AN EVALUATION OF THE POTENTIAL FOR USING DRAINAGE CONTROL TO REDUCE NITRATE LOSS FROM AGRICULTURAL FIELDS TO SURFACE WATERS

by

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ABSTRACT

The potential of drainage control to reduce the nitrate losses to surface waters from artificially drained agricultural fields was investigated. This research was an outgrowth of previous work which showed that considerable denitrification occurred in poorly drained soils with high water tables. This resulted in less nitrate leaving the fields in drainage waters than occurred in better drained soils.

Two locations were selected for these experiments so as to cover a range of soil conditions representative of large areas of drained soils in the Coastal Plains of North Carolina. The poorly drained soils of the Tidewater Research Station offered great potential for increased denitrification while the potential for denitrification in the moderately well drained soils at the Lower Coastal Plain Tobacco Research Station was considered to be less.

Flashboard riser type water control structures were installed in the four main tile lines or four collector ditches at each location. Drainage was allowed to proceed normally or was prevented until water table in the field reached any predetermined elevation. Each control structure was equipped with a weir and a stage recorder so that total outflow of drainage water could be computed. A semi-proportional water sampler was also installed at each weir to take samples for chemical analyses.

The water control structures in the main tile outlets on the moderately well drained soils were very effective in controlling the loss of nitrate-nitrogen through the tile lines. The annual loss of nitrate-nitrogen under controlled conditions was 1-7 kg/ha as compared to the 25-40 kg/ha under uncontrolled conditions. However, this reduction was due entirely to prevention of water movement through the tile lines. We have no indication that the water control resulted in the anticipated increased denitrification in the fields. We were able to maintain a high water table for only a short period of time, insufficient for reducing conditions to develop in the fields. However, the prevention of direct entry of the nitrate into surface waters greatly increases the probability of denitrification or uptake which would prevent its entry into surface water.

Water table control on the poorly drained soils was much more successful. However, even though we were able to control and maintain the water table at higher levels, particularly during the winter, this did not result in a significant difference in oxidation-reduction potential throughout the soil profile. Extensive laboratory studies showed that this lack of effect was due to the low winter temperatures. There was also no significant change in nitrogen concentration in water leaving the fields in the drainage ditches under controlled and uncontrolled conditions. However, there was a reduction of approximately 50% in the amount of water moving through the drainage system under controlled conditions. Thus, the total nitrogen movement through the ditches was approximately 50% as much under controlled as uncontrolled conditions. The observed difference in drainage outflow was due to increased deep seepage under controlled conditions. Since the conditions below 1 m in the soil profile were favorable for denitrification and no nitrate was ever observed below this depth, we concluded that the

increased deep seepage resulted in approximately 50% of the nitrate which would have entered surface water being denitrified under water controlled conditions. It is potentially possible to reduce the average winter loss of nitrate-nitrogen from 11 kg/ha to approximately 5 kg/ha. The average yearly loss of nitrate-nitrogen from these soils was 25 kg/ha under freely drained conditions.

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SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The objective of this research was to determine the feasibility of and water management criteria for using water table control to reduce the nitrate losses from tile drained fields to surface waters in the North Carolina Coastal Plain. If denitrification could be increased by water table control, much of the nitrogen not utilized by the crop would be converted to a harmless gas instead of draining to surface waters where it can potentially cause problems.

The two locations chosen for these experiments were selected because they cover a wide range of soil conditions which are representative of large areas of drained soils in the Coastal Plains of North Carolina. The poorly drained soils of the Tidewater Research Station offered great potential for increased denitrification while potential for denitrification in the moderately well drained soils at the Lower Coastal Plain Tobacco Research Station was much less.

Drainage outlet control structures used in the main tile outlets on the moderately well drained soils were very effective in controlling the loss of nitrate-nitrogen through the tile lines. We were able to reduce the annual loss of nitrate-nitrogen of 25-40 kg/ha to levels of 1-7 kg/ha. However, our data do not indicate that this decrease was a result of increased denitrification in the field but rather was due to a forced change in drainage patterns from the field with little loss through the tile lines. We do not know what happened to the nitrate which was prevented from leaving the fields through the tile lines, but it is possible that some of it was prevented from entering surface water as a result of denitrification at the seep where the water came to the surface or was removed by plants at a lower elevation.

Control of the drainage outlets on the poorly drained soils resulted in a decrease of approximately 50 percent in the nitrate-nitrogen reaching surface waters. The average annual loss of nitrate-nitrogen to surface water under no control was approximately 25 kg/ha. If control were used only during the winter, the decrease was from 11 kg/ha to approximately 5 kg/ha.

The decrease in nitrate-nitrogen loss to surface waters under controlled conditions was due to an increase in the amount of water which was forced to leave the fields through deep seepage. The nitrate which moved with this water was lost through denitrification at the lower depths in the soil profile. No nitrate was ever found below approximately one meter in these poorly drained soils.

From results reported here, it is concluded that the amount of nitrate-nitrogen entering surface waters may be reduced by the use of drainage control on artificially drained Atlantic Coastal Plain soils. This reduction can occur with no immediate harmful effect on crop yields because the loss and control occurs primarily during winter months when no crops are growing. It is possible that such practices could have detrimental effects on the soil structure and productivity if used on long term basis. This possibility has not been investigated.

A quantitative estimate of the decrease which potentially could be achieved over all drained soils in North Carolina is difficult because of the inability to quantify the effect of drainage control on moderately well drained soils. It seems realistic to assume an annual reduction of 10-20% on these soils which would be 3-8 kg/ha per year. Drainage control in the poorly drained soils in the winter only resulted in an average decrease of 6 kg/ha. Drainage control throughout the year resulted a much bigger decrease. Thus, a conservative estimate of possible annual decrease in nitrate-nitrogen entry into surface waters through drainage control might be 5 kg/ha. The potential decrease might be 2-3 times this estimate. In the North Carolina Coastal Plain there are approximately 700,000 ha which are artificially drained. A decrease of 5 kg/ha would then mean a decrease of 3.5 million kg (7.7 million pounds) of nitrate-nitrogen entering surface waters.

There is no question that a significant reduction in nitrate-nitrogen entering into surface water could be achieved using the methods described herein. There is a question of what benefits would result from this reduction. As was pointed out by Gambrell et al. (1974) in UNC-WRRI Report No. 93 and further substantiated by data in this report, there is considerably more nitrate-nitrogen loss from cultivated fields in North Carolina than total movement of nitrate-nitrogen to estuaries through North Carolina rivers. Much of the nitrogen is apparently lost from the system between its entry into surface water at the fields and the entry into the estuaries. Thus, even though excess nitrogen is a potential or real problem in these estuaries, there is considerable doubt that a reduction in nitrate entry at the cultivated field would have a noticeable effect at the estuary. This is further verified by data from another EPA-WRRI sponsored project (Pollution From Rural Land Runoff) which has shown that there is little difference between the nitrate content of small Coastal Plain streams draining predominately well drained soils and streams draining predominately poorly drained soils even though it is known that there is a large difference in the amount of nitrate entering these streams.

The estimated cost of drainage control to reduce nitrate entry into surface water would be $60-$120/ha. The lowest cost would be for nearly flat soils with costs increasing with surface relief of soils. With the unknown benefit from this practice, we are in no position to recommend it at this time. One badly needed focus of research is to determine what happens to nitrogen once it enters surface water at field sites. We now can make reasonable estimates of the amounts of nitrogen entering waters from cultivated and wooded sites and there are considerable data on nitrogen balances in estuaries as a result of work by Copeland and Hobbie but there are almost no quantitative data on the gap between the fields and the estuaries. These are needed before any recommendation can be made for implementation of drainage control to reduce nitrate losses to surface waters.

ACKNOWLEDGMENTS

Most of the work done on this project was by persons not listed as authors. Special thanks are due Toney Jacobs and Bertha Crabtree who were primarily responsible for field and laboratory work, respectively. Their personal interest and dedication, especially during the year that the senior author was on leave, is commended. The cooperation of the research station superintendents, John Smith and Sandy Barnes, is appreciated. The installation of the control structures at the Tidewater Station was a big chore and John Smith and others, stacking sand bags while standing in mud above their knees, was a great help. Bob Gambrell, now at Louisiana State University, made a positive contribution during the first year of this study.

INTRODUCTION

Much research effort has been expended in the last decade to determine the contribution of nitrogen from agricultural fields to surface and ground waters. This work has shown conclusively that nitrogen fertilization of agricultural crops does significantly increase the movement of nitrogen in drainage waters. However, very little work has been done to determine if there are feasible means of reducing this nitrogen contribution while maintaining near maximum crop yields.

It has been well established through previous work here (Gambrell et al., 1974) and elsewhere (Gentzsch, et al., 1974, Gast et al., 1974, Devitt et al., 1976) that soil profile characteristics have a large influence upon the amount of nitrate-nitrogen which leaves fields in drainage waters. Soils which are poorly drained and have a high water table lose less nitrogen to water because of the increased rate of denitrification which results in the nitrogen being lost to the atmosphere as nitrogen gases.

Much of the nitrogen which is lost to surface waters is lost through artificial drainage systems. North Carolina alone has approximately 700,000 hectares drained by open ditches or tile systems. These artificial drains would tend to increase the amount of nitrogen lost from the fields even if no fertilizer was applied (Baker and Johnson, 1977) and when combined with the increased agricultural activity which drainage allows, the increase in nitrogen loss to water is compounded.

Much of the movement of nitrate through the artificial drainage systems occurs during the winter months when no crops are growing. We previously (Gambrell et al., 1975 a) observed that a large amount of denitrification occurred during the winter months in soils with a high water table. Others (Willardson et al., 1970; Raveh and Avnimelech, 1973) have proposed water management as a tool for increasing denitrification and thus nitrate loss to water. Thus, this research was designed to determine if water table control in tile drained fields could be used to increase the amount of denitrification during winter months. If successful, this would reduce the nitrogen content of drainage waters without reducing crop yields.

FIELD EXPERIMENTS

MATERIALS AND METHODS

The two sites used for these experiments were chosen because they cover a wide range of soil conditions and are representative of large areas of artificially drained soils of the North Carolina Coastal Plain. One site was the Lower Coastal Plain Tobacco Research Station near Kinston, and the other site was the Tidewater Research Station near Plymouth. The soils at Kinston are primarily Goldsboro and Lynchburg series which are moderately well drained soils with approximately two percent organic matter in the surface horizon. The soils at Plymouth are predominantly Cape Fear and Portsmouth soils which are poorly drained soils containing approximately ten percent organic matter in the surface horizon. Bore hole description of typical profiles at both locations are given in Appendix A. Some chemical characteristics are given in Table 3 in the section on Laboratory Studies. Measurements of nitrate-nitrogen (NO_3^--N) losses via drainage lines at these two locations have shown that there is a significant contribution of nitrate-nitrogen to surface waters. Previous studies at Kinston have indicated little or no denitrification under current drainage conditions (Gambrell et al., 1975 a). The conditions at Plymouth are much more favorable for denitrification and some nitrogen is believed lost through this process without the drainage control as used in this experiment. An indication of the denitrification occurring in these poorly drained soils is the significantly lower NO_3^--N content of drainage water as compared to water from better drained soils (Gilliam, Daniels and Lutz, 1974) even though the soils at the Plymouth Station can supply more N to a growing corn crop than soils at the Kinston Station (Kamprath, unpublished data).

Four drainage systems were used in the experiments at each location. Flashboard riser type water level control structures were installed in the tile mains or in the outlet ditches in 1973. The individual fields draining into these main outlets or ditches varied from three to sixteen hectares. An example of the installation of the control structures in main tile lines at the Kinston Station is shown in Figure 1. The tanks installed in the mains were approximately 1 m in diameter and 1.2 m in height. Two pieces of angle iron were welded vertically on opposite sides of the tank for the installation of weirs. The gates containing the weirs could be installed at any height so that water flow through the tile line could proceed without any influence of the weir or flow could be prevented until the water table in the field reached any desired height. To prevent leaks or "blowouts" around the tanks, solid plastic drainage pipe was installed for 15 m on the upstream side of the tank. This technique was successful as there was no flow through the lower reaches of the tile line when there was no flow through the weir.

At the Tidewater Research Station near Plymouth, the control structures were placed in the open collector ditches. These ditches not only carried the water from tile drains, but also collected the surface runoff. An example of the structure used to maintain a selected groundwater level in the field before flow could occur is shown in Figure 2.

