11	25.74	6.90	58.91	25.21	57.03
1958	101.82	13.66	29.75	20.21	102.10	39.98	32.16	10.01	69.94	29.97	38.47
1959	80.39	9.83	53.35	18.57	122.70	50.16	15.77	4.34	106.93	45.82	95.33
1960	98.44	12.85	1.10	12.64	10.93	2.80	6.54	0.95	4.39	1.85	37.27
1961	74.59	6.98	0.47	10.05	13.21	1.40	11.04	0.49	2.17	0.91	46.80
1962	73.49	11.72	4.53	11.18	28.80	6.05	16.79	0.93	12.01	5.12	70.17
1963	68.76	10.27	25.24	8.80	80.67	26.67	31.39	5.57	49.28	21.10	73.13
1964	68.95	8.56	19.10	17.30	74.89	26.99	28.19	6.98	46.70	20.01	71.75
1965	77.67	7.89	25.42	7.04	81.51	32.10	24.39	7.64	57.12	24.46	27.66
1966	74.34	10.65	90.25	17.08	175.93	72.73	18.70	5.35	157.23	67.38	70.78
1967	101.03	11.95	1.01	7.04	13.48	2.75	9.25	0.96	4.23	1.79	47.00
1968	83.15	13.36	1.48	2.71	18.69	3.03	13.01	0.61	5.68	2.42	34.63
1969	68.37	5.55	0.40	3.52	18.75	0.96	17.18	0.29	1.57	0.67	50.33
1970	91.55	11.15	15.85	15.25	75.00	21.00	39.59	5.85	35.41	15.15	114.79
1971	76.46	8.49	31.43	9.78	82.62	31.64	24.70	6.85	57.92	24.79	32.75
1972	108.12	20.52	106.68	28.24	195.97	80.26	28.59	8.57	167.38	71.69	75.79
1973	93.39	10.49	92.13	14.25	179.69	75.26	10.98	2.98	168.71	72.28	42.82
1974	94.76	12.25	1.79	15.96	20.01	3.72	13.62	1.01	6.39	2.71	81.92
1975	105.82	21.07	3.36	14.09	23.38	5.70	13.78	1.58	9.60	4.12	86.19
1976	89.42	11.35	1.03	10.33	14.67	2.51	10.63	0.81	4.04	1.70	51.18
1977	95.49	14.94	26.20	16.53	94.22	30.54	39.21	6.97	55.01	23.57	67.74
1978	99.08	12.91	26.11	20.27	90.02	34.78	24.73	6.81	65.29	27.97	57.77
Average	87.19	11.87	26.93	13.06	73.69	26.85	20.93	4.26	52.76	22.59	57.90

Table B2:
Pennsylvania Sub-basin E
Conventional tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	5.93	17.22	5.02	42.26	15.67	6.29	0.27	35.97	15.40	13.13
1950	100.70	16.66	62.70	12.50	120.66	50.18	4.97	0.62	115.69	49.56	11.48
1951	81.31	10.22	18.45	12.94	54.73	20.72	7.26	0.39	47.47	20.33	6.67
1952	98.19	15.24	98.36	22.98	183.12	77.09	4.59	0.61	178.53	76.48	30.39
1953	80.12	10.78	1.01	6.53	10.21	2.01	6.38	0.38	3.83	1.63	16.16
1954	87.28	13.12	1.30	9.65	12.20	3.17	7.42	1.14	4.78	2.03	26.52
1955	93.84	13.57	1.23	13.33	11.92	2.47	7.35	0.53	4.57	1.94	44.21
1956	91.45	15.37	23.36	13.73	53.89	20.23	7.98	0.57	45.91	19.66	24.83
1957	84.48	8.68	27.55	14.34	64.50	25.56	5.59	0.35	58.91	25.21	26.21
1958	101.82	13.66	29.75	20.21	74.63	30.44	4.69	0.47	69.94	29.97	16.06
1959	80.39	9.83	53.35	18.57	110.22	46.24	3.29	0.42	106.93	45.82	37.15
1960	98.44	12.85	1.10	12.64	8.04	2.52	3.65	0.67	4.39	1.85	16.44
1961	74.59	6.98	0.47	10.05	7.12	1.95	4.95	1.04	2.17	0.91	19.70
1962	73.49	11.72	4.53	11.18	19.19	5.53	7.18	0.41	12.01	5.12	27.67
1963	68.76	10.27	25.24	8.80	57.47	21.51	8.19	0.41	49.28	21.10	34.95
1964	68.95	8.56	19.10	17.30	54.07	20.38	7.37	0.37	46.70	20.01	38.43
1965	77.67	7.89	25.42	7.04	68.34	24.79	11.22	0.33	57.12	24.46	30.33
1966	74.34	10.65	90.25	17.08	163.00	67.77	5.77	0.39	157.23	67.38	34.17
1967	101.03	11.95	1.01	7.04	8.90	2.27	4.67	0.48	4.23	1.79	19.35
1968	83.15	13.36	1.48	2.71	12.00	3.06	6.32	0.64	5.68	2.42	13.79
1969	68.37	5.55	0.40	3.52	9.23	1.03	7.66	0.36	1.57	0.67	19.77
1970	91.55	11.15	15.85	15.25	46.55	15.59	11.14	0.44	35.41	15.15	47.75
1971	76.46	8.49	31.43	9.78	62.97	25.13	5.05	0.34	57.92	24.79	12.82
1972	108.12	20.52	106.68	28.24	173.62	72.46	6.24	0.77	167.38	71.69	58.17
1973	93.39	10.49	92.13	14.25	171.27	72.70	2.56	0.42	168.71	72.28	15.68
1974	94.76	12.25	1.79	15.96	12.99	3.18	6.60	0.47	6.39	2.71	35.73
1975	105.82	21.07	3.36	14.09	16.51	4.95	6.91	0.83	9.60	4.12	34.37
1976	89.42	11.35	1.03	10.33	9.01	2.25	4.97	0.55	4.04	1.70	21.78
1977	95.49	14.94	26.20	16.53	65.23	24.12	10.22	0.55	55.01	23.57	29.56
1978	99.08	12.91	26.11	20.27	69.68	28.51	4.39	0.54	65.29	27.97	23.47
Average	87.19	11.87	26.93	13.06	59.12	23.12	6.36	0.53	52.76	22.59	26.22

Table B3:
Pennsylvania Sub-basin E
Contour tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.29	8.72	5.76	38.72	13.55	17.62	4.53	21.10	9.02	26.58
1950	100.70	13.23	45.62	15.30	115.96	45.95	30.83	9.48	85.13	36.47	30.86
1951	81.31	8.07	13.23	14.88	62.20	22.30	28.14	7.73	34.06	14.57	25.53
1952	98.19	10.68	79.06	26.22	155.42	64.73	13.85	4.08	141.57	60.65	81.81
1953	80.12	8.83	0.45	7.41	12.34	1.11	10.60	0.37	1.74	0.74	35.14
1954	87.28	9.64	0.54	11.82	15.93	1.44	13.64	0.48	2.29	0.96	69.03
1955	93.84	10.07	0.58	16.65	15.51	1.49	13.05	0.45	2.46	1.04	113.74
1956	91.45	12.35	12.19	16.49	51.92	16.72	26.80	5.99	25.12	10.73	50.42
1957	84.48	5.80	11.70	16.28	53.05	19.48	22.76	6.52	30.29	12.96	57.92
1958	101.82	10.53	19.01	23.35	74.74	28.40	31.16	9.75	43.58	18.65	41.91
1959	80.39	6.65	44.94	21.75	102.22	41.97	13.54	3.99	88.68	37.98	106.64
1960	98.44	8.50	0.38	15.69	6.53	1.14	4.80	0.41	1.73	0.73	42.83
1961	74.59	5.57	0.18	11.24	10.10	0.74	9.24	0.38	0.86	0.36	46.22
1962	73.49	8.91	3.81	14.05	24.25	4.82	14.59	0.70	9.66	4.12	81.42
1963	68.76	7.50	14.14	11.19	57.39	18.27	27.08	5.30	30.31	12.97	80.68
1964	68.95	6.03	10.74	19.67	53.16	18.89	24.65	6.69	28.51	12.20	66.42
1965	77.67	5.91	17.55	8.10	64.18	24.89	23.32	7.40	40.86	17.49	32.19
1966	74.34	8.11	78.23	19.51	149.24	61.67	17.21	5.08	132.03	56.59	80.01
1967	101.03	8.80	0.45	9.15	9.31	1.40	7.17	0.51	2.14	0.89	56.24
1968	83.15	11.18	0.63	4.35	12.78	1.56	10.10	0.43	2.68	1.13	43.24
1969	68.37	4.78	0.22	4.18	13.13	0.54	12.20	0.15	0.93	0.39	47.71
1970	91.55	8.13	8.52	18.03	52.38	13.81	32.95	5.50	19.43	8.31	105.77
1971	76.46	6.27	23.96	11.13	66.20	25.65	21.63	6.57	44.57	19.08	29.76
1972	108.12	15.21	80.50	33.48	151.22	61.67	26.24	8.15	124.98	53.52	86.88
1973	93.39	7.95	68.68	16.73	134.98	56.48	9.46	2.70	125.52	53.78	53.61
1974	94.76	8.57	0.36	18.92	12.56	1.20	10.93	0.52	1.63	0.68	82.10
1975	105.82	16.65	1.37	17.55	15.71	2.86	11.12	0.92	4.59	1.94	94.34
1976	89.42	8.18	0.40	12.65	10.02	1.29	8.24	0.54	1.78	0.75	55.37
1977	95.49	11.82	11.72	19.55	61.62	18.05	35.07	6.70	26.55	11.35	68.66
1978	99.08	8.88	16.36	23.73	63.23	24.14	21.93	6.46	41.30	17.68	61.47
Average	87.19	8.90	19.14	15.49	55.53	19.87	18.33	3.95	37.20	15.92	61.82

Table B4:
Pennsylvania Sub-basin E
Contour tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.29	8.72	5.76	26.77	9.18	5.67	0.16	21.10	9.02	15.36
1950	100.70	13.23	45.62	15.30	89.49	36.95	4.36	0.48	85.13	36.47	13.99
1951	81.31	8.07	13.23	14.88	40.52	14.86	6.46	0.29	34.06	14.57	9.07
1952	98.19	10.68	79.06	26.22	144.63	61.04	3.06	0.39	141.57	60.65	30.35
1953	80.12	8.83	0.45	7.41	7.29	1.05	5.55	0.31	1.74	0.74	16.42
1954	87.28	9.64	0.54	11.82	8.59	1.58	6.30	0.62	2.29	0.96	29.26
1955	93.84	10.07	0.58	16.65	8.49	1.40	6.03	0.36	2.46	1.04	46.15
1956	91.45	12.35	12.19	16.49	30.87	11.16	5.75	0.43	25.12	10.73	23.39
1957	84.48	5.80	11.70	16.28	34.11	13.17	3.82	0.21	30.29	12.96	26.06
1958	101.82	10.53	19.01	23.35	47.54	19.01	3.96	0.36	43.58	18.65	17.56
1959	80.39	6.65	44.94	21.75	91.10	38.22	2.42	0.24	88.68	37.98	41.25
1960	98.44	8.50	0.38	15.69	4.50	1.03	2.77	0.30	1.73	0.73	18.84
1961	74.59	5.57	0.18	11.24	5.07	0.70	4.21	0.34	0.86	0.36	19.88
1962	73.49	8.91	3.81	14.05	15.89	4.42	6.23	0.30	9.66	4.12	32.05
1963	68.76	7.50	14.14	11.19	36.47	13.25	6.16	0.28	30.31	12.97	40.04
1964	68.95	6.03	10.74	19.67	33.89	12.44	5.38	0.24	28.51	12.20	35.19
1965	77.67	5.91	17.55	8.10	50.52	17.70	9.66	0.21	40.86	17.49	33.00
1966	74.34	8.11	78.23	19.51	135.85	56.86	3.82	0.27	132.03	56.59	33.71
1967	101.03	8.80	0.45	9.15	5.84	1.21	3.70	0.32	2.14	0.89	22.68
1968	83.15	11.18	0.63	4.35	7.78	1.58	5.10	0.45	2.68	1.13	17.22
1969	68.37	4.78	0.22	4.18	6.59	0.54	5.66	0.15	0.93	0.39	18.77
1970	91.55	8.13	8.52	18.03	27.79	8.58	8.36	0.27	19.43	8.31	44.57
1971	76.46	6.27	23.96	11.13	47.91	19.28	3.34	0.20	44.57	19.08	11.03
1972	108.12	15.21	80.50	33.48	129.31	54.09	4.33	0.57	124.98	53.52	67.41
1973	93.39	7.95	68.68	16.73	127.46	54.09	1.94	0.31	125.52	53.78	19.64
1974	94.76	8.57	0.36	18.92	7.01	1.00	5.38	0.32	1.63	0.68	36.00
1975	105.82	16.65	1.37	17.55	10.24	2.54	5.65	0.60	4.59	1.94	37.88
1976	89.42	8.18	0.40	12.65	5.70	1.03	3.92	0.28	1.78	0.75	23.87
1977	95.49	11.82	11.72	19.55	34.84	11.75	8.29	0.40	26.55	11.35	32.55
1978	99.08	8.88	16.36	23.73	44.37	18.04	3.07	0.36	41.30	17.68	26.37
Average	87.19	8.90	19.14	15.49	42.21	16.25	5.01	0.33	37.20	15.92	27.99

Table B5:
Pennsylvania Sub-basin E
No-Till without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.56	5.81	6.98	34.73	11.87	17.72	4.59	17.01	7.28	31.61
1950	100.70	13.93	22.19	16.62	75.35	28.54	31.75	9.87	43.60	18.67	32.92
1951	81.31	8.48	8.02	16.13	50.94	17.55	28.24	7.84	22.70	9.71	27.87
1952	98.19	11.39	16.83	26.00	51.02	19.94	14.16	4.17	36.86	15.77	80.09
1953	80.12	9.13	1.26	7.21	15.10	2.23	10.81	0.40	4.29	1.83	34.77
1954	87.28	10.16	1.35	11.48	18.79	2.55	13.97	0.51	4.82	2.04	68.19
1955	93.84	10.53	1.61	16.16	19.07	2.95	13.34	0.51	5.73	2.44	112.23
1956	91.45	12.87	4.77	17.03	39.10	11.44	26.56	6.09	12.54	5.35	52.82
1957	84.48	6.31	2.49	17.25	31.92	10.55	23.00	6.75	8.92	3.80	61.42
1958	101.82	11.05	17.13	24.68	70.18	26.60	30.91	9.79	39.27	16.81	44.76
1959	80.39	7.12	9.44	21.37	41.02	15.69	13.74	4.03	27.28	11.66	104.81
1960	98.44	9.12	1.10	15.21	9.19	2.29	4.98	0.50	4.21	1.79	42.01
1961	74.59	5.74	0.54	11.03	11.71	1.35	9.44	0.39	2.27	0.96	46.32
1962	73.49	9.26	8.07	13.60	34.24	9.03	14.83	0.74	19.41	8.29	79.90
1963	68.76	8.04	2.65	11.73	35.47	9.10	26.84	5.40	8.63	3.70	85.38
1964	68.95	6.44	6.10	20.32	40.13	13.60	24.37	6.85	15.76	6.75	65.49
1965	77.67	6.18	9.57	8.76	47.19	17.68	23.30	7.45	23.89	10.23	34.39
1966	74.34	8.46	15.47	19.20	50.31	19.18	17.35	5.10	32.96	14.08	78.82
1967	101.03	9.20	1.12	8.82	11.92	2.47	7.39	0.54	4.53	1.93	54.68
1968	83.15	11.50	1.70	4.07	16.56	3.07	10.41	0.45	6.15	2.62	41.63
1969	68.37	4.82	0.63	4.11	15.09	1.13	12.77	0.15	2.32	0.98	48.29
1970	91.55	8.83	9.33	19.55	55.59	15.01	34.57	6.03	21.02	8.98	111.30
1971	76.46	6.57	6.57	11.77	37.43	13.52	21.75	6.81	15.68	6.71	30.96
1972	108.12	16.34	30.26	34.56	84.84	33.26	26.90	8.46	57.94	24.80	87.90
1973	93.39	8.27	4.80	16.58	24.49	9.09	9.56	2.72	14.93	6.37	53.20
1974	94.76	9.16	0.96	18.48	15.30	2.19	11.56	0.60	3.74	1.59	84.11
1975	105.82	17.35	3.47	16.96	21.31	5.20	11.47	1.01	9.84	4.19	93.28
1976	89.42	8.60	1.23	12.25	13.13	2.53	8.50	0.56	4.63	1.97	54.84
1977	95.49	12.43	5.27	20.93	49.53	13.28	34.43	6.84	15.10	6.44	69.99
1978	99.08	9.58	9.62	24.38	46.93	17.27	21.97	6.60	24.96	10.67	63.56
Average	87.19	9.38	6.98	15.77	35.58	11.34	18.55	4.06	17.03	7.28	62.58

Table B6:
Pennsylvania Sub-basin E
No-till with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.56	5.81	6.98	22.62	7.45	5.61	0.17	17.01	7.28	18.40
1950	100.70	13.93	22.19	16.62	47.97	19.17	4.37	0.50	43.60	18.67	15.29
1951	81.31	8.48	8.02	16.13	29.14	10.03	6.44	0.32	22.70	9.71	11.61
1952	98.19	11.39	16.83	26.00	39.58	16.22	2.72	0.45	36.86	15.77	26.27
1953	80.12	9.13	1.26	7.21	9.90	2.14	5.61	0.31	4.29	1.83	16.09
1954	87.28	10.16	1.35	11.48	11.26	2.73	6.44	0.69	4.82	2.04	28.80
1955	93.84	10.53	1.61	16.16	11.92	2.81	6.19	0.37	5.73	2.44	45.44
1956	91.45	12.87	4.77	17.03	18.18	5.82	5.64	0.47	12.54	5.35	24.45
1957	84.48	6.31	2.49	17.25	12.70	4.03	3.78	0.23	8.92	3.80	28.31
1958	101.82	11.05	17.13	24.68	43.12	17.20	3.85	0.39	39.27	16.81	19.63
1959	80.39	7.12	9.44	21.37	29.77	11.94	2.49	0.28	27.28	11.66	40.47
1960	98.44	9.12	1.10	15.21	7.09	2.14	2.88	0.35	4.21	1.79	18.49
1961	74.59	5.74	0.54	11.03	6.53	1.40	4.26	0.44	2.27	0.96	19.85
1962	73.49	9.26	8.07	13.60	25.75	8.62	6.34	0.33	19.41	8.29	31.47
1963	68.76	8.04	2.65	11.73	14.69	4.00	6.06	0.30	8.63	3.70	42.35
1964	68.95	6.44	6.10	20.32	20.76	7.00	5.00	0.25	15.76	6.75	35.00
1965	77.67	6.18	9.57	8.76	32.77	10.45	8.88	0.22	23.89	10.23	35.05
1966	74.34	8.46	15.47	19.20	36.63	14.37	3.67	0.29	32.96	14.08	32.66
1967	101.03	9.20	1.12	8.82	8.29	2.25	3.76	0.32	4.53	1.93	21.95
1968	83.15	11.50	1.70	4.07	11.36	3.10	5.21	0.48	6.15	2.62	16.55
1969	68.37	4.82	0.63	4.11	8.21	1.13	5.89	0.15	2.32	0.98	18.98
1970	91.55	8.83	9.33	19.55	29.64	9.29	8.62	0.31	21.02	8.98	47.84
1971	76.46	6.57	6.57	11.77	18.77	6.93	3.09	0.22	15.68	6.71	11.90
1972	108.12	16.34	30.26	34.56	62.30	25.40	4.36	0.60	57.94	24.80	67.93
1973	93.39	8.27	4.80	16.58	16.91	6.68	1.98	0.31	14.93	6.37	19.43
1974	94.76	9.16	0.96	18.48	9.39	1.94	5.65	0.35	3.74	1.59	36.76
1975	105.82	17.35	3.47	16.96	15.69	4.84	5.85	0.65	9.84	4.19	37.40
1976	89.42	8.60	1.23	12.25	8.68	2.28	4.05	0.31	4.63	1.97	23.59
1977	95.49	12.43	5.27	20.93	23.09	6.87	7.99	0.43	15.10	6.44	34.29
1978	99.08	9.58	9.62	24.38	28.06	11.05	3.10	0.38	24.96	10.67	28.85
Average	87.19	9.38	6.98	15.77	22.02	7.64	4.99	0.36	17.03	7.28	28.50

Table B7:
Pennsylvania Sub-basin E
No-till/Contour without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.23	5.22	7.08	32.73	11.04	17.54	4.55	15.19	6.49	32.19
1950	100.70	13.12	13.14	17.34	57.53	20.96	31.48	9.82	26.05	11.14	33.98
1951	81.31	7.98	7.35	16.56	48.54	16.60	28.02	7.81	20.52	8.79	28.49
1952	98.19	10.50	15.89	26.59	47.96	18.68	13.86	4.11	34.10	14.57	82.11
1953	80.12	8.67	0.76	7.47	13.29	1.57	10.47	0.37	2.82	1.20	35.10
1954	87.28	9.43	0.76	11.95	16.59	1.77	13.54	0.48	3.05	1.29	69.68
1955	93.84	9.82	0.94	16.87	16.24	2.01	12.49	0.42	3.75	1.59	111.69
1956	91.45	12.18	2.31	17.69	31.84	8.62	25.77	6.02	6.07	2.60	51.88
1957	84.48	5.64	0.34	17.70	24.18	7.38	22.50	6.68	1.68	0.70	61.76
1958	101.82	10.27	15.24	25.32	64.31	24.13	30.72	9.75	33.59	14.38	45.23
1959	80.39	6.47	8.65	22.04	38.55	14.74	13.41	3.98	25.14	10.76	106.85
1960	98.44	8.22	0.61	15.92	7.33	1.50	4.70	0.40	2.63	1.10	43.18
1961	74.59	5.47	0.34	11.29	10.69	1.03	9.13	0.38	1.56	0.65	46.08
1962	73.49	8.74	7.33	14.23	32.05	8.20	14.51	0.70	17.54	7.50	82.00
1963	68.76	7.45	1.10	12.30	29.73	6.88	26.13	5.35	3.60	1.53	86.77
1964	68.95	5.89	3.32	20.78	31.84	10.26	23.74	6.80	8.10	3.46	63.73
1965	77.67	5.78	9.80	8.98	46.91	17.60	23.12	7.43	23.79	10.17	35.34
1966	74.34	7.97	15.04	19.64	48.72	18.59	17.11	5.07	31.61	13.52	80.79
1967	101.03	8.59	0.58	9.30	9.71	1.58	7.10	0.49	2.61	1.09	56.86
1968	83.15	11.05	0.96	4.45	13.81	2.03	10.01	0.42	3.80	1.61	44.01
1969	68.37	4.74	0.40	4.21	13.70	0.84	12.07	0.15	1.63	0.69	47.69
1970	91.55	8.21	8.14	20.09	50.52	13.16	33.67	5.94	16.85	7.22	109.70
1971	76.46	6.13	2.76	12.01	28.29	9.71	21.42	6.77	6.87	2.94	30.51
1972	108.12	15.18	28.33	35.82	80.13	31.31	26.49	8.36	53.64	22.95	90.00
1973	93.39	7.78	4.30	17.02	22.74	8.41	9.31	2.69	13.43	5.72	54.26
1974	94.76	8.34	0.56	19.15	13.23	1.50	10.81	0.48	2.42	1.02	82.46
1975	105.82	16.40	1.95	17.75	17.03	3.48	10.95	0.89	6.08	2.59	94.67
1976	89.42	7.94	0.67	12.82	10.83	1.71	8.00	0.53	2.83	1.18	55.01
1977	95.49	11.73	3.30	21.65	42.03	10.40	33.57	6.78	8.46	3.62	69.73
1978	99.08	8.70	5.81	25.09	34.64	12.13	21.50	6.52	13.14	5.61	64.42
Average	87.19	8.75	5.53	16.30	31.19	9.59	18.10	4.00	13.09	5.59	63.21

Table B8:
Pennsylvania Sub-basin E
No-till/Contour with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.23	5.22	7.08	20.71	6.64	5.52	0.15	15.19	6.49	18.75
1950	100.70	13.12	13.14	17.34	30.26	11.61	4.21	0.47	26.05	11.14	15.87
1951	81.31	7.98	7.35	16.56	26.81	9.06	6.29	0.27	20.52	8.79	12.06
1952	98.19	10.50	15.89	26.59	36.66	14.97	2.56	0.40	34.10	14.57	27.12
1953	80.12	8.67	0.76	7.47	8.26	1.51	5.44	0.31	2.82	1.20	16.29
1954	87.28	9.43	0.76	11.95	9.30	1.89	6.25	0.60	3.05	1.29	29.47
1955	93.84	9.82	0.94	16.87	9.54	1.94	5.79	0.35	3.75	1.59	45.32
1956	91.45	12.18	2.31	17.69	11.31	3.03	5.24	0.43	6.07	2.60	24.18
1957	84.48	5.64	0.34	17.70	5.14	0.91	3.46	0.21	1.68	0.70	28.32
1958	101.82	10.27	15.24	25.32	37.33	14.73	3.74	0.35	33.59	14.38	19.81
1959	80.39	6.47	8.65	22.04	27.46	11.00	2.32	0.24	25.14	10.76	41.20
1960	98.44	8.22	0.61	15.92	5.32	1.39	2.69	0.29	2.63	1.10	18.98
1961	74.59	5.47	0.34	11.29	5.74	0.96	4.18	0.31	1.56	0.65	19.85
1962	73.49	8.74	7.33	14.23	23.74	7.80	6.20	0.30	17.54	7.50	32.28
1963	68.76	7.45	1.10	12.30	9.35	1.81	5.75	0.28	3.60	1.53	43.29
1964	68.95	5.89	3.32	20.78	12.72	3.69	4.62	0.23	8.10	3.46	33.84
1965	77.67	5.78	9.80	8.98	32.45	10.38	8.66	0.21	23.79	10.17	35.64
1966	74.34	7.97	15.04	19.64	34.95	13.79	3.34	0.27	31.61	13.52	32.65
1967	101.03	8.59	0.58	9.30	6.20	1.41	3.59	0.32	2.61	1.09	22.78
1968	83.15	11.05	0.96	4.45	8.84	2.05	5.04	0.44	3.80	1.61	17.51
1969	68.37	4.74	0.40	4.21	7.22	0.84	5.59	0.15	1.63	0.69	18.76
1970	91.55	8.21	8.14	20.09	25.10	7.49	8.25	0.27	16.85	7.22	47.22
1971	76.46	6.13	2.76	12.01	9.76	3.14	2.89	0.20	6.87	2.94	11.62
1972	108.12	15.18	28.33	35.82	57.68	23.49	4.04	0.54	53.64	22.95	69.98
1973	93.39	7.78	4.30	17.02	15.31	6.02	1.88	0.30	13.43	5.72	19.82
1974	94.76	8.34	0.56	19.15	7.72	1.31	5.30	0.29	2.42	1.02	36.13
1975	105.82	16.40	1.95	17.75	11.68	3.19	5.60	0.60	6.08	2.59	38.03
1976	89.42	7.94	0.67	12.82	6.65	1.46	3.82	0.28	2.83	1.18	23.75
1977	95.49	11.73	3.30	21.65	16.07	4.02	7.61	0.40	8.46	3.62	35.28
1978	99.08	8.70	5.81	25.09	16.05	5.94	2.91	0.33	13.14	5.61	29.67
Average	87.19	8.75	5.53	16.30	17.85	5.92	4.76	0.33	13.09	5.59	28.85