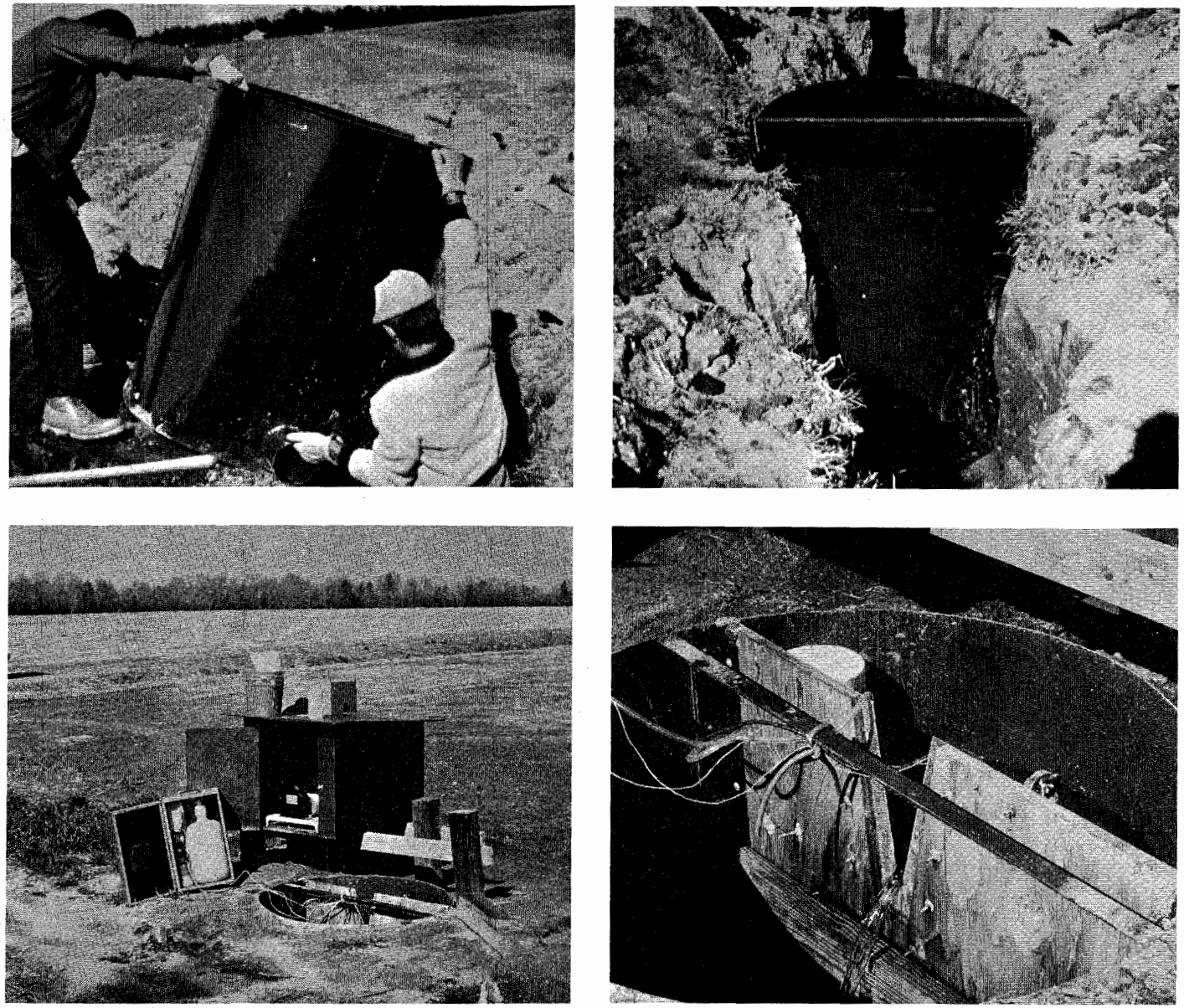

Figure 1. Installation of control structures and measurements and sampling equipment in the main tile line at the Lower Coastal Plain Tobacco Research Station.

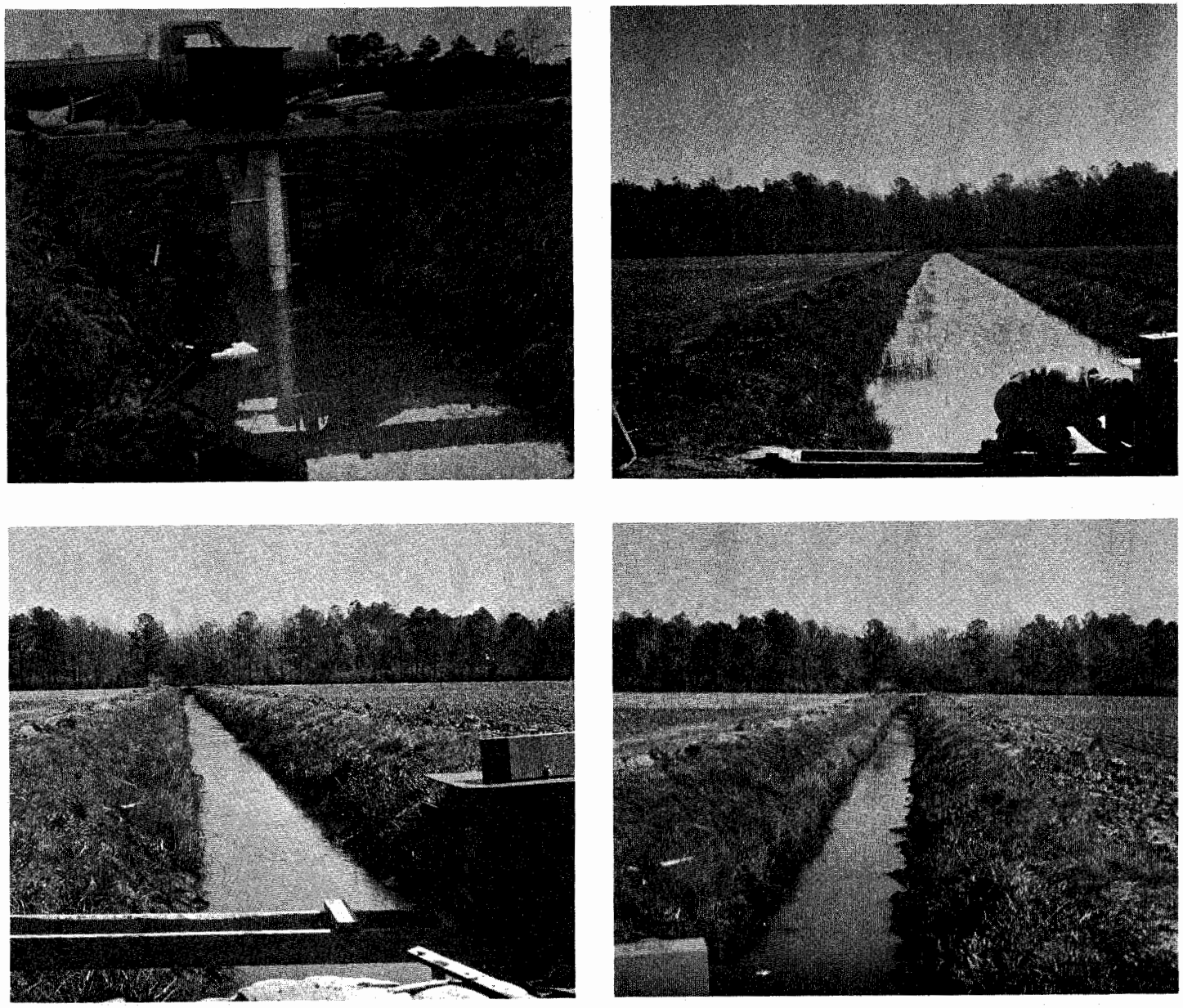

Figure 2. Water control structure and an example of water control in a collector ditch at the Tidewater Research Station. High water level was during control and low water levels are six hours and one day after control was released.

Continuous stage recorders were placed in conjunction with each weir at both locations so that total flow could be computed. A semi-proportional water sampler[1] was installed at each weir to automatically collect water samples. The water samples in the automatic samplers were collected weekly for chemical analyses and the stage recorders were serviced at the time of sample collection.

At the Plymouth Station, porous ceramic cups were placed at 0.3, 0.6, 0.9, 1.2, 1.8 and 2.4 m in each field for taking water samples for chemical analyses. The details of installation and sample collection were described by Gambrell, Gilliam and Weed (1974). These cups were located one-fourth of the distance between two field laterals in the belief that the conditions at this location would be representative of the average conditions between the laterals. At each ceramic cup installation site, plastic pipe access tubes were placed at the same depths as the ceramic cups for the insertion of platinum electrodes for measurement of oxidation-reduction potential. The procedure for measurement of oxidation-reduction potential was the same as described by Gambrell, Gilliam and Weed (1974). Wells were also placed at the same location for the measurement of water table depth. During the first few months of the experiment, water table depths were measured weekly in three fields and continuously recorded in one field. During the remaining time, water table depth was continuously recorded by means of a stage recorder in all fields.

Water samples from the automatic sampler were collected weekly and analyzed for NO_3^--N, NH_4^+-N and total N. Although we were primarily interested in NO_3^--N, the losses of P and C were of sufficient interest that we also analyzed samples for total P and total organic C. At the time of collection of the water samples, a grab sample was also taken. When the automatic sampler malfunctioned, this grab sample was treated as though it was a flow proportional sample and that all water which flowed through the weir since the last sample had the same concentration as the grab sample. The grab sample and flow proportional samples were both usually analyzed so that a good comparison of grab versus automated sampling can be made. The same chemical analyses were performed on samples taken from the ceramic cups at monthly intervals except that P was not determined on the cup samples.

At each location, two fields were allowed to drain normally and drainage was controlled in the other two fields. We initially planned to control the water table only during the winter because this is the time when the largest amount of NO_3^--N moves from the fields in drainage waters, and there was no chance of interference with cropping during this season. Later the control structures were used during the growing season in some fields both to reduce the nutrient loss via drainage and to reduce drainage to more efficiently utilize rainfall for crop production. During the last winter of the project, the weir levels in all installations at the Plymouth Station were alternated between a high water table for approximately two weeks and conventional drainage for two weeks.

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[1] The sampling frequency was proportional to stage upstream from the weir. Since the flow rate is nonlinearly related to stage, the sampler is not a proportional sampler as claimed by some.

RESULTS AND DISCUSSION

Moderately Well Drained Soils

The water control structures in the main tile outlets in the moderately well drained soils at the Lower Coastal Plain Tobacco Research Station near Kinston were very effective in controlling the loss of NO_3^--N through the tile lines (Fig. 3). The annual loss of NO_3^--N through the tile lines under conventional drainage was 25-40 kg/ha. Nitrate-nitrogen movement through the lines was reduced to 1-7 kg/ha per year under controlled drainage. The NO_3^--N loss under conventional drainage was very similar to that measured in a previous experiment at this location (Gambrell, Gilliam and Weed, 1975b). The crops grown on the fields during the study period were corn, soybeans, wheat and tobacco. Our data in this experiment are not sufficient to determine the N losses from each crop or to determine if there were any effects of N fertilizer application rate on N losses.

Even though there was a dramatic decrease in NO_3^- movement through the tile lines under controlled conditions as anticipated during the design of this experiment, this reduction in movement was not a result of a decrease in NO_3^--N concentration in the tile effluent. The decrease in NO_3^--N flux through the drain lines was due entirely to a decrease in water flux through the lines (Fig. 4). The controlled drainage reduced the annual water flux through the tile lines from 185-270 mm to 5-30 mm.

The control structures were set to prevent drainage through the tile lines until the saturated water level in the field immediately adjacent to the control was within 0.3 m of the soil surface. During most rainfall events, the water level in the controlled fields never reached a level which would permit flow through the weir. The types of data obtained for field water levels and water flow under controlled and conventional conditions are shown in Fig. 5. The water table depth in Fig. 5 was measured in the outlet structure immediately upstream from the weir. This depth is assumed to be somewhat greater than the water table depth in the field at the same time. A rainfall of 31 mm produced a flow of 9.0 mm through the tile in conventionally drained Field C. The same rain produced essentially no flow in Field D under controlled conditions. The water level in the controlled field came to within 0.3 m of the soil surface and remained near this level for approximately two days. There was only a very small amount of water which passed the weir (<0.1 mm). After two days the water level in the field dropped at a rate of approximately 60 mm/day. This drop was apparently due to downward movement through the clayey B and C soil horizons and to unidentified surface outlets. There were rainfall events which produced flow through the tile lines as is also illustrated in Fig. 5. A rainfall event of 102 mm produced a flow of 35 mm through the controlled field and 46 mm through the conventionally drained field. Events like this were unusual though as illustrated in Fig. 4 showing total flow data. However, even under these conditions where there were two relatively large rains in a short period of time, saturated conditions existed in the topsoil for only a relatively short time period.

The important question which still remains after presentation of the above data is what happened to the NO_3^--N which was not allowed to leave the fields via tile effluent under the controlled conditions. The experiment was designed to determine if denitrification of NO_3^--N which was previously leaving the field via

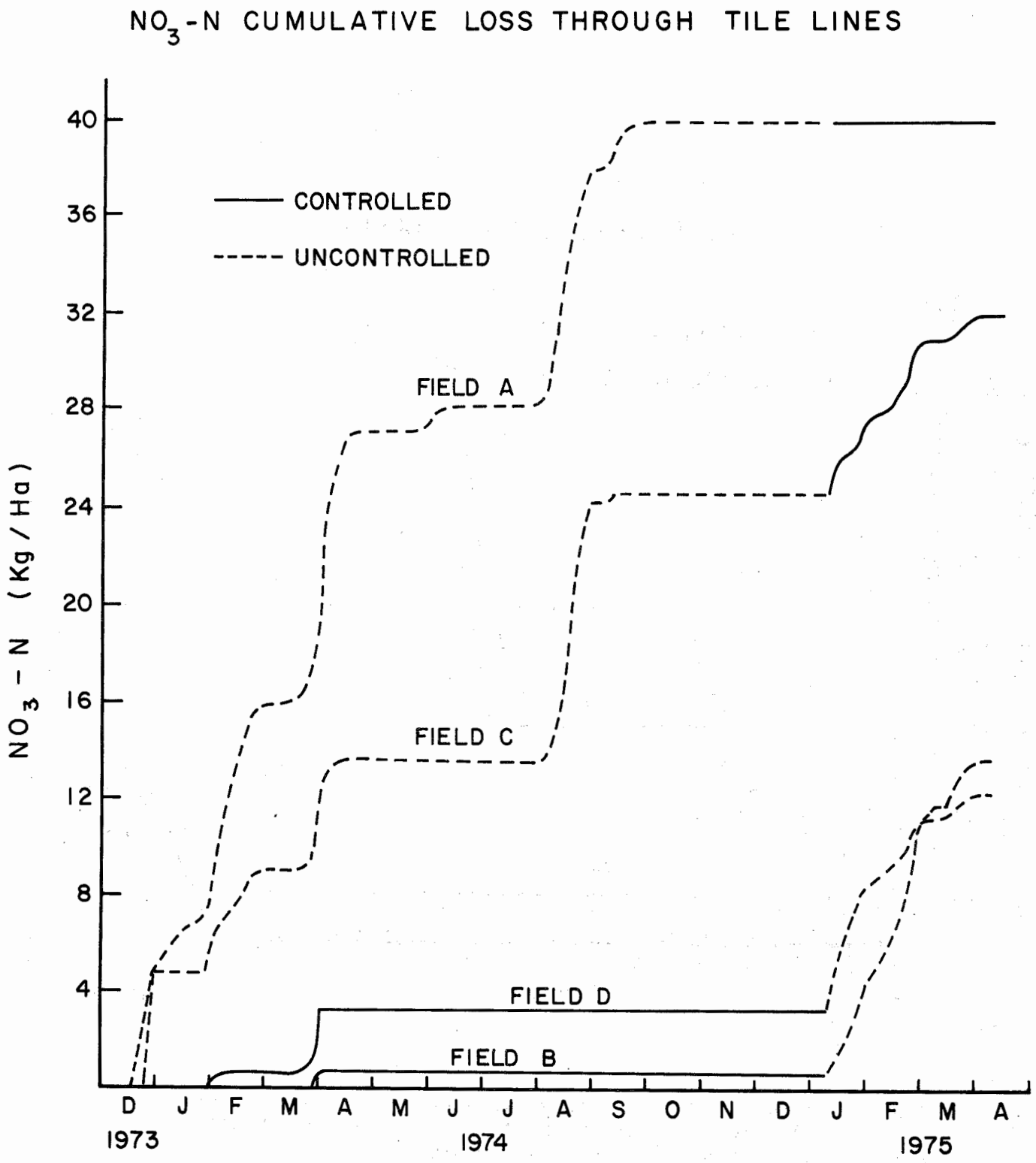

Figure 3. Loss of NO_3^--N through the main tile lines in four fields at the Lower Coastal Plain Tobacco Research Station during controlled and conventional drainage.

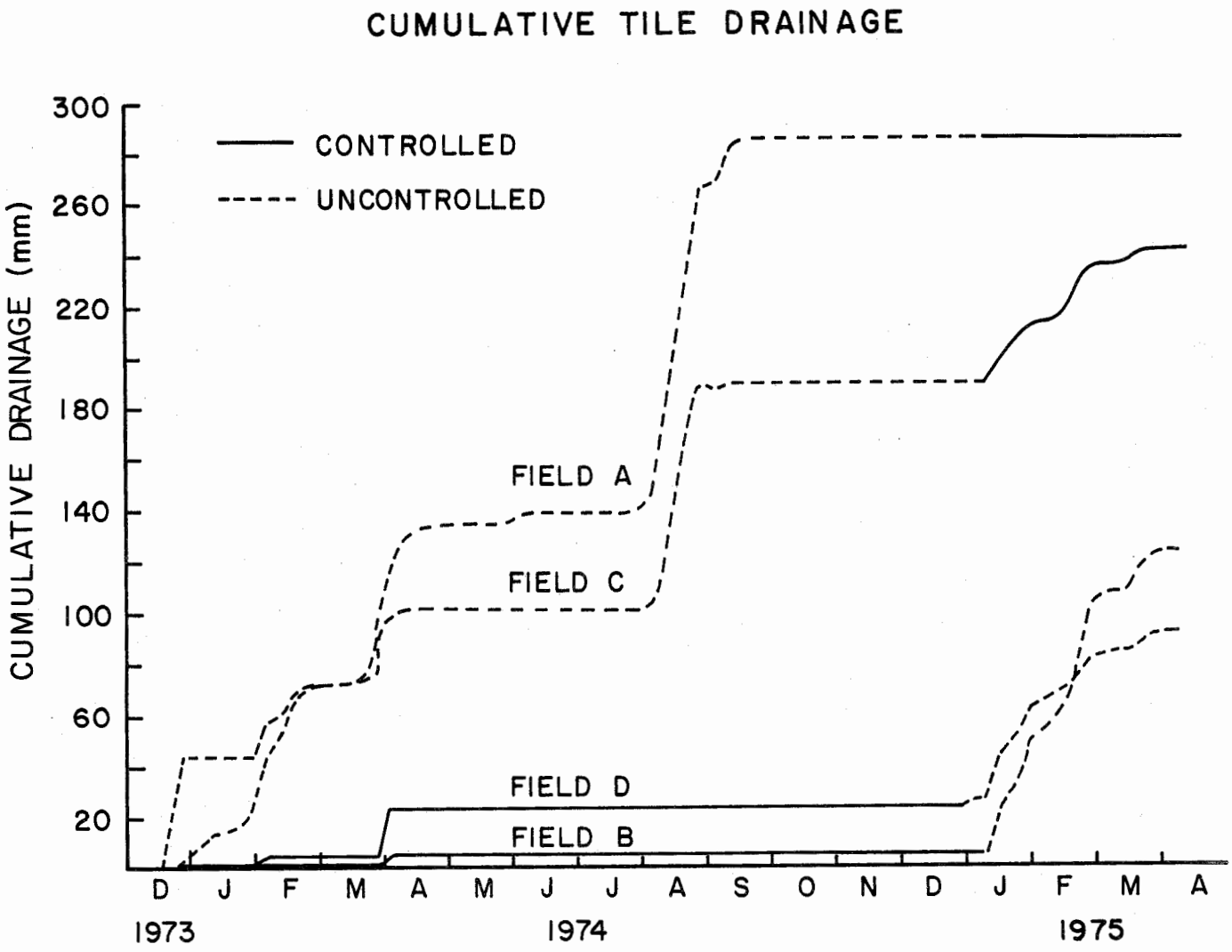

Figure 4. Loss of water through the main tile lines in four fields at the Lower Coastal Plain Tobacco Research Station during controlled and conventional drainage.

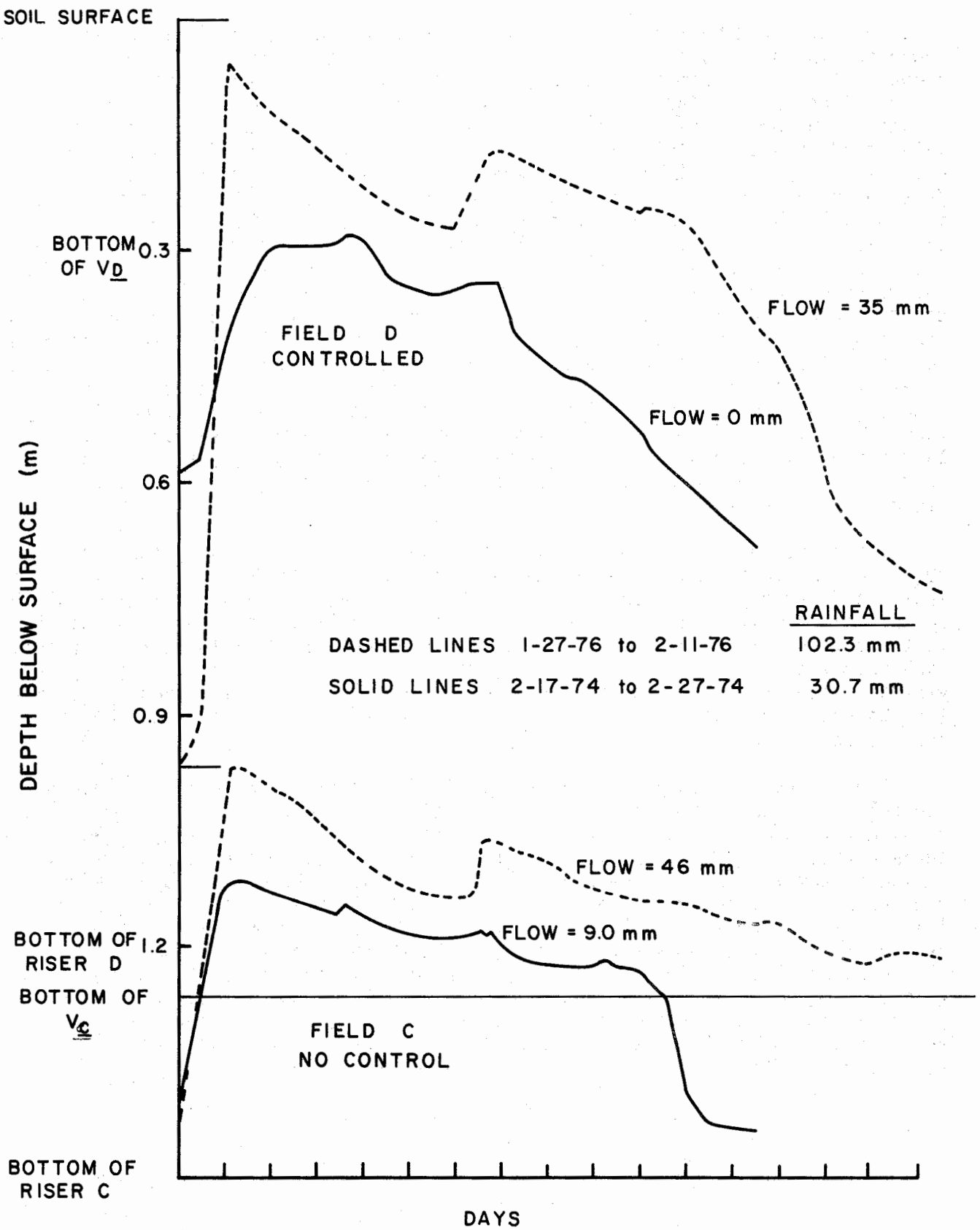

Figure 5. Field water levels and tile flows in a controlled and in a conventionally drained field during two rainfall events. V_C and V_D refer to weirs in Fields C and D, respectively.

tile outflow could be increased. There is no evidence that denitrification was increased in these moderately well drained soils in the field. For large amounts of denitrification to occur, saturated soil must reach an oxidation-reduction potential of 350 mV or below (Patrick, 1960) or must contain a significant amount of reduced microsites (Greenland, 1962). Under the controlled water conditions, the soil always remained well oxidized (Eh>550 mV) throughout the soil profile. There are several requirements for reducing conditions to develop in soils. These conditions may be summarized by stating that microbes must be able to use the oxygen present in soil faster than it can be replaced by diffusion from the atmosphere. Thus, it is necessary that favorable conditions exist for microbial activity and unfavorable conditions for oxygen diffusion. The microbes need a favorable temperature, pH and an energy source. Since we could maintain saturated conditions in the topsoil for only short periods of time, the conditions for microbial activity during this time would have had to be rather favorable for reducing conditions to develop. As will be developed more extensively later in this report, we believe that the primary limiting factor for reducing conditions was the relatively low temperature (2-12°C) which existed in these topsoils during the winter when we were trying to increase denitrification. In the subsoils, there was not sufficient energy source for denitrification to occur. Thus, we believe that little denitrification occurred in any of the fields studied at this site.