Table B9:
Pennsylvania Sub-basin E
Strip Cropping with diversion and grassed waterway
(Corn and Hay)

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.08	2.38	2.89	18.62	5.38	11.49	2.34	7.13	3.04	5.89
1950	100.70	13.29	6.25	9.85	44.50	11.23	30.61	5.29	13.89	5.94	46.06
1951	81.31	8.02	0.07	13.32	24.52	4.14	24.16	3.99	0.36	0.15	50.81
1952	98.19	10.66	10.94	19.60	39.70	11.50	20.50	3.29	19.20	8.21	85.64
1953	80.12	8.86	0.16	7.75	16.84	3.77	16.08	3.45	0.76	0.32	20.75
1954	87.28	9.58	0.22	11.36	26.85	4.63	25.86	4.21	0.99	0.42	73.59
1955	93.84	10.26	6.88	16.68	37.59	10.18	22.82	3.86	14.77	6.32	85.48
1956	91.45	12.20	3.38	12.77	26.52	7.77	18.12	4.18	8.40	3.59	42.53
1957	84.48	5.77	0.04	13.84	14.96	2.76	14.72	2.66	0.24	0.10	43.12
1958	101.82	10.63	0.94	21.23	32.51	6.72	29.81	5.57	2.70	1.15	55.88
1959	80.39	6.02	1.55	10.52	22.00	5.24	16.31	2.81	5.69	2.43	66.02
1960	98.44	8.59	1.34	16.33	18.29	4.47	13.65	2.49	4.64	1.98	62.43
1961	74.59	5.51	0.13	10.89	19.42	4.36	18.82	4.11	0.60	0.25	38.16
1962	73.49	9.06	6.75	13.49	38.42	10.13	22.65	3.39	15.77	6.74	71.94
1963	68.76	7.64	0.20	7.09	20.01	3.33	19.03	2.92	0.98	0.41	49.41
1964	68.95	6.00	2.40	17.46	27.24	5.69	21.84	3.38	5.40	2.31	92.02
1965	77.67	6.00	1.28	6.68	27.07	4.82	23.28	3.21	3.79	1.61	43.17
1966	74.34	7.54	8.63	10.06	49.09	10.95	32.51	3.86	16.58	7.09	70.62
1967	101.03	9.08	0.18	9.37	23.50	3.87	22.60	3.49	0.90	0.38	74.96
1968	83.15	11.22	0.22	4.48	23.76	4.31	22.68	3.85	1.08	0.46	43.31
1969	68.37	4.71	0.04	3.98	24.97	3.73	24.75	3.64	0.22	0.09	42.49
1970	91.55	8.16	6.28	14.91	37.56	9.27	24.25	3.58	13.31	5.69	89.05
1971	76.46	6.21	0.65	9.90	18.73	3.44	16.89	2.65	1.84	0.79	48.46
1972	108.12	15.33	6.41	29.58	34.49	8.80	22.49	3.67	12.00	5.13	115.42
1973	93.39	7.48	0.07	9.73	12.17	3.15	11.81	3.00	0.36	0.15	20.06
1974	94.76	8.63	0.11	19.42	15.81	3.34	15.21	3.09	0.60	0.25	51.11
1975	105.82	16.66	4.28	17.50	27.08	7.70	18.00	3.82	9.08	3.88	70.95
1976	89.42	8.17	0.16	12.57	17.67	3.83	16.98	3.54	0.69	0.29	48.59
1977	95.49	11.97	3.83	14.10	33.62	9.04	24.08	4.96	9.54	4.08	61.53
1978	99.08	8.80	1.73	19.81	21.20	5.66	16.04	3.45	5.16	2.21	47.64
Average	87.19	8.87	2.58	12.91	26.49	6.11	20.60	3.59	5.89	2.52	57.24

Table B10:
Pennsylvania Sub-basin E
Strip Cropping with diversion and grassed waterway
(Corn and Hay)
with Nutrient Management Plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	73.34	4.08	2.38	2.89	12.68	3.19	5.55	0.15	7.13	3.04	3.92
1950	100.70	13.29	6.25	9.85	25.31	6.41	11.42	0.47	13.89	5.94	22.17
1951	81.31	8.02	0.07	13.32	6.45	0.44	6.09	0.29	0.36	0.15	4.63
1952	98.19	10.66	10.94	19.60	26.23	8.62	7.03	0.41	19.20	8.21	39.50
1953	80.12	8.86	0.16	7.75	5.01	0.63	4.25	0.31	0.76	0.32	8.55
1954	87.28	9.58	0.22	11.36	11.35	0.94	10.36	0.52	0.99	0.42	44.52
1955	93.84	10.26	6.88	16.68	23.63	6.68	8.86	0.36	14.77	6.32	48.42
1956	91.45	12.20	3.38	12.77	13.30	4.02	4.90	0.43	8.40	3.59	21.45
1957	84.48	5.77	0.04	13.84	5.24	0.31	5.00	0.21	0.24	0.10	20.67
1958	101.82	10.63	0.94	21.23	11.77	1.64	9.07	0.49	2.70	1.15	26.38
1959	80.39	6.02	1.55	10.52	11.83	2.67	6.14	0.24	5.69	2.43	39.23
1960	98.44	8.59	1.34	16.33	10.04	2.30	5.40	0.32	4.64	1.98	34.17
1961	74.59	5.51	0.13	10.89	5.26	0.54	4.66	0.29	0.60	0.25	17.53
1962	73.49	9.06	6.75	13.49	25.00	7.05	9.23	0.31	15.77	6.74	42.83
1963	68.76	7.64	0.20	7.09	9.44	0.75	8.46	0.34	0.98	0.41	31.38
1964	68.95	6.00	2.40	17.46	14.38	2.57	8.98	0.26	5.40	2.31	55.08
1965	77.67	6.00	1.28	6.68	14.75	1.82	10.96	0.21	3.79	1.61	28.02
1966	74.34	7.54	8.63	10.06	31.46	7.35	14.88	0.26	16.58	7.09	43.07
1967	101.03	9.08	0.18	9.37	10.86	0.72	9.96	0.34	0.90	0.38	46.40
1968	83.15	11.22	0.22	4.48	9.04	0.88	7.96	0.42	1.08	0.46	25.58
1969	68.37	4.71	0.04	3.98	9.77	0.24	9.55	0.15	0.22	0.09	23.66
1970	91.55	8.16	6.28	14.91	22.49	5.97	9.18	0.28	13.31	5.69	47.90
1971	76.46	6.21	0.65	9.90	8.65	0.99	6.81	0.20	1.84	0.79	26.98
1972	108.12	15.33	6.41	29.58	20.49	5.73	8.49	0.60	12.00	5.13	65.71
1973	93.39	7.48	0.07	9.73	3.10	0.40	2.74	0.25	0.36	0.15	8.50
1974	94.76	8.63	0.11	19.42	4.60	0.59	4.00	0.34	0.60	0.25	19.10
1975	105.82	16.66	4.28	17.50	14.66	4.48	5.58	0.60	9.08	3.88	36.63
1976	89.42	8.17	0.16	12.57	6.00	0.57	5.31	0.28	0.69	0.29	24.44
1977	95.49	11.97	3.83	14.10	16.24	4.59	6.70	0.51	9.54	4.08	31.05
1978	99.08	8.80	1.73	19.81	9.79	2.55	4.63	0.34	5.16	2.21	21.36
Average	87.19	8.87	2.58	12.91	13.30	2.86	7.41	0.34	5.89	2.52	30.29

Table B11:
Sub-basin E
Summary of (30 year) average annual results for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional Tillage										
without NMP	11.87	26.93	13.06	73.69	26.85	20.93	4.26	52.76	22.59	57.90
with NMP	11.87	26.93	13.06	59.12	23.12	6.36	0.53	52.76	22.59	26.22
Contour Tillage										
without NMP	8.90	19.14	15.49	55.53	19.87	18.33	3.95	37.20	15.92	61.82
with NMP	8.90	19.14	15.49	42.21	16.25	5.01	0.33	37.20	15.92	27.99
No-till without Contours										
without NMP	9.38	6.98	15.77	35.58	11.34	18.55	4.06	17.03	7.28	62.58
with NMP	9.38	6.98	15.77	22.02	7.64	4.99	0.36	17.03	7.28	28.50
No-till with Contours										
without NMP	8.75	5.53	16.30	31.19	9.59	18.10	4.00	13.09	5.59	63.21
with NMP	8.75	5.53	16.30	17.85	5.92	4.76	0.33	13.09	5.59	28.85
Strip Cropping with diversion and grassed waterway										
without NMP	8.87	2.58	12.91	26.49	6.11	20.60	3.59	5.89	2.52	57.24
with NMP	8.87	2.58	12.91	13.30	2.86	7.41	0.34	5.89	2.52	30.29

Table B12:
Sub-basin E
Summary of 30 year totals for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional Tillage										
without NMP	356.01	807.86	391.86	2210.52	805.52	627.86	127.80	1582.66	677.72	1736.90
with NMP	356.01	807.86	391.86	1773.53	693.48	190.87	15.76	1582.66	677.72	786.74
Contour Tillage										
without NMP	267.09	574.24	464.81	1666.00	596.21	549.92	118.48	1116.08	477.73	1854.50
with NMP	267.09	574.24	464.81	1266.43	487.75	150.35	10.02	1116.08	477.73	839.56
No-till without Contours										
without NMP	281.42	209.36	473.22	1067.58	340.16	556.59	121.75	510.99	218.41	1877.54
with NMP	281.42	209.36	473.22	660.77	229.28	149.78	10.87	510.99	218.41	855.10
No-till with Contours										
without NMP	262.62	165.90	489.11	935.69	287.82	543.14	120.14	392.55	167.68	1896.17
with NMP	262.62	165.90	489.11	535.33	177.47	142.78	9.79	392.55	167.68	865.47
Strip Cropping with diversion and grassed waterway										
without NMP	266.13	77.50	387.16	794.71	183.21	618.04	107.75	176.67	75.46	1717.09
with NMP	266.13	77.50	387.16	398.82	85.64	222.15	10.18	176.67	75.46	908.83

APPENDIX C

Tables C1-C12 for Sub-basin C

(Yearly Variations and 30 Year Averages Plus Totals

Table C1:
Pennsylvania Sub-basin C

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	6.2	10.24	14.24	42.26	14.79	18.59	4.66	23.67	10.13	40.55
1950	110.46	10.07	15.02	23.85	52.57	19.1	21.05	5.62	31.52	13.48	73.35
1951	98.01	8.17	9.26	22.73	45.42	17.03	21.15	6.65	24.27	10.38	72.81
1952	100.27	9.18	15.74	19.89	50.06	19.04	17.79	5.25	32.27	13.79	60.36
1953	103.16	12.53	12.1	18.53	45.33	17.06	17.65	5.21	27.68	11.85	56.57
1954	99.67	8.58	0.61	2.51	13.64	1.44	11.52	0.54	2.12	0.9	46.35
1955	94.2	10.26	3.18	9.09	31.95	7.48	23.67	3.95	8.28	3.53	114.52
1956	104.97	7.7	0.36	5.58	38.95	4.68	37.52	4.07	1.43	0.61	83.49
1957	72.26	5.43	1.64	12.9	39.12	8.94	33.65	6.62	5.47	2.32	165.14
1958	103.14	7.05	18.45	24.1	58.16	21.3	21.96	5.8	36.2	15.5	55.33
1959	98.1	6.09	6.52	5.12	46.03	16.32	28.93	9.02	17.1	7.3	27.45
1960	90.51	5.95	6.01	16.93	36.09	13.1	19.04	5.8	17.05	7.3	74.57
1961	98.05	9.93	29.81	17.43	82.75	31.08	25.34	6.5	57.41	24.58	60.92
1962	85.27	13.62	1.41	6.76	23.42	2.52	18.81	0.55	4.61	1.97	63.01
1963	70.96	9.56	0.72	1.32	32.71	5.41	30.06	4.28	2.65	1.13	19.26
1964	79.9	4.51	0.13	12.27	15.9	2.62	15.18	2.32	0.72	0.3	184.15
1965	81.04	10.88	2.71	8.66	57.99	13.15	50.25	9.85	7.74	3.3	102.08
1966	73.11	5.09	2.49	7.85	34.76	11.9	27.33	8.74	7.43	3.16	31.24
1967	102.19	14.23	27.77	2.92	100.55	36.88	48.65	14.66	51.9	22.22	15.95
1968	89.66	4.44	3.54	11.82	30.65	9.71	18.91	4.71	11.74	5	57.7
1969	64.99	3.47	3.05	2.34	23.77	7.22	14.53	3.28	9.24	3.94	38.6
1970	133.81	9.47	0.49	23.8	10.98	1.34	9.03	0.51	1.95	0.83	216.18
1971	99.69	8.2	6.1	19.1	26.32	8.49	13.86	3.16	12.46	5.33	114.18
1972	128.94	18.8	2.13	26.54	21.28	6.3	15.07	3.65	6.21	2.65	169.99
1973	102.42	4.47	3.45	25.32	24.18	8.3	15.34	4.52	8.84	3.78	98.97
1974	97.29	7.07	6.61	22.42	45.5	15.45	27.32	7.69	18.18	7.76	69.7
1975	109.36	9.78	17.42	22.32	66.04	24.04	24.88	6.44	41.16	17.6	74.36
1976	110.57	9.38	10.42	25.11	53.41	18.94	25.05	6.82	28.36	12.12	83.77
1977	92.5	7.68	13.79	17.98	44.37	16.84	15.73	4.58	28.64	12.26	126.49
1978	96.59	3.22	0.02	13.33	4.35	0.17	4.23	0.12	0.12	0.05	59.87
Average	95.89	8.37	7.71	14.76	39.95	12.69	22.4	5.19	17.55	7.5	81.9