The above point is illustrated by the data in Table 1 showing the average NO_3^--N content in six soil profiles under water control and six soil profiles from fields which were draining freely. There appears to be slightly less NO_3^--N in the soil profiles under controlled drainage conditions, but the NO_3^--N content in the six profiles under both controlled and uncontrolled drainage was variable. Each sampling site is likely to largely reflect previous fertilizer history and yields. However, it is possible that the apparently lower values under the controlled drainage condition are a result of more denitrification under the controlled conditions.

Even though there apparently was little denitrification in the field under controlled drainage conditions, the fact that most of the nitrate was not allowed to directly enter surface waters increases the chances that it will not enter surface waters. It is possible that the nitrate may be lost by denitrification in the streamline toward a seep or at the seep itself where the goundwater carrying the nitrate enters surface water (Gilliam, Daniels and Lutz, 1974; Lance, 1972). Since there is little chance that fertilizer nitrogen will ever be a problem in deeper groundwaters (>10 m) in the North Carolina Coastal Plain, (Daniels, et al., 1978) there is little danger that forcing more of the nitrate to move in subsurface water could be a problem. Thus, the net effect of the groundwater control on these soils in reducing NO_3^--N entry into surface waters would have to be positive even though it is not possible to quantitatively evaluate the reduction.

Table 1. The average nitrate content of six moderately well drained soil profiles under controlled drainage and six profiles with no control. Samples were taken in January, 1976 after a period of wet weather.

Depth (m)	Soil Average NO_3^--N Content (ug/g) Controlled Drainage	No Control
0.3	3.8	4.0
0.6	3.5	6.1
0.9	4.0	6.4
1.2	4.4	5.9
1.5	4.2	6.3
1.8	3.8	6.3
2.1	5.8	6.1

Average NO_3^--N concentration in tile effluent from above fields at time of soil sampling was 14.8 ppm from conventionally drained fields and 12.1 ppm from controlled fields.

Poorly Drained Soils

Water management was more successful on the poorly drained soils at the Tidewater Research Station at Plymouth as compared to moderately well drained soils at Kinston. We were able to maintain more water in the fields for a longer period of time and exert a significant influence upon drainage patterns, water table levels and nutrient losses to surface waters. We installed four control structures at this location but because of consistent problems at one collection ditch with water entering the ditch from an adjacent wooded area, only the data from three fields were collected and analyzed for the duration of the study. In the original design of the experiment, it was planned to compare results from two fields with drainage control with two fields without control during the same time period. However, the data can more easily be interpreted by comparing the same field under controlled and conventional drainage during different time periods. We did always have at least one controlled and one uncontrolled field so that effect of variation in rainfall from year to year could be analyzed.

Water Table Control

The effects of the water control structures on the water table levels during the winter in Fields M, E and D are illustrated in Figs. 6, 7 and 8, respectively. (The water table levels for complete years are given in Appendix Figs. 1-13.) Although the water table depth in all fields is relatively shallow, even during conventional drainage, the effects of control in raising the average water table level in Fields M and E can be clearly seen in these figures. Rainfall certainly has an effect upon water table level but the higher water table during the years of controlled drainage in Fields M and E cannot be attributed to differences in rainfall. This is illustrated by the relatively high water table in Field M during the winter of 1974-75 and relatively low water table level in Field E during the same period. The next winter when the control structure was raised in Field E, the water table in Field E was high and the level in Field M was low. Our success in controlling the water table during the winter was not complete as shown in Fig. 8 for Field D. The drainage in this field is poorer than in Fields M and E and it has a relatively higher water table than Fields M and E during free drainage. Thus, our control structures had little or no effect upon field water table levels during the winter. However, as will be shown later, the control did have an effect upon quantity of drainage water lost through the ditch.

Initially we planned to control drainage only during the winter. However, we later decided to attempt control during the growing season. This was done both to reduce nutrient losses to surface water and to improve utilization of rainfall for crop production. Our structures allowed us to set the controls at any desired level, and the control was placed at a lower level during the growing season to lessen the chance of water damage during a wet period.

The structures did have an effect upon water table level during the summer (Figs. 9 and 10). To see the effect, one needs to compare Fields E and M which have similar drainage conditions. During the summer of 1974, Field M was controlled and Field E was not controlled. During the summer of 1976, the treatments were reversed. June and July of 1974 were considerably drier months than

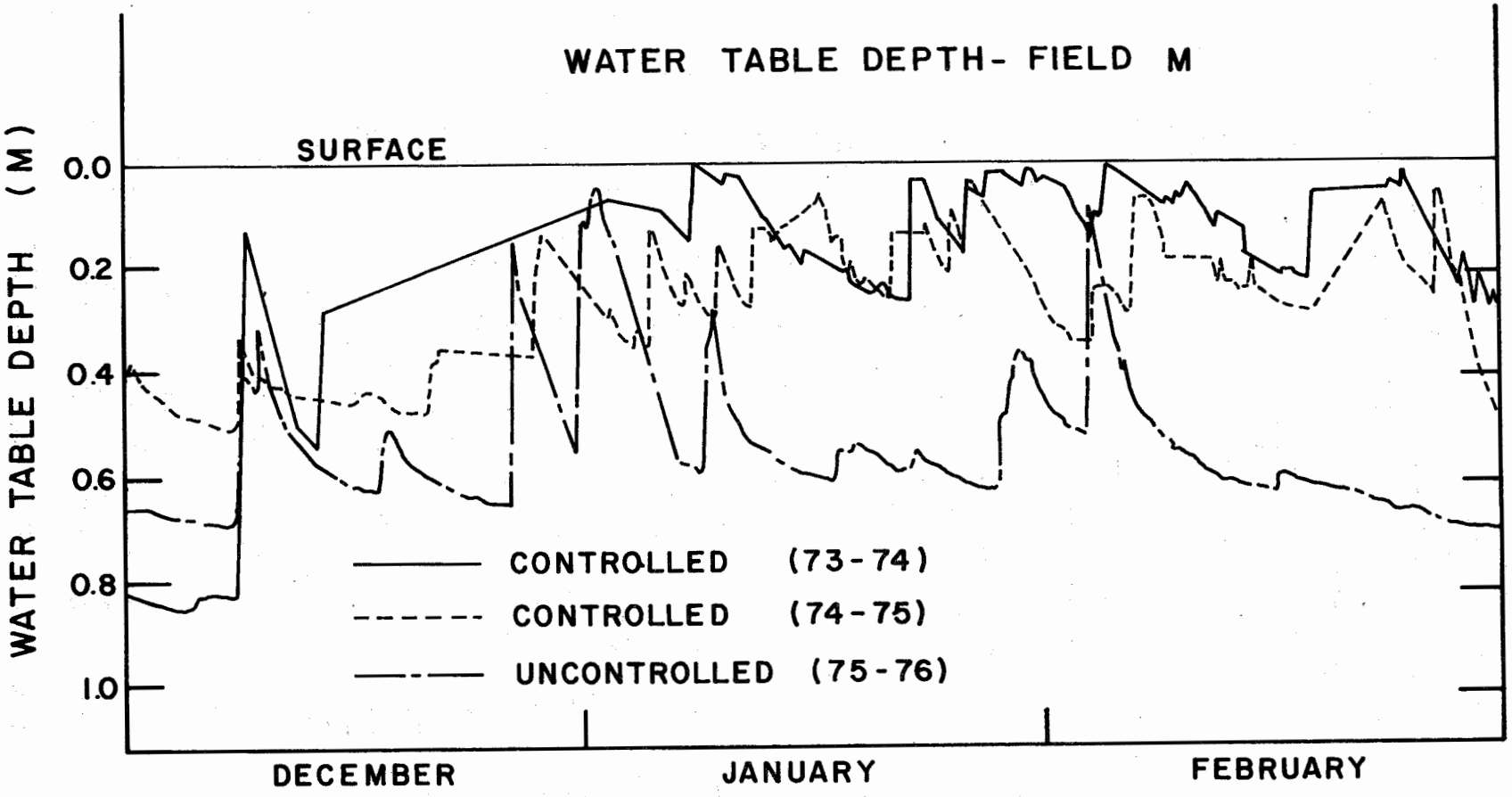

Figure 6. Water table levels in Field M at the Tidwater Research Station during winters of controlled and conventional drainage.

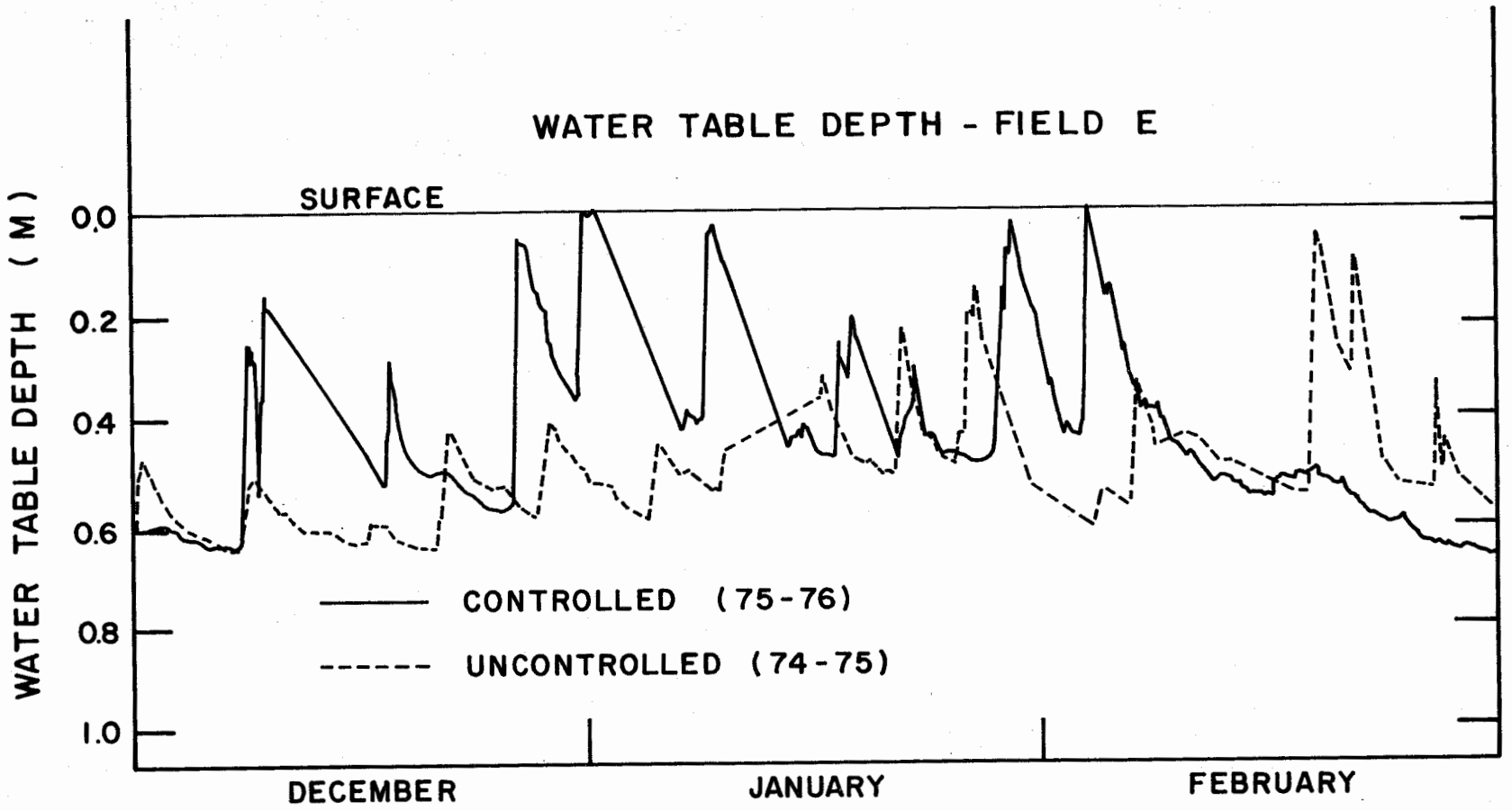

Figure 7. Water table levels in Field E at the Tidewater Research Station during winters of controlled and conventional drainage.