Table C2:
Pennsylvania Sub-basin C
Conventional tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	6.2	10.24	14.24	29.23	10.28	5.56	0.15	23.67	10.13	16.41
1950	110.46	10.07	15.02	23.85	37.13	13.73	5.61	0.25	31.52	13.48	20.34
1951	98.01	8.17	9.26	22.73	26.72	10.57	2.45	0.19	24.27	10.38	35.23
1952	100.27	9.18	15.74	19.89	34.48	14.03	2.21	0.24	32.27	13.79	26.43
1953	103.16	12.53	12.1	18.53	30.92	12.36	3.24	0.51	27.68	11.85	21.48
1954	99.67	8.58	0.61	2.51	12.01	1.32	9.89	0.42	2.12	0.9	43.22
1955	94.2	10.26	3.18	9.09	21.49	3.91	13.21	0.38	8.28	3.53	104.11
1956	104.97	7.7	0.36	5.58	27.01	0.86	25.58	0.25	1.43	0.61	77.12
1957	72.26	5.43	1.64	12.9	20.24	2.45	14.77	0.13	5.47	2.32	147.47
1958	103.14	7.05	18.45	24.1	41.63	15.68	5.43	0.18	36.2	15.5	31.7
1959	98.1	6.09	6.52	5.12	19.37	7.44	2.27	0.14	17.1	7.3	14.2
1960	90.51	5.95	6.01	16.93	19.21	7.47	2.16	0.17	17.05	7.3	37.97
1961	98.05	9.93	29.81	17.43	64.12	25	6.71	0.42	57.41	24.58	21.6
1962	85.27	13.62	1.41	6.76	20.38	2.38	15.77	0.41	4.61	1.97	50.03
1963	70.96	9.56	0.72	1.32	20.37	1.4	17.72	0.27	2.65	1.13	17.49
1964	79.9	4.51	0.13	12.27	9.55	0.44	8.83	0.14	0.72	0.3	167.2
1965	81.04	10.88	2.71	8.66	30.15	3.67	22.41	0.37	7.74	3.3	93.07
1966	73.11	5.09	2.49	7.85	9.18	3.3	1.75	0.14	7.43	3.16	17.5
1967	102.19	14.23	27.77	2.92	57.82	22.58	5.92	0.36	51.9	22.22	9.82
1968	89.66	4.44	3.54	11.82	16.57	5.1	4.83	0.1	11.74	5	27.24
1969	64.99	3.47	3.05	2.34	14.15	4.09	4.91	0.15	9.24	3.94	24.85
1970	133.81	9.47	0.49	23.8	8.88	1.24	6.93	0.41	1.95	0.83	166.76
1971	99.69	8.2	6.1	19.1	17.75	5.54	5.29	0.21	12.46	5.33	104.42
1972	128.94	18.8	2.13	26.54	13.26	3.25	7.05	0.6	6.21	2.65	157.69
1973	102.42	4.47	3.45	25.32	11.81	3.91	2.97	0.13	8.84	3.78	69.26
1974	97.29	7.07	6.61	22.42	23.5	7.93	5.32	0.17	18.18	7.76	26.77
1975	109.36	9.78	17.42	22.32	47.36	17.87	6.2	0.27	41.16	17.6	33.29
1976	110.57	9.38	10.42	25.11	34.04	12.36	5.68	0.24	28.36	12.12	41.86
1977	92.5	7.68	13.79	17.98	31.06	12.6	2.42	0.34	28.64	12.26	75.86
1978	96.79	3.22	0.02	13.33	3.59	0.16	3.47	0.11	0.12	0.05	44.95
Average	95.89	8.37	7.71	14.76	25.1	7.76	7.55	0.26	17.55	7.5	57.51

Table C3:
Pennsylvania Sub-basin C
Contour tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.2	6.93	16.06	28.04	9.91	11.08	2.66	16.96	7.25	46.24
1950	110.46	7.77	6.68	26.19	26.21	9.15	12.13	3.13	14.08	6.02	81.54
1951	98.01	5.9	6.01	25.01	29.22	11.02	12.78	3.99	16.44	7.03	80.26
1952	100.27	6.94	11.95	22.12	34.9	13.47	10.5	3.04	24.4	10.43	67.36
1953	103.16	9.45	9.01	21.58	31.64	12.06	10.61	3.06	21.03	9	71.46
1954	99.67	6.35	0.34	3.32	7.57	0.87	6.36	0.35	1.21	0.52	57.88
1955	94.2	7.53	1.34	11.17	17.65	4.14	13.01	2.17	4.64	1.97	126.07
1956	104.97	5.54	0.2	7.69	21.38	2.62	20.55	2.27	0.83	0.35	106.68
1957	72.26	3.84	0.94	14.42	22.91	5.27	19.75	3.91	3.16	1.36	165.64
1958	103.14	4.55	13.97	26.49	40.13	15.07	12.21	3.13	27.92	11.94	62.56
1959	98.1	4.35	4.51	6.87	28.93	10.33	17.1	5.27	11.83	5.06	35.03
1960	90.51	4.09	3.72	18.55	22.13	8.04	11.07	3.33	11.06	4.71	80.18
1961	98.05	7.54	17.91	19.69	51.84	19.48	14.78	3.61	37.06	15.87	69.57
1962	85.27	11.06	1.28	9.22	15.95	2.09	11.95	0.38	4	1.71	81.89
1963	70.96	7.47	0.43	3.2	19.11	3.18	17.48	2.49	1.63	0.69	41.99
1964	79.9	2.9	0	13.87	8.03	1.26	8.03	1.26	0	0	187.98
1965	81.04	8.97	1.32	10.63	35.33	8.08	31.23	6.33	4.1	1.75	116.47
1966	73.11	3.49	1.55	9.35	20.06	6.96	15.28	4.92	4.78	2.04	36.15
1967	102.19	11.84	23.02	5.35	73.4	27.38	30.38	8.97	43.02	18.41	26.74
1968	89.66	2.69	1.84	13.6	17.93	5.49	11.4	2.71	6.53	2.78	64.58
1969	64.99	2.27	1.82	2.69	14.37	4.36	8.52	1.87	5.85	2.49	44.29
1970	133.81	6.83	0.29	26.54	6.55	0.83	5.37	0.33	1.18	0.5	228.21
1971	99.69	5.44	3.97	21.65	15.99	5.28	7.44	1.62	8.55	3.66	118.76
1972	128.94	15.35	1.64	29.91	13.78	4.27	9.04	2.24	4.74	2.03	174.39
1973	102.42	3.02	2.22	26.86	15.13	5.27	9.02	2.66	6.11	2.61	100.18
1974	97.29	4.8	4.48	24.49	29.39	10.09	16.32	4.52	13.07	5.57	79.83
1975	109.36	6.94	12.44	25.15	43.52	15.94	14.63	3.59	28.89	12.35	82.73
1976	110.57	6.49	6.43	27.93	33.12	11.78	14.73	3.94	18.39	7.84	93.17
1977	92.5	5.87	10.96	19.73	32.68	12.64	9.51	2.72	23.17	9.92	132.99
1978	96.79	1.81	0	14.38	2.35	0.03	2.35	0.03	0	0	62.05
Average	95.89	6.18	5.24	16.79	25.3	8.22	13.15	3.02	12.15	5.2	90.76

Table C4:
Pennsylvania Sub-basin C
Contour tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.2	6.93	16.06	20.62	7.35	3.66	0.1	16.96	7.25	18.55
1950	110.46	7.77	6.68	26.19	17.74	6.21	3.66	0.19	14.08	6.02	22.76
1951	98.01	5.9	6.01	25.01	18.11	7.19	1.67	0.16	16.44	7.03	37.35
1952	100.27	6.94	11.95	22.12	25.92	10.61	1.52	0.18	24.4	10.43	28.06
1953	103.16	9.45	9.01	21.58	23.23	9.36	2.2	0.36	21.03	9	28.69
1954	99.67	6.35	0.34	3.32	6.79	0.78	5.58	0.26	1.21	0.52	54.7
1955	94.2	7.53	1.34	11.17	12.18	2.23	7.54	0.26	4.64	1.97	114.02
1956	104.97	5.54	0.2	7.69	14.89	0.52	14.06	0.17	0.83	0.35	97.76
1957	72.26	3.84	0.94	14.42	11.77	1.46	8.61	0.1	3.16	1.36	142.84
1958	103.14	4.55	13.97	26.49	31.26	12.05	3.34	0.11	27.92	11.94	33.68
1959	98.1	4.35	4.51	6.87	13.28	5.16	1.45	0.1	11.83	5.06	16.95
1960	90.51	4.09	3.72	18.55	12.44	4.82	1.38	0.11	11.06	4.71	39.88
1961	98.05	7.54	17.91	19.69	41.54	16.18	4.48	0.31	37.06	15.87	24.06
1962	85.27	11.06	1.28	9.22	14.17	2.01	10.17	0.3	4	1.71	65.26
1963	70.96	7.47	0.43	3.2	12.16	0.9	10.53	0.21	1.63	0.69	37.75
1964	79.9	2.9	0	13.87	4.59	0.1	4.59	0.1	0	0	169.1
1965	81.04	8.97	1.32	10.63	17.57	2.05	13.47	0.3	4.1	1.75	102.66
1966	73.11	3.49	1.55	9.35	5.92	2.14	1.14	0.1	4.78	2.04	18.62
1967	102.19	11.84	23.02	5.35	47.28	18.71	4.26	0.3	43.02	18.41	13.04
1968	89.66	2.69	1.84	13.6	9.74	2.84	3.21	0.06	6.53	2.78	29.71
1969	64.99	2.27	1.82	2.69	8.9	2.56	3.05	0.07	5.85	2.49	28.4
1970	133.81	6.83	0.29	26.54	5.34	0.78	4.16	0.28	1.18	0.5	176.78
1971	99.69	5.44	3.97	21.65	11.61	3.82	3.06	0.16	8.55	3.66	106.97
1972	128.94	15.35	1.64	29.91	9.17	2.47	4.43	0.44	4.74	2.03	160.13
1973	102.42	3.02	2.22	26.86	7.84	2.67	1.73	0.06	6.11	2.61	67
1974	97.29	4.8	4.48	24.49	16.45	5.69	3.38	0.12	13.07	5.57	29.43
1975	109.36	6.94	12.44	25.15	33.01	12.52	4.12	0.17	28.89	12.35	36.41
1976	110.57	6.49	6.43	27.93	21.87	8	3.48	0.16	18.39	7.84	45.79
1977	92.5	5.87	10.96	19.73	24.75	10.15	1.58	0.23	23.17	9.92	78.3
1978	96.79	1.81	0	14.38	1.93	0.04	1.93	0.04	0	0	46.78
Average	95.89	6.18	5.24	16.79	16.73	5.38	4.58	0.18	12.15	5.2	62.38

Table C5:
Pennsylvania Sub-basin C
No-Till without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.2	2.87	16.06	19.76	6.37	11.08	2.66	8.68	3.71	46.24
1950	110.46	7.77	5.96	26.19	24.27	8.31	12.13	3.13	12.14	5.18	81.54
1951	98.01	6.38	2.29	29.36	20.95	7.5	13.42	4.28	7.53	3.22	88.1
1952	100.27	7.35	4.21	30.85	22.07	8.03	11.36	3.46	10.71	4.57	87.8
1953	103.16	9.53	2.67	21.81	19.16	6.71	10.92	3.19	8.24	3.52	70.65
1954	99.67	6.35	0.34	3.32	7.55	0.87	6.34	0.35	1.21	0.52	57.78
1955	94.2	7.53	1.34	11.17	17.64	4.14	13	2.17	4.64	1.97	125.92
1956	104.97	5.54	0.2	7.69	21.38	2.62	20.55	2.27	0.83	0.35	106.62
1957	72.26	3.84	0.47	14.42	21.77	4.76	19.75	3.91	2.02	0.85	165.6
1958	103.14	4.55	6.01	26.49	25.34	8.73	12.21	3.13	13.13	5.6	62.56
1959	98.1	4.85	1.84	14.99	24.7	8.43	18.96	5.99	5.74	2.44	61.46
1960	90.51	4.65	1.19	23.56	16.23	5.57	11.85	3.71	4.38	1.86	94.18
1961	98.05	7.79	5.49	21.24	29.54	9.89	15.43	3.85	14.11	6.04	72.03
1962	85.27	11.06	1.1	9.22	15.56	1.94	11.9	0.38	3.66	1.56	81.42
1963	70.96	7.47	0.47	3.2	19.21	3.23	17.46	2.49	1.75	0.74	41.9
1964	79.9	2.9	0	13.87	8.01	1.26	8.01	1.26	0	0	187.75
1965	81.04	8.97	2.4	10.63	37.62	9.06	31.23	6.33	6.39	2.73	116.42
1966	73.11	3.49	1.23	9.35	19.15	6.56	15.28	4.92	3.87	1.64	36.15
1967	102.19	12.32	9.68	13.66	53.47	18.84	32.29	9.78	21.18	9.06	48.13
1968	89.66	3.09	0.63	21.74	14.41	4.14	11.65	2.98	2.76	1.16	89.06
1969	64.99	2.3	0.22	2.92	9.63	2.36	8.55	1.91	1.08	0.45	44.1
1970	133.81	6.83	0.29	26.54	6.48	0.83	5.3	0.33	1.18	0.5	225.96
1971	99.69	5.44	3.99	21.65	16.08	5.33	7.41	1.62	8.67	3.71	118.55
1972	128.94	15.35	1.66	29.91	13.82	4.29	9.04	2.24	4.78	2.05	174.31
1973	102.42	3.02	1.57	26.86	14.02	4.79	9.02	2.66	5	2.13	100.18
1974	97.29	4.8	1.99	24.49	22.75	7.25	16.32	4.52	6.43	2.73	79.83
1975	109.36	7.65	4.82	33.79	29.03	9.82	15.51	4.05	13.52	5.77	99.23
1976	110.57	7.41	3.05	35.32	25.95	8.61	16.37	4.55	9.58	4.06	103.34
1977	92.5	5.97	2.98	20.06	17.84	6.28	9.84	2.86	8	3.42	131.66
1978	96.79	1.81	0	14.38	2.34	0.03	2.34	0.03	0	0	61.58
Average	95.89	6.34	2.37	18.82	19.85	5.89	13.48	3.17	6.37	2.72	95.34

Table C6:
Pennsylvania Sub-basin C
No-till with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.2	2.87	16.06	12.34	3.81	3.66	0.1	8.68	3.71	18.55
1950	110.46	7.77	5.96	26.19	15.8	5.37	3.66	0.19	12.14	5.18	22.76
1951	98.01	6.38	2.29	29.36	9.16	3.38	1.63	0.16	7.53	3.22	42.06
1952	100.27	7.35	4.21	30.85	12.19	4.77	1.48	0.2	10.71	4.57	39.34
1953	103.16	9.53	2.67	21.81	10.46	3.89	2.22	0.37	8.24	3.52	28.6
1954	99.67	6.35	0.34	3.32	6.78	0.78	5.57	0.26	1.21	0.52	54.64
1955	94.2	7.53	1.34	11.17	12.18	2.23	7.54	0.26	4.64	1.97	113.92
1956	104.97	5.54	0.2	7.69	14.89	0.52	14.06	0.17	0.83	0.35	97.73
1957	72.26	3.84	0.47	14.42	10.63	0.95	8.61	0.1	2.02	0.85	142.83
1958	103.14	4.55	6.01	26.49	16.47	5.71	3.34	0.11	13.13	5.6	33.68
1959	98.1	4.85	1.84	14.99	7.2	2.55	1.46	0.11	5.74	2.44	28.83
1960	90.51	4.65	1.19	23.56	5.74	1.99	1.36	0.13	4.38	1.86	47.54
1961	98.05	7.79	5.49	21.24	18.6	6.36	4.49	0.32	14.11	6.04	25.8
1962	85.27	11.06	1.1	9.22	13.82	1.86	10.16	0.3	3.66	1.56	64.98
1963	70.96	7.47	0.47	3.2	12.25	0.95	10.5	0.21	1.75	0.74	37.69
1964	79.9	2.9	0	13.87	4.57	0.1	4.57	0.1	0	0	168.99
1965	81.04	8.97	2.4	10.63	19.86	3.03	13.47	0.3	6.39	2.73	102.62
1966	73.11	3.49	1.23	9.35	5.01	1.74	1.14	0.1	3.87	1.64	18.62
1967	102.19	12.32	9.68	13.66	25.39	9.38	4.21	0.32	21.18	9.06	22.04
1968	89.66	3.09	0.63	21.74	5.88	1.23	3.12	0.07	2.76	1.16	42.8
1969	64.99	2.3	0.22	2.92	4.09	0.52	3.01	0.07	1.08	0.45	28.38
1970	133.81	6.83	0.29	26.54	5.32	0.78	4.14	0.28	1.18	0.5	175.78
1971	99.69	5.44	3.99	21.65	11.73	3.87	3.06	0.16	8.67	3.71	106.87
1972	128.94	15.35	1.66	29.91	9.21	2.49	4.43	0.44	4.78	2.05	160.12
1973	102.42	3.02	1.57	26.86	6.73	2.19	1.73	0.06	5	2.13	67
1974	97.29	4.8	1.99	24.49	9.81	2.85	3.38	0.12	6.43	2.73	29.43
1975	109.36	7.65	4.82	33.79	17.61	5.99	4.09	0.22	13.52	5.77	46.21
1976	110.57	7.41	3.05	35.32	13.37	4.26	3.79	0.2	9.58	4.06	51.4
1977	92.5	5.97	2.98	20.06	9.57	3.65	1.57	0.23	8	3.42	77.62
1978	96.79	1.81	0	14.38	1.93	0.04	1.93	0.04	0	0	46.55
Average	95.89	6.34	2.37	18.82	10.95	2.91	4.58	0.19	6.37	2.72	64.78

Table C7:
Pennsylvania Sub-basin C
No-till/Contour without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.05	2.33	16.27	18.25	5.75	11.01	2.66	7.24	3.09	46.79
1950	110.46	7.36	4.98	26.59	22.28	7.5	11.96	3.09	10.32	4.41	82.31
1951	98.01	6.09	2.06	29.58	20.07	7.14	13.23	4.23	6.84	2.91	88.67
1952	100.27	6.97	3.81	31.19	20.73	7.49	11.17	3.41	9.56	4.08	88.38
1953	103.16	9.06	2.26	22.3	17.83	6.19	10.78	3.17	7.05	3.02	73.4
1954	99.67	6.13	0.31	3.58	7.32	0.82	6.17	0.33	1.15	0.49	60.91
1955	94.2	7.29	1.32	11.33	17.32	4.06	12.76	2.13	4.56	1.93	124.2
1956	104.97	5.26	0.18	7.9	20.91	2.57	20.15	2.25	0.76	0.32	108.51
1957	72.26	3.78	0.31	14.47	21.04	4.51	19.6	3.89	1.44	0.62	163.78
1958	103.14	4.29	5.56	26.77	24.27	8.28	12.14	3.1	12.13	5.18	62.95
1959	98.1	4.61	1.68	15.14	23.89	8.1	18.8	5.94	5.09	2.16	62.1
1960	90.51	4.44	1.08	23.71	15.76	5.39	11.73	3.68	4.03	1.71	94.56
1961	98.05	7.53	5.22	21.41	28.73	9.58	15.27	3.82	13.46	5.76	72.53
1962	85.27	10.93	1.08	9.37	15.31	1.88	11.8	0.38	3.51	1.5	82.27
1963	70.96	7.31	0.45	3.3	18.9	3.17	17.25	2.47	1.65	0.7	42.82
1964	79.9	2.72	0	14.04	7.86	1.25	7.86	1.25	0	0	188.32
1965	81.04	8.84	1.57	10.75	35.56	8.27	31.02	6.33	4.54	1.94	116.52
1966	73.11	3.46	1.28	9.37	19.15	6.57	15.26	4.92	3.89	1.65	36.24
1967	102.19	12.08	9.57	13.91	52.96	18.66	32.18	9.76	20.78	8.9	48.67
1968	89.66	2.85	0.47	21.93	13.55	3.79	11.53	2.93	2.02	0.86	89.57
1969	64.99	2.14	0.22	3.03	9.52	2.35	8.44	1.9	1.08	0.45	45.5
1970	133.81	6.36	0.22	26.99	5.99	0.65	5.11	0.28	0.88	0.37	227.36
1971	99.69	5.23	3.97	21.84	15.86	5.26	7.31	1.6	8.55	3.66	117.28
1972	128.94	14.66	1.52	30.57	13.28	4.09	8.82	2.19	4.46	1.9	172.74
1973	102.42	2.83	1.55	27.04	13.43	4.55	8.85	2.6	4.58	1.95	98.96
1974	97.29	4.46	1.46	24.72	20.96	6.49	16.06	4.41	4.9	2.08	80.62
1975	109.36	7.24	4.06	34.25	27.09	9.01	15.27	3.97	11.82	5.04	99.65
1976	110.57	6.81	2.94	35.83	25.09	8.29	16.11	4.47	8.98	3.82	104.17
1977	92.5	5.78	3	20.19	17.57	6.2	9.7	2.84	7.87	3.36	132.3
1978	96.79	1.61	0	14.47	2.25	0.03	2.25	0.03	0	0	61.53
Average	95.89	6.07	2.15	19.06	19.09	5.59	13.32	3.13	5.77	2.46	95.79

Table C8:
Pennsylvania Sub-basin C
No-till/Contour with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	4.05	2.33	16.27	10.88	3.18	3.64	0.09	7.24	3.09	18.72
1950	110.46	7.36	4.98	26.59	13.9	4.59	3.58	0.18	10.32	4.41	23.02
1951	98.01	6.09	2.06	29.58	8.39	3.07	1.55	0.16	6.84	2.91	42.44
1952	100.27	6.97	3.81	31.19	10.97	4.26	1.41	0.18	9.56	4.08	39.58
1953	103.16	9.06	2.26	22.3	9.16	3.36	2.11	0.34	7.05	3.02	30.31
1954	99.67	6.13	0.31	3.58	6.6	0.75	5.45	0.26	1.15	0.49	57.8
1955	94.2	7.29	1.32	11.33	11.85	2.18	7.29	0.25	4.56	1.93	112.57
1956	104.97	5.26	0.18	7.9	14.44	0.47	13.68	0.15	0.76	0.32	99.66
1957	72.26	3.78	0.31	14.47	9.92	0.72	8.48	0.1	1.44	0.62	141.12
1958	103.14	4.29	5.56	26.77	15.43	5.27	3.3	0.09	12.13	5.18	33.85
1959	98.1	4.61	1.68	15.14	6.5	2.27	1.41	0.11	5.09	2.16	29.12
1960	90.51	4.44	1.08	23.71	5.34	1.83	1.31	0.12	4.03	1.71	47.85
1961	98.05	7.53	5.22	21.41	17.84	6.05	4.38	0.29	13.46	5.76	26.01
1962	85.27	10.93	1.08	9.37	13.6	1.8	10.09	0.3	3.51	1.5	65.73
1963	70.96	7.31	0.45	3.3	11.97	0.9	10.32	0.2	1.65	0.7	38.55
1964	79.9	2.72	0	14.04	4.44	0.08	4.44	0.08	0	0	169.54
1965	81.04	8.84	1.57	10.75	17.85	2.23	13.31	0.29	4.54	1.94	102.71
1966	73.11	3.46	1.28	9.37	5.01	1.75	1.12	0.1	3.89	1.65	18.69
1967	102.19	12.08	9.57	13.91	24.93	9.21	4.15	0.31	20.78	8.9	22.27
1968	89.66	2.85	0.47	21.93	5.08	0.92	3.06	0.06	2.02	0.86	43.07
1969	64.99	2.14	0.22	3.03	4.02	0.51	2.94	0.06	1.08	0.45	29.29
1970	133.81	6.36	0.22	26.99	4.79	0.61	3.91	0.24	0.88	0.37	177.35
1971	99.69	5.23	3.97	21.84	11.51	3.82	2.96	0.16	8.55	3.66	105.77
1972	128.94	14.66	1.52	30.57	8.65	2.32	4.19	0.42	4.46	1.9	158.51
1973	102.42	2.83	1.55	27.04	6.25	2.01	1.67	0.06	4.58	1.95	65.62
1974	97.29	4.46	1.46	24.72	8.21	2.2	3.31	0.12	4.9	2.08	29.7
1975	109.36	7.24	4.06	34.25	15.83	5.22	4.01	0.18	11.82	5.04	46.49
1976	110.57	6.81	2.94	35.83	12.64	3.99	3.66	0.17	8.98	3.82	51.91
1977	92.5	5.78	3	20.19	9.34	3.57	1.47	0.21	7.87	3.36	77.99
1978	96.79	1.61	0	14.47	1.86	0.04	1.86	0.04	0	0	46.53
Average	95.89	6.07	2.15	19.06	10.24	2.64	4.47	0.18	5.77	2.46	65.06