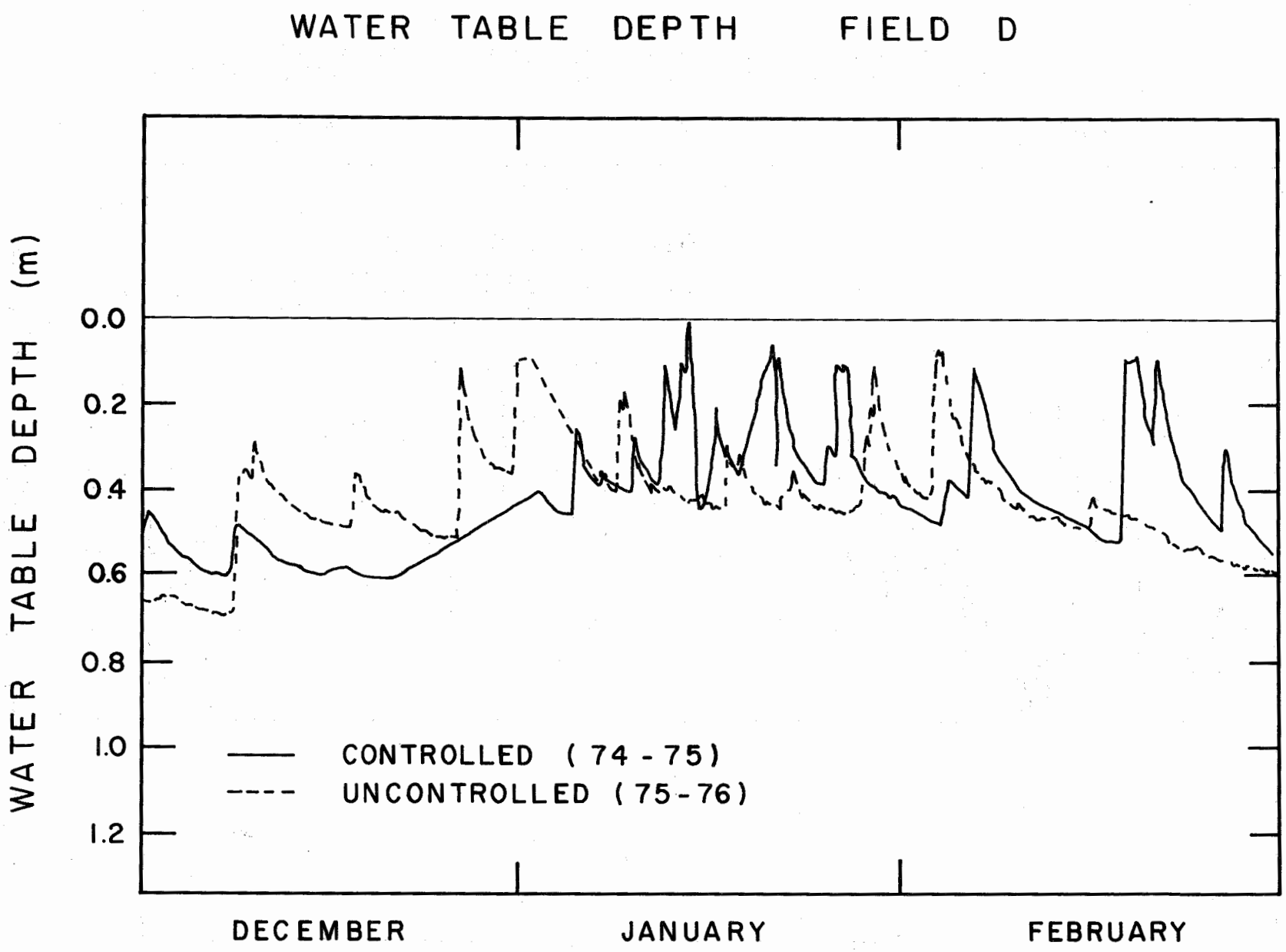

Figure 8. Water table levels in Field D at the Tidewater Research Station during winters of controlled and conventional drainage.

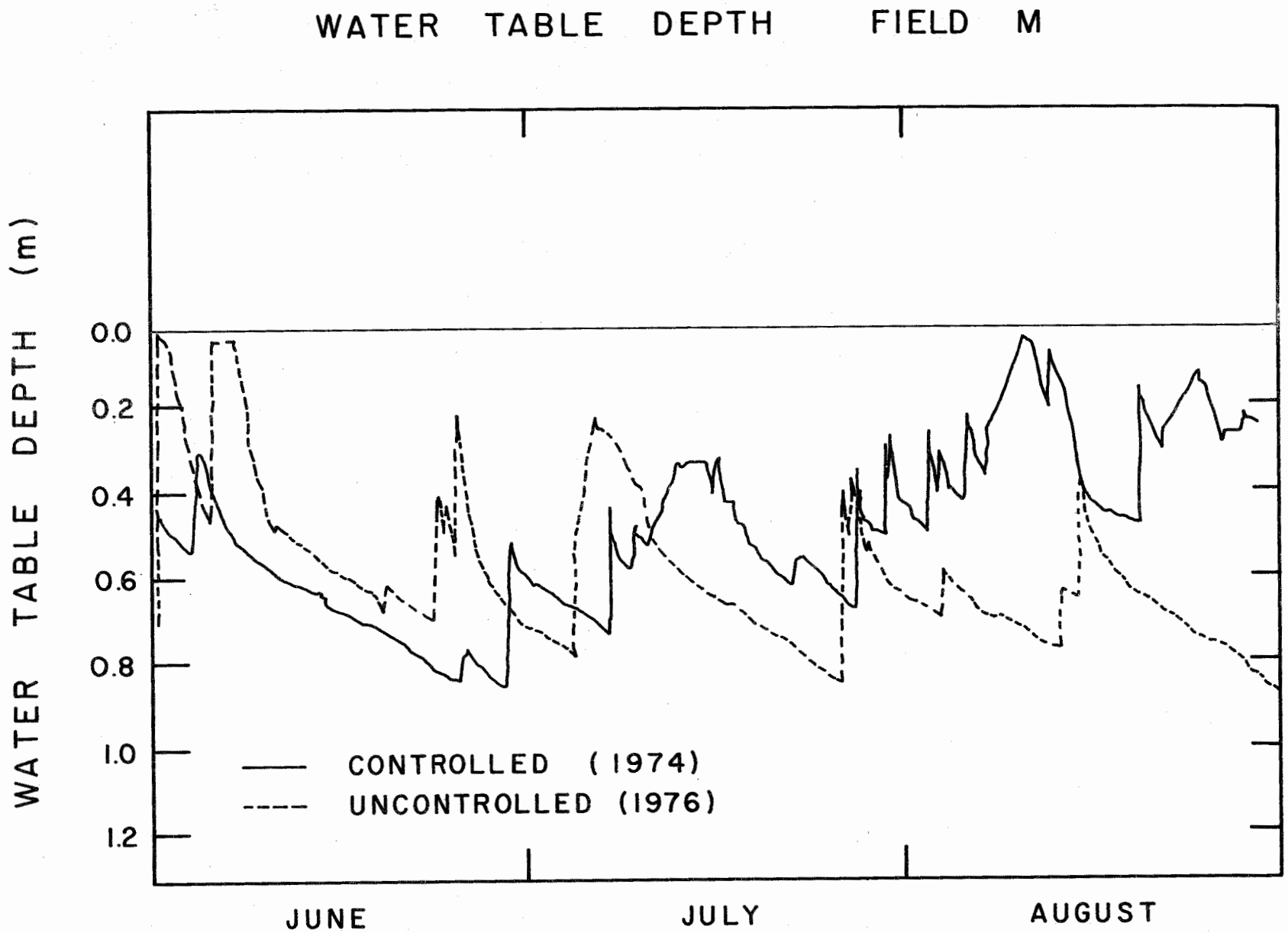

Figure 9. Water table levels in Field M at the Tidewater Research Station during summers of controlled and conventional drainage.

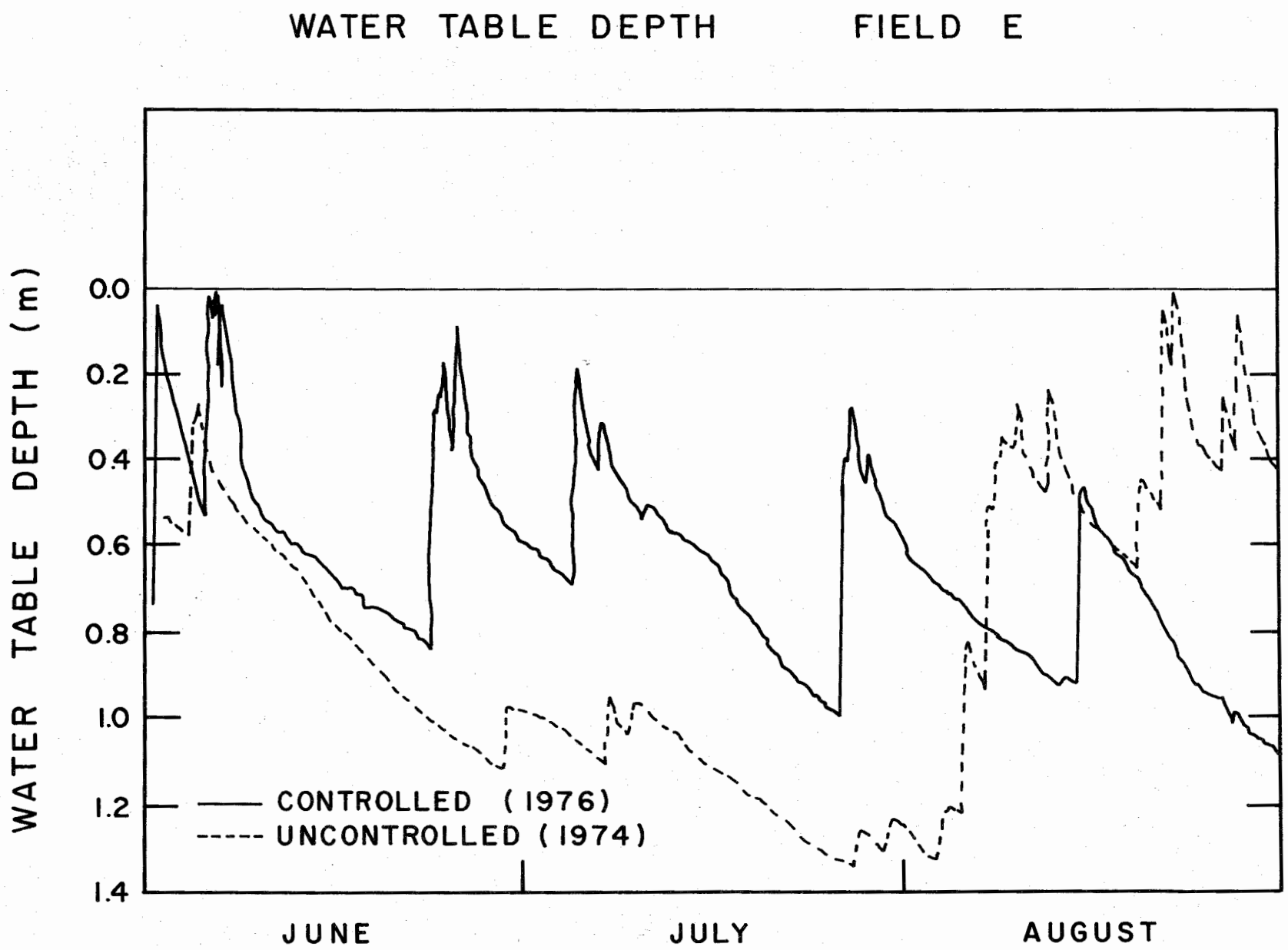

Figure 10. Water table levels in Field E at the Tidewater Research Station during summers of controlled and conventional drainage.

June and July of 1976 (177 mm rain vs. 251 mm). However, the water table in Field M during 1974 when drainage was controlled was essentially as high as it was during the wetter year of 1976 under free drainage. Field E had a higher water table during 1976 when drainage was controlled than during 1974 when there was no control. The water table levels during 1975 were not shown because both fields were controlled that year. These data are in Appendix Figures. The effect of summer drainage control on drainage outflow through the ditches will be discussed in a later section.

NO_3^--N Concentration and Oxidation-Reduction Potentials

The control structures at the Plymouth location were flashboard risers located in the collection ditches. The ditches collect both surface and subsurface flow so the NO_3^--N concentration shown in Fig. 11 for the drainage water from the three fields represents the total NO_3^--N leaving the surface waters during the winters. There was a field-to-field difference in the average drainage water NO_3^--N concentrations, but there was a tendency for the concentration from a particular field to be similar from year to year. Field E was the only field to show much variation in this pattern as the NO_3^--N concentration was significantly higher in the winter of 1975-76 than the previous two winters.

The higher water table during controlled drainage as shown in Figs. 6-10 did not affect the NO_3^--N concentration in the drainage waters of a particular field (Fig. 11). This result was initially quite surprising. However, the average oxidation-reduction potentials (Eh) profiles during the winters for the fields during controlled and uncontrolled conditions (Figs. 12, 13, 14) indicate that we should not expect a difference in NO_3^--N concentration in the drainage ditches. It is generally accepted that a critical Eh for denitrification is approximately 350 mV. Above this potential, little denitrification occurs in soils while denitrification readily occurs at lower Eh's (Patrick, 1960). The soil profile above the drainage lines was generally oxidized under both controlled and uncontrolled conditions. Since the Eh values at 0.6 m or below in Fields D and M were not greatly larger than those considered necessary for denitrification, some denitrification almost certainly occurred in the microsites of this zone. Field E had an Eh profile which decreased with depth as did D and M, but the Eh at any given depth above 1.2 m was higher in Field E than in the other two fields. The effect that this has upon denitrification can be seen in the higher NO_3^--N concentration in the drainage ditch in this field compared to the concentration in ditches from the other two fields.

Field measurements of oxidation-reduction potentitals are difficult and the results extremely variable. The Eh values given in Figs. 12, 13 and 14 are averaged from at least six different dates. However, the consistency of the measurements for the same depth at a given site on different dates was very good. For example, there were some depths which consistently showed a higher Eh than the depth immediately above or below it. The repeatability of these measurements lends confidence that Eh-depth relationships are correct. All measurements made are given in Appendix Table 1.

The NO_3^--N concentrations in the soil water obtained through the porous cups located at several depths in the soil profile in the three fields are shown in

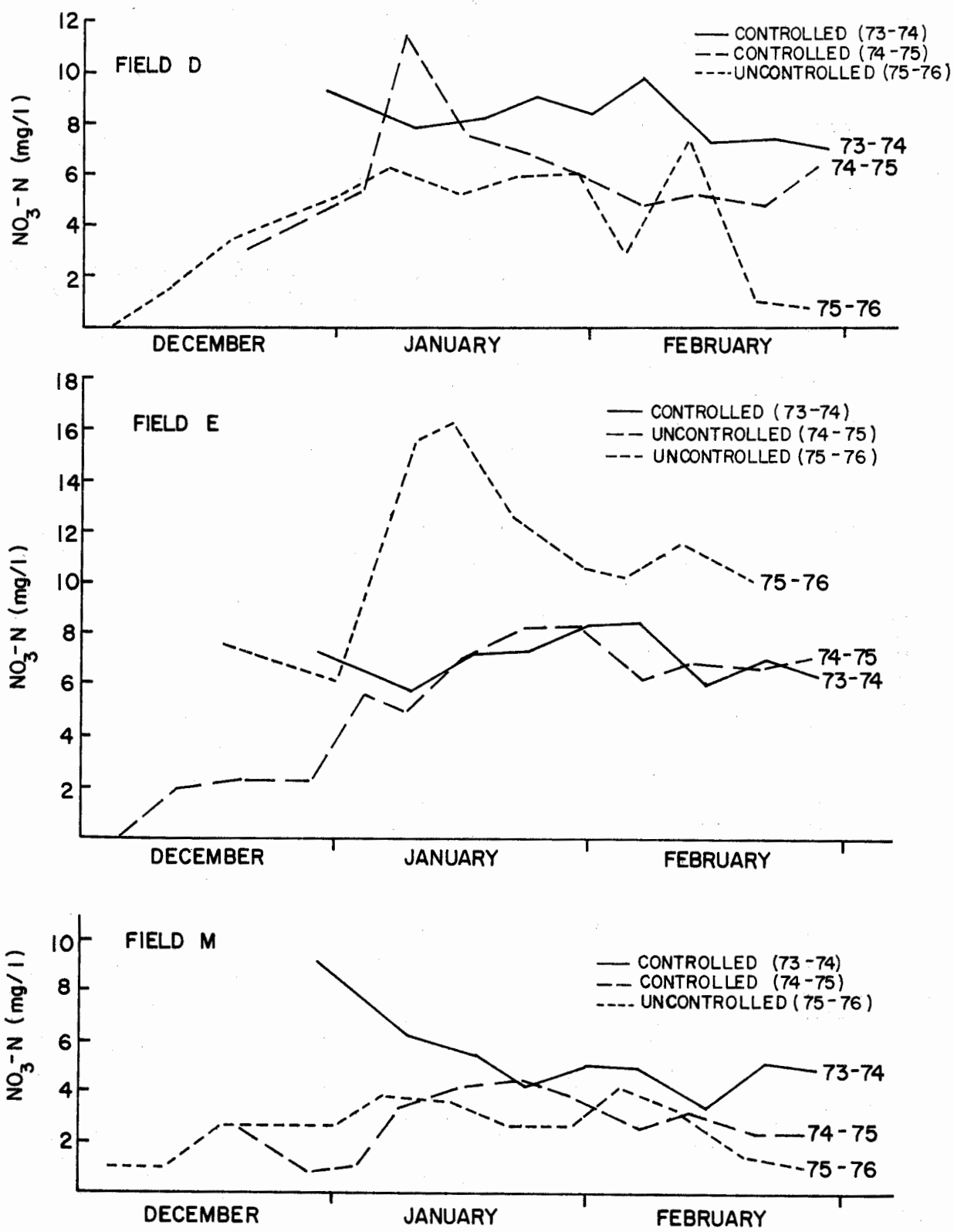

Figure 11. Concentration of NO_3^--N moving through the field collector ditches in Fields M, E and D at the Tidewater Research Station during three winters.

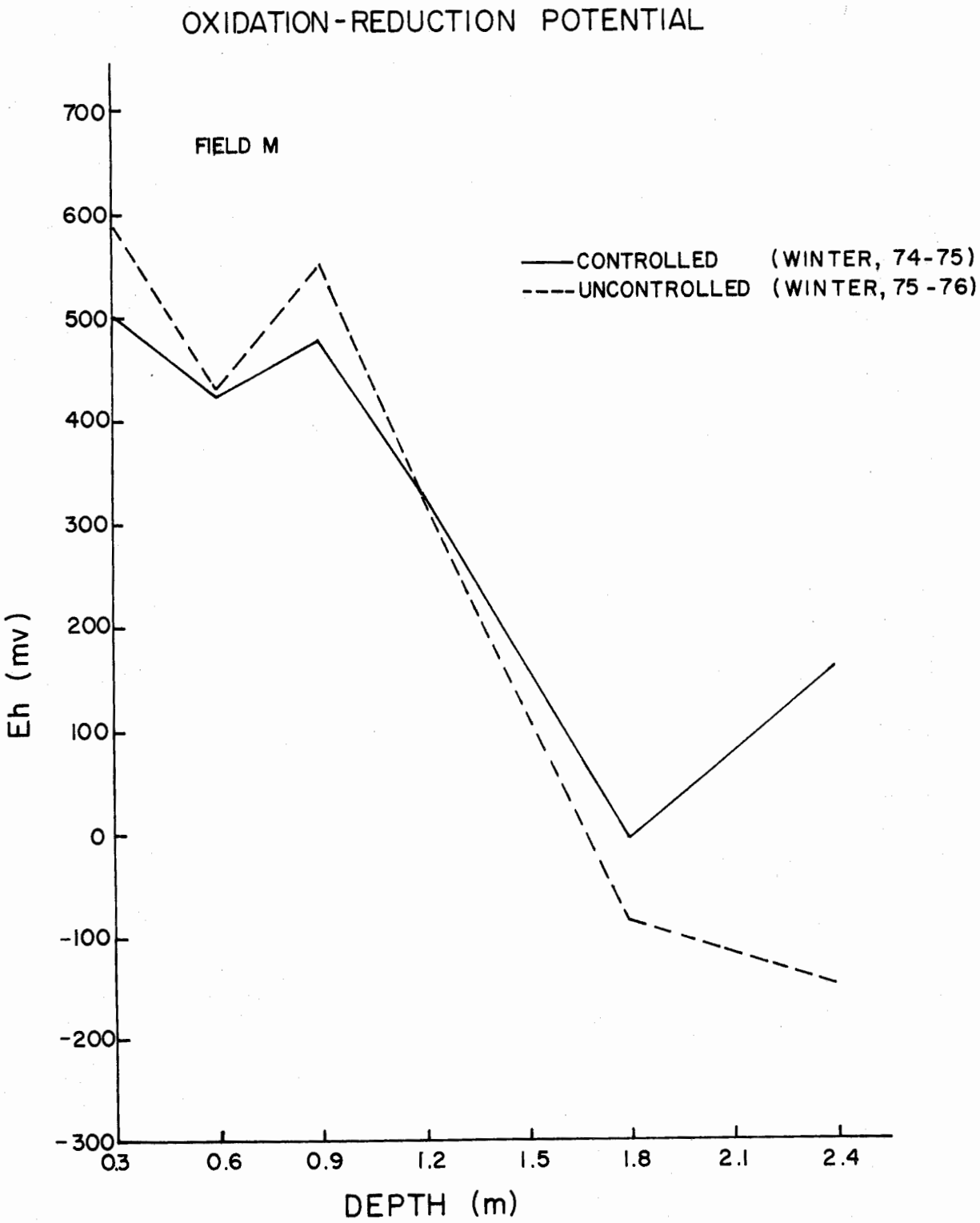

Figure 12. Average oxidation-reduction potentials at several soil depths in Field M at the Tidewater Research Station during a winter of controlled drainage and a winter of conventional drainage. Each point is an average of at least six measurements on different dates.