Table C9:
Pennsylvania Sub-basin C
Terraces without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	3.56	2.76	16.72	19.69	6.4	10.88	2.64	8.81	3.76	47.99
1950	110.46	6.33	7.35	27.63	25.08	8.74	11.52	2.94	13.56	5.8	84.19
1951	98.01	4.83	1.26	26	16.59	5.66	12.09	3.75	4.5	1.91	82.89
1952	100.27	5.7	2.96	23.43	18.34	6.48	9.9	2.88	8.44	3.6	69.71
1953	103.16	7.6	2.6	23.46	18.1	6.34	10.12	2.95	7.98	3.39	80.74
1954	99.67	5.34	0.02	4.19	5.66	0.34	5.54	0.29	0.12	0.05	67.16
1955	94.2	6.54	4.35	11.66	22.49	6.58	11.96	2.07	10.53	4.51	117.02
1956	104.97	4.73	0.87	8.55	21.65	3.21	19.31	2.21	2.34	1	112.61
1957	72.26	3.65	0	14.62	19.17	3.89	19.17	3.89	0	0	156.59
1958	103.14	3.51	4.21	27.52	21.47	7.12	11.85	3.01	9.62	4.11	63.66
1959	98.1	3.87	2.47	7.33	23.17	7.91	16.84	5.21	6.33	2.7	36.5
1960	90.51	3.43	1.26	19.02	15.38	5.24	10.67	3.24	4.71	2	81.5
1961	98.05	6.71	4.98	20.41	28.43	9.55	14.35	3.54	14.08	6.01	71.38
1962	85.27	10.6	6.14	9.66	24.16	5.76	11.56	0.36	12.6	5.4	84.05
1963	70.96	7.04	0.09	3.53	17.34	2.6	16.96	2.44	0.38	0.16	44.75
1964	79.9	2.36	0	14.34	7.56	1.18	7.56	1.18	0	0	187.91
1965	81.04	8.61	1.66	11.11	34.57	7.98	30.67	6.31	3.9	1.67	117.35
1966	73.11	3.44	0.34	9.4	16.67	5.51	15.25	4.91	1.42	0.6	36.31
1967	102.19	11.18	3.74	6.05	40.3	13.26	30.18	8.93	10.12	4.33	28.92
1968	89.66	2.15	0.67	14.16	13.86	3.84	11.01	2.64	2.85	1.2	66.43
1969	64.99	1.94	0.65	2.97	11.06	3.02	8.28	1.85	2.78	1.17	48.16
1970	133.81	5.23	0	28.11	4.76	0.22	4.76	0.22	0	0	233.17
1971	99.69	4.76	5.16	22.36	18.13	6.33	7.04	1.57	11.09	4.76	117.42
1972	128.94	13.05	5.02	32.22	18.22	6.27	8.43	2.08	9.79	4.19	174.24
1973	102.42	2.39	0.02	27.47	8.68	2.58	8.56	2.53	0.12	0.05	97.69
1974	97.29	3.61	0.49	25.41	17.78	5.2	15.56	4.27	2.22	0.93	82.62
1975	109.36	5.39	1.19	26.67	18.28	5.23	13.85	3.35	4.43	1.88	85.03
1976	110.57	4.71	2.26	29.68	21.93	7.14	13.88	3.72	8.05	3.42	97.1
1977	92.5	5.29	2.94	20.21	17.54	6.3	9.03	2.67	8.51	3.63	135.62
1978	96.79	1.38	0	14.55	2.14	0.02	2.14	0.02	0	0	61.39
Average	95.89	5.3	2.18	17.61	18.27	5.33	12.63	2.92	5.64	2.41	92.34

Table C10:
Pennsylvania Sub-basin C
Terraces with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
1949	85.47	3.56	2.76	16.72	12.35	3.84	3.54	0.08	8.81	3.76	19.07
1950	110.46	6.33	7.35	27.63	16.98	5.96	3.42	0.16	13.56	5.8	23.74
1951	98.01	4.83	1.26	26	5.9	2.03	1.4	0.12	4.5	1.91	39.05
1952	100.27	5.7	2.96	23.43	9.76	3.74	1.32	0.14	8.44	3.6	29.14
1953	103.16	7.6	2.6	23.46	9.8	3.66	1.82	0.27	7.98	3.39	34.36
1954	99.67	5.34	0.02	4.19	5.06	0.26	4.94	0.21	0.12	0.05	64.58
1955	94.2	6.54	4.35	11.66	17.07	4.72	6.54	0.21	10.53	4.51	107.06
1956	104.97	4.73	0.87	8.55	15.31	1.12	12.97	0.12	2.34	1	103.98
1957	72.26	3.65	0	14.62	8.1	0.1	8.1	0.1	0	0	134.39
1958	103.14	3.51	4.21	27.52	12.78	4.18	3.16	0.07	9.62	4.11	34.11
1959	98.1	3.87	2.47	7.33	7.7	2.79	1.37	0.09	6.33	2.7	17.54
1960	90.51	3.43	1.26	19.02	5.93	2.09	1.22	0.09	4.71	2	41.05
1961	98.05	6.71	4.98	20.41	18.23	6.22	4.15	0.21	14.08	6.01	24.78
1962	85.27	10.6	6.14	9.66	22.52	5.7	9.92	0.3	12.6	5.4	67.27
1963	70.96	7.04	0.09	3.53	10.45	0.35	10.07	0.19	0.38	0.16	40.32
1964	79.9	2.36	0	14.34	4.19	0.07	4.19	0.07	0	0	169.28
1965	81.04	8.61	1.66	11.11	16.87	1.96	12.97	0.29	3.9	1.67	103.48
1966	73.11	3.44	0.34	9.4	2.53	0.69	1.11	0.09	1.42	0.6	18.76
1967	102.19	11.18	3.74	6.05	14.29	4.61	4.17	0.28	10.12	4.33	13.86
1968	89.66	2.15	0.67	14.16	5.86	1.25	3.01	0.05	2.85	1.2	30.8
1969	64.99	1.94	0.65	2.97	5.67	1.22	2.89	0.05	2.78	1.17	30.9
1970	133.81	5.23	0	28.11	3.5	0.19	3.5	0.19	0	0	182.14
1971	99.69	4.76	5.16	22.36	13.82	4.89	2.73	0.13	11.09	4.76	106
1972	128.94	13.05	5.02	32.22	13.61	4.54	3.82	0.35	9.79	4.19	159.79
1973	102.42	2.39	0.02	27.47	1.63	0.1	1.51	0.05	0.12	0.05	63.98
1974	97.29	3.61	0.49	25.41	5.36	1.03	3.14	0.1	2.22	0.93	30.5
1975	109.36	5.39	1.19	26.67	8.21	2.01	3.78	0.13	4.43	1.88	37.94
1976	110.57	4.71	2.26	29.68	11.12	3.53	3.07	0.11	8.05	3.42	48.06
1977	92.5	5.29	2.94	20.21	9.79	3.8	1.28	0.17	8.51	3.63	79.87
1978	96.79	1.38	0	14.55	1.73	0.03	1.73	0.03	0	0	46.39
Average	95.89	5.3	2.18	17.61	9.87	2.56	4.23	0.15	5.64	2.41	63.41

Table C11:
Sub-basin C
Summary of (30 year) average annual results for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional										
without NMP	8.37	7.71	14.76	39.95	12.69	22.4	5.19	17.55	7.5	81.9
with NMP	8.37	7.71	14.76	25.1	7.76	7.55	0.26	17.55	7.5	57.51
Contour										
without NMP	6.18	5.24	16.79	25.3	8.22	13.15	3.02	12.15	5.2	90.76
with NMP	6.18	5.24	16.79	16.73	5.38	4.58	0.18	12.15	5.2	62.38
No-till										
without NMP	6.34	2.37	18.82	19.85	5.89	13.48	3.17	6.37	2.72	95.34
with NMP	6.34	2.37	18.82	10.95	2.91	4.58	0.19	6.37	2.72	64.78
No-till/Contour										
without NMP	6.07	2.15	19.06	19.09	5.59	13.32	3.13	5.77	2.46	95.79
with NMP	6.07	2.15	19.06	10.24	2.64	4.47	0.18	5.77	2.46	65.06
Terraces										
without NMP	5.3	2.18	17.61	18.27	5.33	12.63	2.92	5.64	2.41	92.34
with NMP	5.3	2.18	17.61	9.87	2.56	4.23	0.15	5.64	2.41	63.41

Table C12:
Sub-basin C
Summary of 30 year totals for all practices

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-SUR	P-SUR	N-RUN	P-RUN (kg/ha)	N-SED	P-SED	N-LEACH
Conventional										
without NMP	251.01	231.19	442.76	1198.51	380.64	672.09	155.57	526.42	225.07	2456.91
with NMP	251.01	231.19	442.76	752.98	232.92	226.56	7.85	526.42	225.07	1725.34
Contour										
without NMP	185.29	157.20	503.71	759.24	246.36	394.61	90.50	364.63	155.86	2722.87
with NMP	185.29	157.20	503.71	502.07	161.37	137.44	5.51	364.63	155.86	1871.43
No-till										
without NMP	190.21	70.96	564.74	595.73	176.55	404.52	95.01	191.21	81.54	2860.05
with NMP	190.21	70.96	564.74	328.59	87.24	137.38	5.7	191.21	81.54	1943.38
No-till/Contour										
without NMP	182.17	64.46	571.84	572.73	167.89	399.59	94.03	173.14	73.86	2873.61
with NMP	182.17	64.46	571.84	307.2	79.18	134.06	5.32	173.14	73.86	1951.77
Terraces										
without NMP	158.93	65.46	528.44	548.2	159.9	378.92	87.67	169.28	72.23	2770.10
with NMP	158.93	65.46	528.44	296.12	76.68	126.84	4.45	169.28	72.23	1902.19

IMPACT OF BEST MANAGEMENT PRACTICES ON WATER WATER QUALITY IN PENNSYLVANIA

CREAMS Modeling Results for Sub-basin F of Potomac River

Description of Sub-basin F

Sub-basin F is located in the lower Susquehanna and upper Potomac River basins within the Piedmont physiographic region. The representative soil for the sub-basin is a silty-clay-loam. For a hypothetical field of 5 acres the average slope is 8% with a convex-concave surface configuration. A 7 year crop rotation was used with one year corn grain, 3 years corn silage, followed by 3 years of hay. Dairy manure is applied daily to the corn grain and silage fields. A total yearly application of 10 tons/acre is simulated for modeling purposes by 5 equal applications during the year. When the nutrient management plan is applied the commercial fertilization rate is reduced to account for nutrients provided by manure application. The manure application is changed to a single application at the beginning of the growing season, but for modeling purposes it is split into three dates at the rate of 50, 30, and 20%, to simulate the availability of nitrogen to the crop.

Sub-basin F was modeled for typical best mangement practices including, no-till, contour tillage, and combined no-till and contour, under both conventional fertilization practices and nutrient management.

IV. Sub-basin F:

1.) Without nutrient management plan:

a.) commercial fertilzer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn grain & Silage	5/8	17.8 cm incorporation	84.3	26.9
	5/17	5.1 cm "	22.5	22.03
	6/22	surface applied	56.2	
Hay(yr 1)	4/15	2.54 cm	22.5	19.6
Hay (yr 2-3)	6/10	surface applied	0	19.6

* 3 fertilizer applications for each year of corn

b.) manure (dairy) application

With 10-4-8 analysis, at 23.0 Mg/ha (10 t/ac) per year rate, manure was surface applied to both corn grain and silage.

Crop	Dates	Manure Applied* (Mg/ha)	N (kg/ha)	P (kg/ha)
		-------- each date		----------
Corn Grain & Silage	11/1,12/1, 1/15,3/1,4/20	4.60	11.24	3.92

* Surface applied unless otherwise indicated

2.) with nutrient management plan (NMP)

a.) commercial fertilzer

Crop	Date	Application Method	N	P
			-- kg/ha --	
Corn Grain	5/17	10.2 cm incorporation	89.8	4.9
Corn Silage	5/17	10.2 cm incorporation	140.4	26.93
Hay(yr 1)	4/15	10.2 cm incorporation	22.5	29.40
(yr 2-3)	4/15	surface applied	--	34.30

b.) manure (dairy) application

With 10-4-8 analysis, at 23.0 Mg/ha (10 t/ac) per year rate, three applications (50%, 30%, 20%) on corn only were used to represent the avaiability of N in the model.