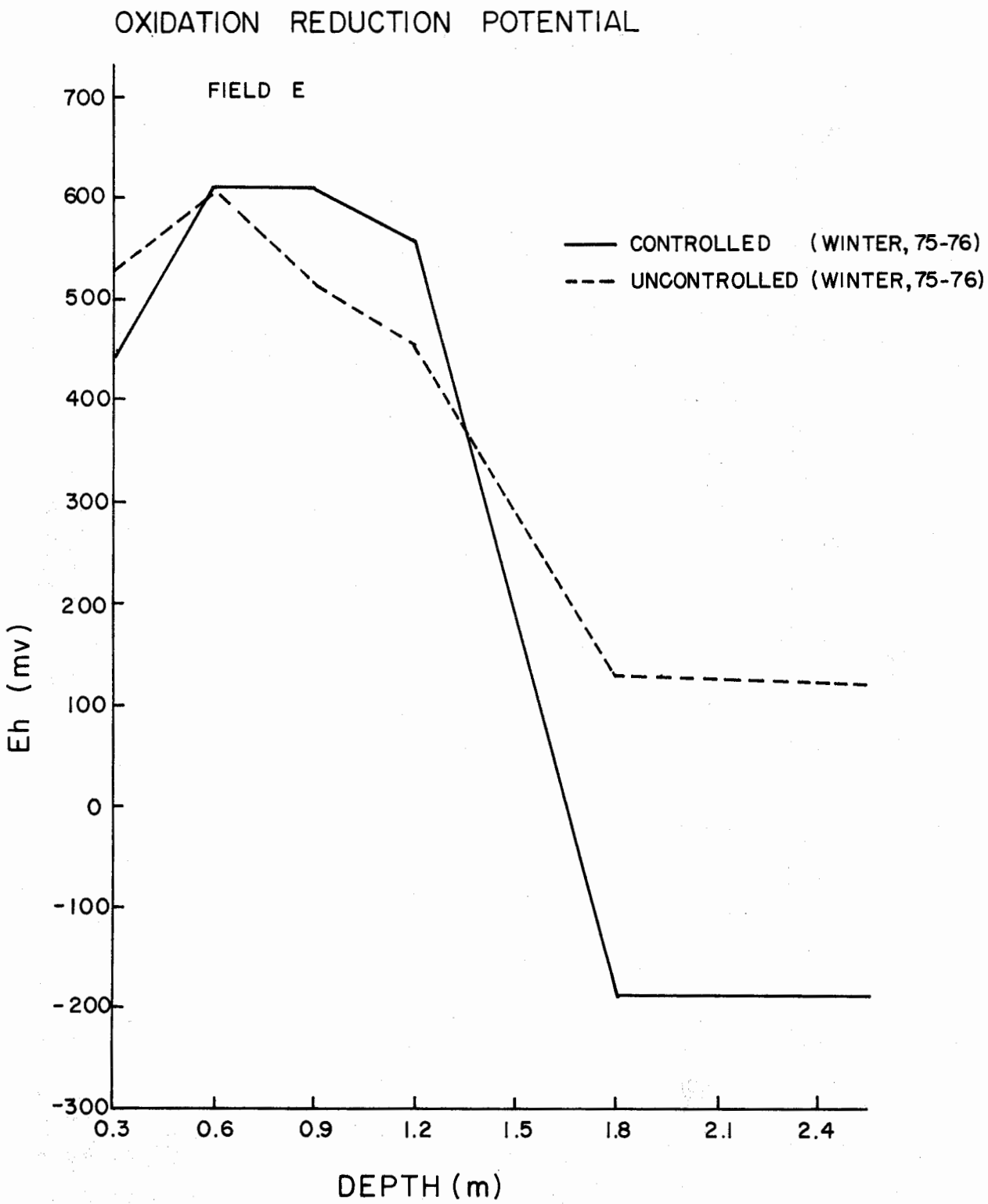

Figure 13. Average oxidation-reduction potentials at several soil depths in Field E at the Tidewater Research Station during a winter of controlled drainage and a winter of conventional drainage. Each point is an average of at least six measurements on different dates.

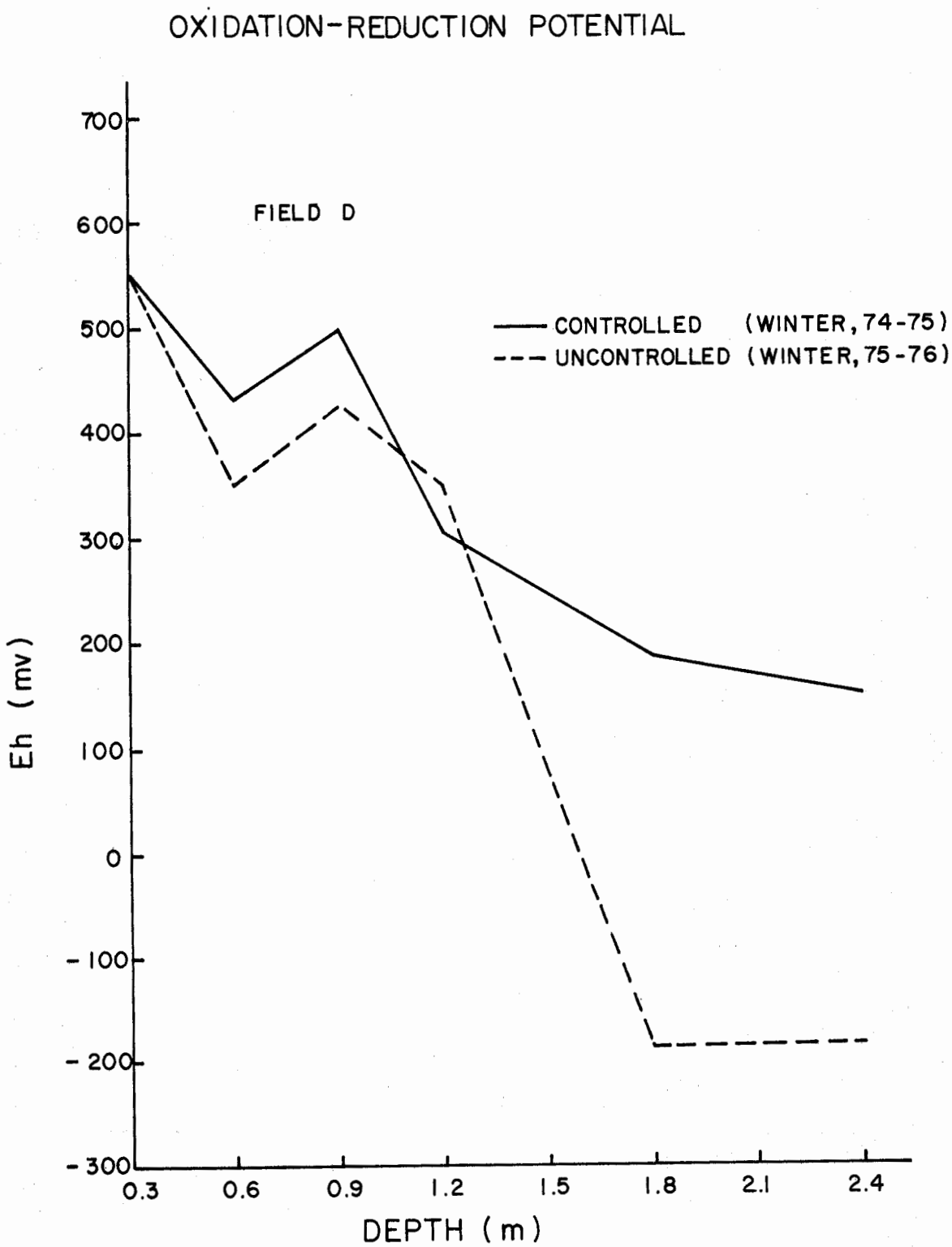

Figure 14. Average oxidation-reduction potentials at several soil depths in Field D at the Tidewater Research Station during a winter of controlled drainage and a winter of conventional drainage. Each point is an average of at least six measurements on different dates.

Figs. 15, 16 and 17 for three winters. The concentration decreased with depth and no NO_3^--N was ever found at 0.90 m or below in Fields D and M and below 1.2 m in Field E. The generally higher NO_3^--N in the soil profile in Field E as compared to the other two fields corresponds well with the higher NO_3^--N in the drainage ditches. The higher concentrations also follow logically from the higher Eh observation (Fig. 13) as compared to other fields. The Eh in Field E was above 400 mV to a depth of 1.2 m (Fig. 13) and this is the only field where NO_3^--N was ever observed at a depth of 1.2 m (Fig. 16). In Fields D and M, the Eh at 1.2 m was approximately 350 mV and no NO_3^--N was ever observed at this depth or below. The generally higher Eh in the top 0.90 m of the soil in Field E is believed responsible for the generally higher NO_3^--N concentration in this zone and the higher NO_3^--N in the drainage ditch from this field. Unfortunately, the reasons for the higher Eh in Field E as compared to Field M are not apparent to us. The soil and drainage conditions in the two fields appeared to be very similar.

Laboratory experiments discussed in more detail later have helped to explain the field Eh profiles. The temperatures which exist in the shallow ground water during much of the winter range from 5 to 15°C (Appendix Table 2). At these temperatures, the topsoil and subsoil will become reduced under saturated conditions but this process takes a few weeks, particularly for the subsoils. Under field conditions, oxygenated water is frequently added in rainfall. As this water moves through the soil profile, the oxygen is slowly utilized by the soil microbes so that, below about 1.2 m, no oxygen exists in the soil water. Below this depth, the NO_3^- is readily reduced as can be observed from the soil water NO_3^--N concentration data.

Total Loss of Water and NO_3^--N Through Ditches

Since drainage control had little or no effect on the NO_3^--N concentration in the drainage waters from a particular field, the total NO_3^--N lost through the ditches was directly proportional to the volume of drainage water. Drainage volumes from Fields M, E and D during three winters of the experiment are plotted in Fig. 18 for periods of both controlled and uncontrolled drainage. All four fields studied showed similar reductions in water moving through the ditches under controlled drainage. The total rainfall during the drainage periods is also shown in Fig. 18. Although variations in rainfall totals and the distribution affect drainage volumes, this apparently was a small factor in the measured differences in outflow volumes from controlled and uncontrolled ditches during the three years studied.

During the late fall and winter of 1976-77, drainage was controlled in the fields for approximately two weeks after a substantial rainfall event. Then the field was allowed to drain freely until two weeks after the next rain. Fields D and E are adjacent and were controlled in the same way. Drainage in Field M was uncontrolled during the time that Fields D and E were being controlled and visa versa. The effects of alternate control and no control upon drainage volumes are shown in Fig. 19. The effects are magnified by the storage of water in the upper part of the profile during control and drainage of this water when the controls were removed. However, soil storage and drainage do not account for all of the differences and the effects of control can be easily seen in Fig. 19.

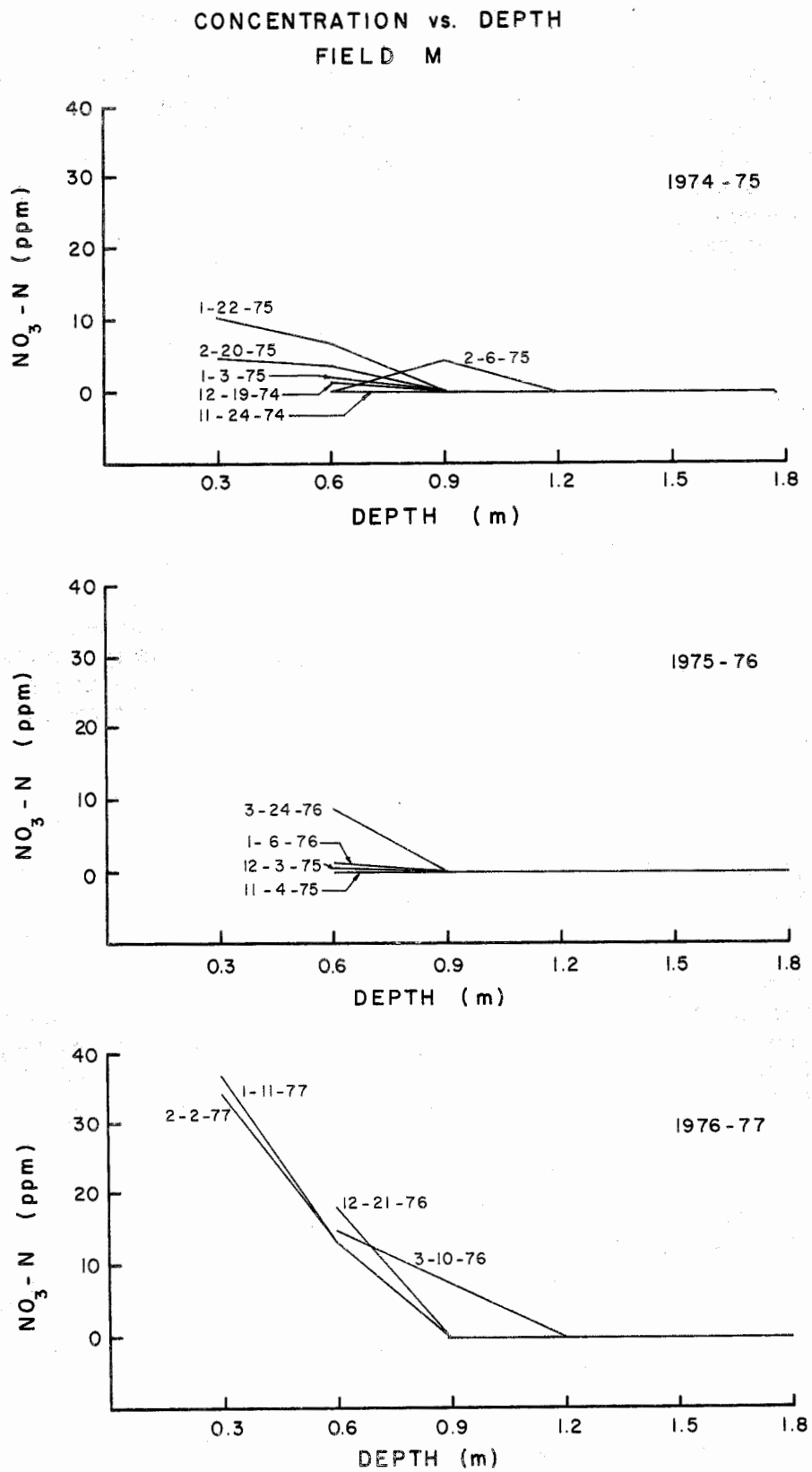

Figure 15. Concentration of NO_3^--N in the soil water at various depths in the soil profile on several dates in Field M at the Tidewater Research Station.