Crop	Dates	Manure Applied* (Mg/ha)	N (kg/ha)	P (kg/ha)
		-------- each date		----------
Corn*	4/15	23.0	28.10	9.60
	5/25	--	16.90	0
	6/25	--	11.20	0

* manure on corn incorporated 22.86 cm

Table 1: Pennsylvania Field F
Conventional tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN	P-RUN	N-SED (kg/ha)	P-SED	N-LEACH
1949	85.42	14.36	5.74	10.32	32.37	9.45	15.87	6.78	39.76
1950	110.44	21.76	10.49	18.21	47.44	12.36	21.95	9.37	74.44
1951	98.00	18.93	13.85	15.71	41.57	9.58	36.53	15.61	58.80
1952	100.23	21.51	15.31	15.84	42.75	9.50	36.47	15.59	57.50
1953	103.07	24.15	6.88	6.25	13.09	1.13	20.68	8.85	24.40
1954	99.63	14.86	1.64	8.08	14.14	0.48	4.74	2.02	81.85
1955	94.17	19.02	1.32	8.87	15.93	0.73	5.35	2.27	63.49
1956	104.92	20.28	5.16	15.15	69.50	16.13	14.22	6.07	82.35
1957	72.21	10.86	0.60	5.00	34.54	7.93	2.97	1.24	21.41
1958	103.14	16.45	10.71	11.61	79.84	13.43	29.64	12.65	72.51
1959	98.05	13.59	11.28	5.91	44.48	9.51	32.36	13.84	40.15
1960	90.46	14.19	6.86	5.95	12.94	0.73	20.04	8.57	36.73
1961	97.98	19.27	1.73	7.07	20.31	0.64	6.60	2.80	49.06
1962	85.23	22.15	5.18	9.53	20.42	0.89	13.29	5.70	79.30
1963	71.00	16.15	2.58	5.22	44.16	9.49	8.15	3.46	48.32
1964	79.85	15.82	1.61	8.81	65.51	10.70	6.04	2.55	68.09
1965	80.98	18.13	10.49	3.30	67.09	10.05	26.41	11.28	29.61
1966	73.04	12.05	5.94	3.20	97.66	11.19	18.69	7.98	38.52
1967	102.15	20.70	12.64	7.40	32.91	0.59	30.30	12.97	108.53
1968	89.63	10.25	0.45	9.50	17.03	0.58	2.15	0.90	114.00
1969	64.92	5.40	0.16	2.60	19.40	3.75	0.80	0.33	44.97
1970	133.74	25.10	8.38	34.98	68.86	10.68	24.17	10.33	197.64
1971	99.68	18.21	3.79	19.81	6.96	0.55	12.47	5.30	26.24
1972	128.89	32.84	47.07	27.38	10.86	1.28	80.55	34.46	38.23
1973	102.40	13.11	5.92	16.55	28.43	8.11	19.89	8.47	30.66
1974	97.28	16.92	5.02	9.94	7.81	0.78	16.47	7.02	37.95
1975	109.28	21.45	3.77	14.86	16.95	0.78	11.56	4.94	83.56
1976	110.55	21.73	1.66	18.18	14.56	1.16	6.63	2.81	91.26
1977	92.44	11.80	2.31	17.96	26.15	6.77	7.96	3.40	87.36
1978	77.72	12.22	1.88	14.60	46.84	10.52	6.92	2.93	59.59
Ave.	95.22	17.44	7.01	11.93	35.35	5.98	18.00	7.68	62.88

Table 2: Pennsylvania Field F
Conventional tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN (kg/ha)	P-RUN (kg/ha)	N-SED (kg/ha)	P-SED (kg/ha)	N-LEACH (kg/ha)
1949	85.42	14.36	5.74	10.32	5.73	0.43	15.87	6.78	35.28
1950	110.44	21.76	10.49	18.21	10.72	0.78	21.95	9.37	68.56
1951	98.00	18.93	13.85	15.71	14.54	0.60	36.53	15.61	62.89
1952	100.23	21.51	15.31	15.84	13.97	0.64	36.47	15.59	53.16
1953	103.07	24.15	6.88	6.25	13.37	0.70	20.68	8.85	25.07
1954	99.63	14.86	1.64	8.08	14.21	0.43	4.74	2.02	82.24
1955	94.17	19.02	1.32	8.87	15.90	0.60	5.35	2.27	62.74
1956	104.92	20.28	5.16	15.15	23.85	0.59	14.22	6.07	72.54
1957	72.21	10.86	0.60	5.00	8.97	0.33	2.97	1.24	18.74
1958	103.14	16.45	10.71	11.61	38.38	0.52	29.64	12.65	73.82
1959	98.05	13.59	11.28	5.91	16.17	0.40	32.36	13.84	40.25
1960	90.46	14.19	6.86	5.95	12.31	0.46	20.04	8.57	35.66
1961	97.98	19.27	1.73	7.07	20.07	0.59	6.60	2.80	48.43
1962	85.23	22.15	5.18	9.53	20.04	0.66	13.29	5.70	77.41
1963	71.00	16.15	2.58	5.22	15.81	0.49	8.15	3.46	44.13
1964	79.85	15.82	1.61	8.81	28.66	0.47	6.04	2.55	55.91
1965	80.98	18.13	10.49	3.30	36.60	0.55	26.41	11.28	26.98
1966	73.04	12.05	5.94	3.20	65.78	0.37	18.69	7.98	39.24
1967	102.15	20.70	12.64	7.40	33.75	0.59	30.30	12.97	115.50
1968	89.63	10.25	0.45	9.50	17.40	0.30	2.15	0.90	115.37
1969	64.92	5.40	0.16	2.60	7.30	0.17	0.80	0.33	35.05
1970	133.74	25.10	8.38	34.98	31.53	0.77	24.17	10.33	161.32
1971	99.68	18.21	3.79	19.81	7.07	0.56	12.47	5.30	49.50
1972	128.89	32.84	47.07	27.38	21.82	1.00	80.55	34.46	103.71
1973	102.40	13.11	5.92	16.55	7.94	0.42	19.89	8.47	46.26
1974	97.28	16.92	5.02	9.94	10.37	0.51	16.47	7.02	45.22
1975	109.28	21.45	3.77	14.86	17.92	0.71	11.56	4.94	86.95
1976	110.55	21.73	1.66	18.18	14.18	0.64	6.63	2.81	91.74
1977	92.44	11.80	2.31	17.96	6.26	0.34	7.96	3.40	64.73
1978	77.72	12.22	1.88	14.60	12.73	0.38	6.92	2.93	43.04
Average	95.22	17.44	7.01	11.93	18.78	0.53	18.00	7.68	62.71

Table 3: Pennsylvania Field F
Contour tillage without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN	P-RUN	N-SED (kg/ha)	P-SED	N-LEACH
1949	85.42	12.75	4.28	11.62	31.09	9.27	12.26	5.22	45.56
1950	110.44	18.79	7.78	20.89	43.92	11.81	16.27	6.95	81.15
1951	98.00	16.73	9.64	17.79	38.77	9.28	26.79	11.45	63.96
1952	100.23	19.30	11.93	18.01	40.50	9.27	28.56	12.21	63.12
1953	103.07	21.20	4.73	7.32	11.34	0.84	15.19	6.49	27.90
1954	99.63	12.58	0.99	9.07	10.75	0.37	3.20	1.37	78.63
1955	94.17	16.44	0.76	11.06	12.28	0.52	3.36	1.42	67.52
1956	104.92	18.08	3.65	17.30	64.84	15.85	10.13	4.30	84.20
1957	72.21	9.98	0.20	5.57	31.82	7.78	1.04	0.43	23.17
1958	103.14	13.99	7.55	13.81	75.14	13.22	21.26	9.07	79.56
1959	98.05	11.86	6.05	7.57	38.19	9.38	17.80	7.61	40.47
1960	90.46	12.40	5.22	6.89	9.35	0.50	15.50	6.61	36.02
1961	97.98	17.79	0.99	8.04	17.47	0.56	4.20	1.76	50.57
1962	85.23	20.98	4.33	10.62	18.22	0.72	11.03	4.70	83.56
1963	71.00	15.04	1.43	6.31	41.61	9.33	5.02	2.14	57.34
1964	79.85	14.29	1.01	9.61	60.53	10.47	3.97	1.67	67.82
1965	80.98	16.85	8.23	4.31	63.13	9.97	20.59	8.79	36.59
1966	73.04	11.12	4.19	4.40	92.52	11.19	13.67	5.82	52.34
1967	102.15	19.05	9.62	8.62	28.85	0.54	22.59	9.67	114.59
1968	89.63	8.41	0.20	10.73	13.62	0.40	1.04	0.43	117.45
1969	64.92	4.20	0.07	3.49	16.41	3.56	0.36	0.15	55.87
1970	133.74	20.82	5.94	38.71	62.66	10.27	17.67	7.52	199.09
1971	99.68	15.38	2.94	22.22	6.31	0.44	8.66	3.68	28.64
1972	128.89	29.09	29.61	30.98	9.51	1.02	54.56	23.35	41.20
1973	102.40	11.07	2.67	18.45	27.08	7.85	10.29	4.38	33.55
1974	97.28	14.84	3.05	11.11	6.76	0.57	10.85	4.61	41.99
1975	109.28	18.89	2.71	16.58	15.10	0.59	8.63	3.67	89.31
1976	110.55	18.37	0.83	20.44	12.41	0.85	3.72	1.57	94.15
1977	92.44	10.21	1.50	19.64	23.93	6.49	5.47	2.34	84.90
1978	77.72	10.47	1.50	15.96	42.58	10.22	5.03	2.13	60.74
Average	95.22	15.37	4.79	13.57	32.22	5.77	12.62	5.38	66.70

Table 4: Pennsylvania Field F
Contour tillage with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN (kg/ha)	P-RUN (kg/ha)	N-SED (kg/ha)	P-SED (kg/ha)	N-LEACH (kg/ha)
1949	85.42	12.75	4.28	11.62	5.13	0.37	12.26	5.22	40.33
1950	110.44	18.79	7.78	20.89	8.90	0.62	16.27	6.95	75.87
1951	98.00	16.73	9.64	17.79	12.44	0.52	26.79	11.45	68.81
1952	100.23	19.30	11.93	18.01	12.10	0.58	28.56	12.21	58.28
1953	103.07	21.20	4.73	7.32	11.55	0.60	15.19	6.49	28.55
1954	99.63	12.58	0.99	9.07	10.81	0.36	3.20	1.37	78.92
1955	94.17	16.44	0.76	11.06	12.30	0.49	3.36	1.42	66.66
1956	104.92	18.08	3.65	17.30	19.96	0.53	10.13	4.30	72.34
1957	72.21	9.98	0.20	5.57	7.10	0.29	1.04	0.43	21.04
1958	103.14	13.99	7.55	13.81	34.82	0.42	21.26	9.07	81.12
1959	98.05	11.86	6.05	7.57	10.07	0.34	17.80	7.61	40.54
1960	90.46	12.40	5.22	6.89	8.70	0.37	15.50	6.61	34.59
1961	97.98	17.79	0.99	8.04	17.20	0.52	4.20	1.76	49.78
1962	85.23	20.98	4.33	10.62	17.97	0.61	11.03	4.70	81.48
1963	71.00	15.04	1.43	6.31	14.21	0.43	5.02	2.14	51.84
1964	79.85	14.29	1.01	9.61	24.82	0.41	3.97	1.67	55.12
1965	80.98	16.85	8.23	4.31	32.93	0.47	20.59	8.79	33.37
1966	73.04	11.12	4.19	4.40	60.72	0.32	13.67	5.82	53.55
1967	102.15	19.05	9.62	8.62	29.59	0.54	22.59	9.67	122.47
1968	89.63	8.41	0.20	10.73	14.11	0.26	1.04	0.43	118.74
1969	64.92	4.20	0.07	3.49	5.55	0.14	0.36	0.15	43.00
1970	133.74	20.82	5.94	38.71	27.15	0.64	17.67	7.52	161.16
1971	99.68	15.38	2.94	22.22	5.91	0.45	8.66	3.68	54.50
1972	128.89	29.09	29.61	30.98	18.03	0.85	54.56	23.35	106.24
1973	102.40	11.07	2.67	18.45	5.95	0.33	10.29	4.38	48.27
1974	97.28	14.84	3.05	11.11	8.95	0.44	10.85	4.61	48.83
1975	109.28	18.89	2.71	16.58	15.84	0.59	8.63	3.67	92.28
1976	110.55	18.37	0.83	20.44	12.24	0.53	3.72	1.57	94.34
1977	92.44	10.21	1.50	19.64	4.98	0.29	5.47	2.34	61.61
1978	77.72	10.47	1.50	15.96	10.04	0.33	5.03	2.13	44.30
Average	95.22	15.37	4.79	13.57	16.00	0.45	12.62	5.38	66.26

Table 5: Pennsylvania Sub-basin F
No-Till without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN (kg/ha)	P-RUN (kg/ha)	N-SED (kg/ha)	P-SED (kg/ha)	N-LEACH (kg/ha)
1949	85.42	12.75	2.42	11.62	31.09	9.27	7.43	3.17	45.56
1950	110.44	18.91	4.62	22.49	43.95	12.10	11.73	4.98	82.68
1951	98.00	16.90	5.25	19.33	37.61	9.48	16.53	7.06	63.89
1952	100.23	19.45	11.59	19.47	39.18	9.52	27.82	11.87	61.36
1953	103.07	21.20	4.98	7.37	10.45	0.84	15.86	6.76	25.90
1954	99.63	12.58	1.30	9.07	10.58	0.37	3.91	1.66	77.59
1955	94.17	16.44	1.10	11.06	12.16	0.52	4.55	1.93	67.04
1956	104.92	18.08	3.97	17.30	64.79	15.85	10.10	4.31	84.06
1957	72.21	10.16	0.49	6.47	31.63	7.90	2.46	1.03	26.17
1958	103.14	14.25	4.06	15.80	73.23	13.88	12.20	5.18	87.07
1959	98.05	12.19	5.78	10.14	38.47	10.01	17.00	7.28	48.38
1960	90.46	12.42	4.17	6.94	7.93	0.50	13.50	5.75	32.59
1961	97.98	17.79	1.82	8.04	16.74	0.56	6.60	2.81	48.57
1962	85.23	20.98	5.13	10.62	17.96	0.72	13.13	5.63	82.51
1963	71.00	15.04	1.05	6.31	41.52	9.33	4.05	1.71	57.10
1964	79.85	14.49	1.17	10.71	59.09	10.80	4.78	2.02	72.10
1965	80.98	16.97	4.71	5.21	59.41	10.24	12.73	5.43	41.34
1966	73.04	11.45	3.38	6.31	87.50	12.04	11.64	4.96	65.75
1967	102.15	19.05	10.33	8.70	23.46	0.54	24.05	10.30	98.78
1968	89.63	8.41	0.38	10.73	12.10	0.40	1.81	0.76	108.21
1969	64.92	4.20	0.09	3.49	16.13	3.56	0.48	0.20	54.21
1970	133.74	20.82	5.69	38.71	61.78	10.27	15.64	6.67	195.38
1971	99.68	15.49	2.94	23.63	5.95	0.45	9.34	3.95	30.01
1972	128.89	29.32	14.55	33.53	8.88	1.03	31.95	13.65	42.90
1973	102.40	11.20	2.60	20.64	27.48	8.13	10.01	4.26	34.75
1974	97.28	14.86	3.12	11.16	6.18	0.57	11.13	4.73	40.26
1975	109.28	18.89	3.34	16.58	14.88	0.59	10.47	4.47	88.51
1976	110.55	18.37	1.28	20.44	12.38	0.85	5.23	2.22	93.93
1977	92.44	10.21	1.03	19.64	23.93	6.49	3.88	1.65	84.89
1978	77.72	10.58	0.90	17.14	42.94	10.61	4.17	1.74	63.55
Average	95.22	15.45	3.77	14.29	31.31	5.91	10.81	4.60	66.83

Table 6: Pennsylvania Field F
No-Till with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN	P-RUN	N-SED (kg/ha)	P-SED	N-LEACH
1949	85.42	12.75	2.42	11.62	5.13	0.37	7.43	3.17	40.33
1950	110.44	18.91	4.62	22.49	8.44	0.63	11.73	4.98	77.40
1951	98.00	16.90	5.25	19.33	10.85	0.52	16.53	7.06	69.03
1952	100.23	19.45	11.59	19.47	10.48	0.58	27.82	11.87	57.37
1953	103.07	21.20	4.98	7.37	10.60	0.60	15.86	6.76	26.30
1954	99.63	12.58	1.30	9.07	10.59	0.36	3.91	1.66	77.77
1955	94.17	16.44	1.10	11.06	12.17	0.49	4.55	1.93	66.12
1956	104.92	18.08	3.97	17.30	19.88	0.53	10.10	4.31	72.15
1957	72.21	10.16	0.49	6.47	6.79	0.29	2.46	1.03	23.91
1958	103.14	14.25	4.06	15.80	31.45	0.42	12.20	5.18	89.54
1959	98.05	12.19	5.78	10.14	8.95	0.34	17.00	7.28	48.50
1960	90.46	12.42	4.17	6.94	7.62	0.37	13.50	5.75	31.97
1961	97.98	17.79	1.82	8.04	16.64	0.52	6.60	2.81	48.22
1962	85.23	20.98	5.13	10.62	17.76	0.61	13.13	5.63	80.70
1963	71.00	15.04	1.05	6.31	14.12	0.43	4.05	1.71	51.63
1964	79.85	14.49	1.17	10.71	23.00	0.42	4.78	2.02	58.89
1965	80.98	16.97	4.71	5.21	28.98	0.47	12.73	5.43	38.06
1966	73.04	11.45	3.38	6.31	54.00	0.34	11.64	4.96	67.82
1967	102.15	19.05	10.33	8.70	24.44	0.54	24.05	10.30	107.31
1968	89.63	8.41	0.38	10.73	12.63	0.26	1.81	0.76	109.83
1969	64.92	4.20	0.09	3.49	5.29	0.14	0.48	0.20	41.41
1970	133.74	20.82	5.69	38.71	26.32	0.64	15.64	6.67	157.55
1971	99.68	15.49	2.94	23.63	5.60	0.46	9.34	3.95	57.62
1972	128.89	29.32	14.55	33.53	16.11	0.86	31.95	13.65	108.15
1973	102.40	11.20	2.60	20.64	5.46	0.33	10.01	4.26	51.45
1974	97.28	14.86	3.12	11.16	8.21	0.44	11.13	4.73	46.88
1975	109.28	18.89	3.34	16.58	15.60	0.59	10.47	4.47	91.34
1976	110.55	18.37	1.28	20.44	12.18	0.53	5.23	2.22	94.13
1977	92.44	10.21	1.03	19.64	4.97	0.29	3.88	1.65	61.59
1978	77.72	10.58	0.90	17.14	9.56	0.33	4.17	1.74	47.69
Average	95.22	15.45	3.77	14.29	14.79	0.46	10.81	4.60	66.69

Table 7: Pennsylvania Field F
No-till/Contour without nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN (kg/ha)	P-RUN (kg/ha)	N-SED (kg/ha)	P-SED (kg/ha)	N-LEACH (kg/ha)
1949	85.42	11.95	2.15	12.27	30.58	9.20	6.51	2.78	48.46
1950	110.44	17.51	4.03	23.97	42.64	11.85	9.96	4.24	84.26
1951	98.00	15.77	3.61	20.41	36.39	9.33	11.60	4.95	65.99
1952	100.23	18.39	7.76	20.51	38.09	9.43	19.53	8.35	62.99
1953	103.07	19.65	3.52	8.72	9.89	0.74	11.96	5.10	32.24
1954	99.63	11.58	0.85	9.91	9.67	0.33	2.80	1.19	83.14
1955	94.17	15.20	0.67	12.18	11.17	0.45	3.03	1.27	70.34
1956	104.92	17.04	3.16	18.31	63.43	15.76	8.14	3.47	85.66
1957	72.21	9.76	0.47	6.76	30.62	7.85	2.28	0.96	26.78
1958	103.14	13.06	3.34	16.86	71.52	13.72	10.07	4.30	91.55
1959	98.05	11.57	4.80	10.77	37.61	9.95	14.37	6.13	49.35
1960	90.46	11.53	3.38	7.37	7.24	0.43	10.93	4.65	33.95
1961	97.98	17.22	1.14	8.45	16.22	0.54	4.47	1.88	50.08
1962	85.23	20.45	4.30	11.12	17.00	0.64	10.93	4.66	84.00
1963	71.00	14.40	0.81	6.92	40.35	9.25	3.18	1.34	61.95
1964	79.85	13.75	0.85	11.10	57.33	10.68	3.46	1.46	72.17
1965	80.98	16.38	3.86	5.76	57.97	10.22	10.44	4.46	43.82
1966	73.04	11.02	2.58	6.88	84.89	11.99	9.30	3.95	70.17
1967	102.15	18.26	8.05	8.57	22.20	0.53	19.54	8.35	95.89
1968	89.63	7.38	0.18	11.31	11.30	0.32	0.92	0.38	112.90
1969	64.92	3.56	0.07	3.96	14.96	3.48	0.36	0.15	59.33
1970	133.74	18.71	3.77	40.67	59.02	10.05	10.70	4.58	195.54
1971	99.68	14.17	2.49	24.75	5.66	0.42	7.33	3.12	31.04
1972	128.89	27.31	10.24	35.43	8.31	0.93	23.90	10.20	44.09
1973	102.40	10.36	1.84	21.43	27.00	8.03	7.42	3.15	35.50
1974	97.28	13.76	2.26	11.72	5.86	0.47	8.42	3.58	42.01
1975	109.28	17.57	2.53	17.55	14.02	0.55	8.10	3.45	91.22
1976	110.55	16.59	0.72	21.70	11.37	0.70	3.25	1.37	96.95
1977	92.44	9.48	0.58	20.39	23.04	6.37	2.22	0.95	82.44
1978	77.72	9.79	0.38	17.88	41.29	10.51	1.77	0.74	63.98
Average	95.22	14.44	2.81	15.12	30.22	5.82	8.23	3.51	68.93

Table 8: Pennsylvania Field F
No-till/Contour with nutrient management plan

YEAR	RAIN (cm)	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN	P-RUN	N-SED (kg/ha)	P-SED	N-LEACH
1949	85.42	11.95	2.15	12.27	4.86	0.33	6.51	2.78	42.81
1950	110.44	17.51	4.03	23.97	7.83	0.57	9.96	4.24	79.42
1951	98.00	15.77	3.61	20.41	9.92	0.49	11.60	4.95	71.53
1952	100.23	18.39	7.76	20.51	9.68	0.55	19.53	8.35	58.99
1953	103.07	19.65	3.52	8.72	10.01	0.56	11.96	5.10	32.67
1954	99.63	11.58	0.85	9.91	9.71	0.33	2.80	1.19	83.30
1955	94.17	15.20	0.67	12.18	11.19	0.45	3.03	1.27	69.41
1956	104.92	17.04	3.16	18.31	18.75	0.48	8.14	3.47	72.97
1957	72.21	9.76	0.47	6.76	6.16	0.28	2.28	0.96	24.76
1958	103.14	13.06	3.34	16.86	30.19	0.38	10.07	4.30	94.19
1959	98.05	11.57	4.80	10.77	8.01	0.32	14.37	6.13	49.57
1960	90.46	11.53	3.38	7.37	6.96	0.33	10.93	4.65	33.24
1961	97.98	17.22	1.14	8.45	16.10	0.52	4.47	1.88	49.74
1962	85.23	20.45	4.30	11.12	16.88	0.58	10.93	4.66	82.16
1963	71.00	14.40	0.81	6.92	13.41	0.42	3.18	1.34	55.73
1964	79.85	13.75	0.85	11.10	21.67	0.39	3.46	1.46	58.59
1965	80.98	16.38	3.86	5.76	27.72	0.47	10.44	4.46	40.33
1966	73.04	11.02	2.58	6.88	51.57	0.33	9.30	3.95	72.40
1967	102.15	18.26	8.05	8.57	23.10	0.52	19.54	8.35	104.39
1968	89.63	7.38	0.18	11.31	11.93	0.23	0.92	0.38	114.71
1969	64.92	3.56	0.07	3.96	4.71	0.11	0.36	0.15	45.30
1970	133.74	18.71	3.77	40.67	24.46	0.57	10.70	4.58	157.50
1971	99.68	14.17	2.49	24.75	5.17	0.42	7.33	3.12	60.11
1972	128.89	27.31	10.24	35.43	14.91	0.81	23.90	10.20	111.69
1973	102.40	10.36	1.84	21.43	4.91	0.30	7.42	3.15	52.46
1974	97.28	13.76	2.26	11.72	7.78	0.40	8.42	3.58	48.66
1975	109.28	17.57	2.53	17.55	14.65	0.56	8.10	3.45	93.96
1976	110.55	16.59	0.72	21.70	11.30	0.48	3.25	1.37	97.02
1977	92.44	9.48	0.58	20.39	4.49	0.26	2.22	0.95	58.81
1978	77.72	9.79	0.38	17.88	8.45	0.29	1.77	0.74	47.94
Average	95.22	14.44	2.81	15.12	13.88	0.42	8.23	3.51	68.81

TABLE 9: Summary Table File F

	RUNOFF (cm)	SEDIMENT (Mg/ha)	PERC (cm)	N-RUN	P-RUN	N-SED (kg/ha)	P-SED	N-LEACH
Conventional Tillage								
Average	17.44	7.01	11.93	35.35	5.98	18.00	7.68	62.88
Total	523.26	210.42	357.79	1060.50	179.47	539.87	230.49	1886.28
Conventional Tillage with NMP								
Average	17.44	7.01	11.93	18.78	0.53	18.00	7.68	62.71
Total	523.26	210.42	357.79	563.35	16.00	539.87	230.49	1881.44
Contour Tillage								
Average	15.37	4.79	13.57	32.22	5.77	12.62	5.38	66.70
Total	460.97	143.60	407.12	966.69	173.13	378.71	161.51	2000.96
Contour Tillage with NMP								
Average	15.37	4.79	13.57	16.00	0.45	12.62	5.38	66.26
Total	460.97	143.60	407.12	480.07	13.64	378.71	161.51	1987.93
No-till								
Average	15.45	3.77	14.29	31.31	5.91	10.81	4.60	66.83
Total	463.45	113.24	428.65	939.38	177.42	324.18	138.14	2005.04
No-till with NMP								
Average	15.45	3.77	14.29	14.79	0.46	10.81	4.60	66.69
Total	463.45	113.24	428.65	443.82	13.70	324.18	138.14	2000.66
No-till/contour								
Average	14.44	2.81	15.12	30.22	5.82	8.23	3.51	68.93
Total	433.17	84.39	453.63	906.64	174.72	246.89	105.16	2067.79
No-till/contour with NMP								
Average	14.44	2.81	15.12	13.88	0.42	8.23	3.51	68.81
Total	433.17	84.39	453.63	416.48	12.73	246.89	105.16	2064.36

TABLE 10: Percent increase or reduction (-) in soil loss, N and P loss in runoff, and N-leachate for different BMP's when compared with conventional tillage for Sub-basin F.

BMP	SOIL LOSS	N Surface	P Surface	N Leach
CT-NMP	0	-47	-91	0
CN	-32	- 9	- 4	6
CN-NMP	-32	-55	-92	5
NT	-46	-11	- 1	6
NT-NMP	-46	-58	-92	6
NT-CN	-60	-15	- 3	10
NT-CN-NMP	-60	-61	-93	9