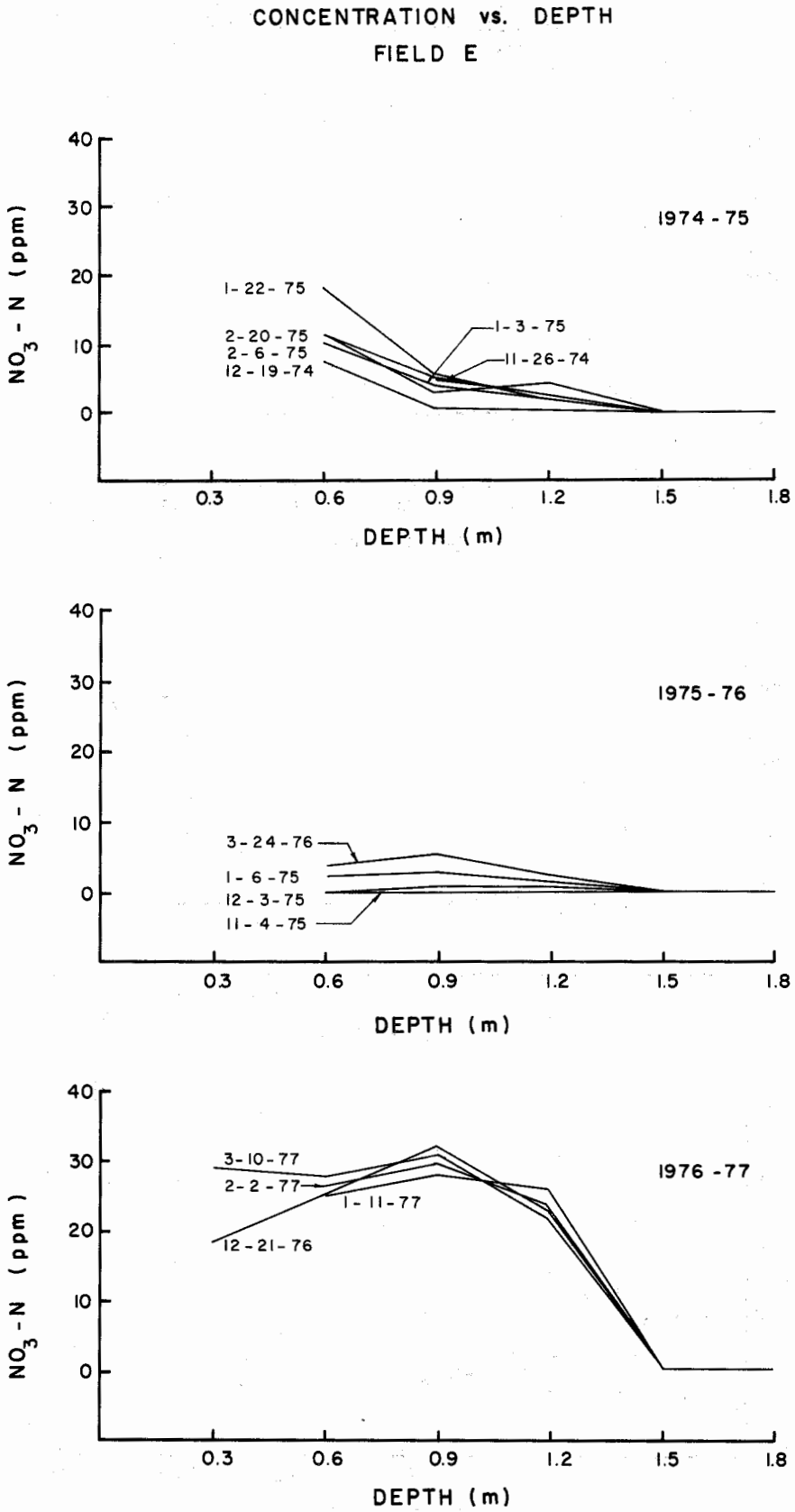

Figure 16. Concentration of NO_3^--N in the soil water at various depths in the soil profile on several dates in Field E at the Tidewater Research Station.

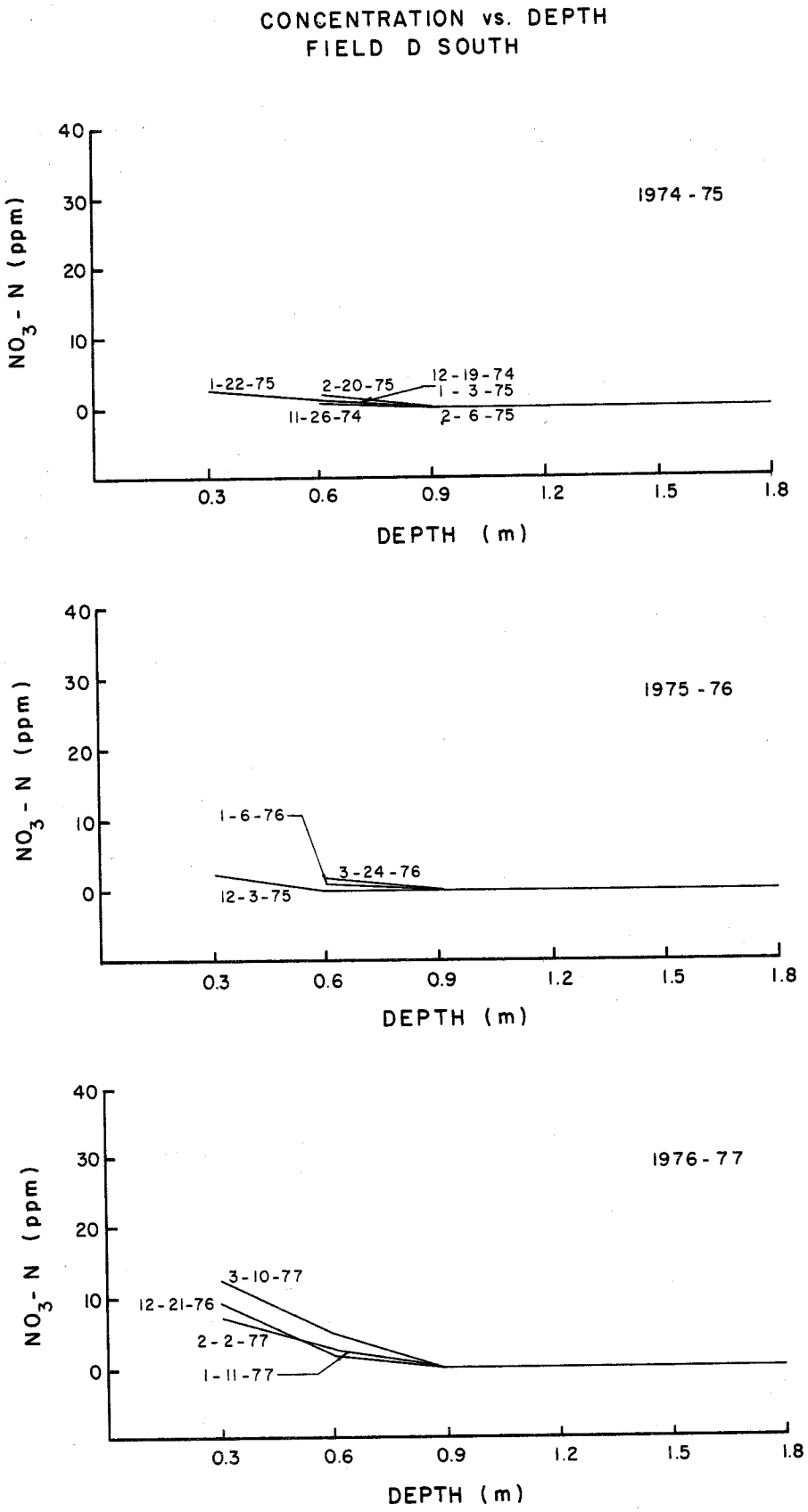

Figure 17. Concentration of NO_3^--N in the soil water at various depths in the soil profile on several dates in Field D at the Tidewater Research Station.

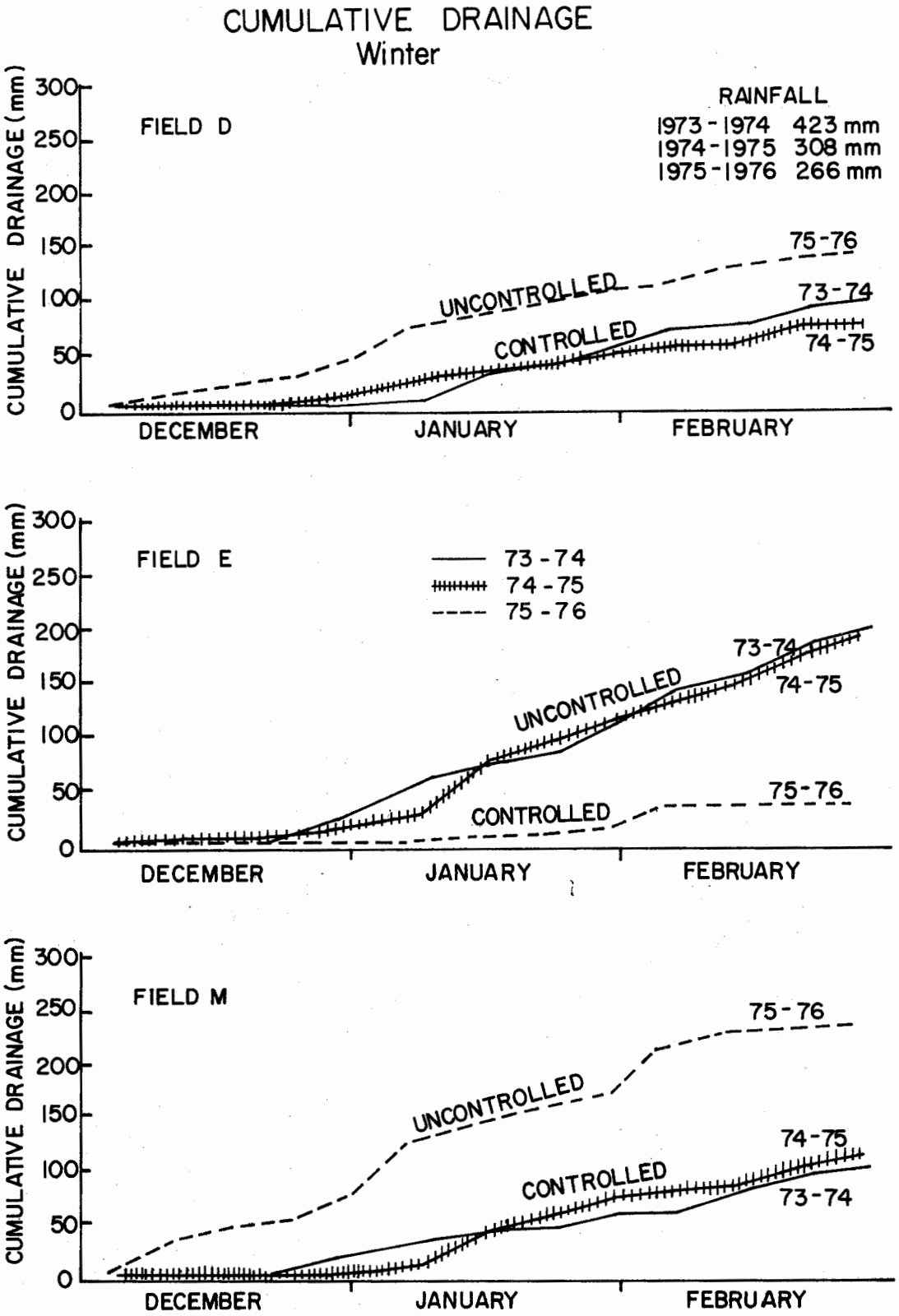

Figure 18. Cumulative drainage volumes through collector ditches in Fields M, E and D at the Tidewater Research Station during winters of controlled and conventional drainage.

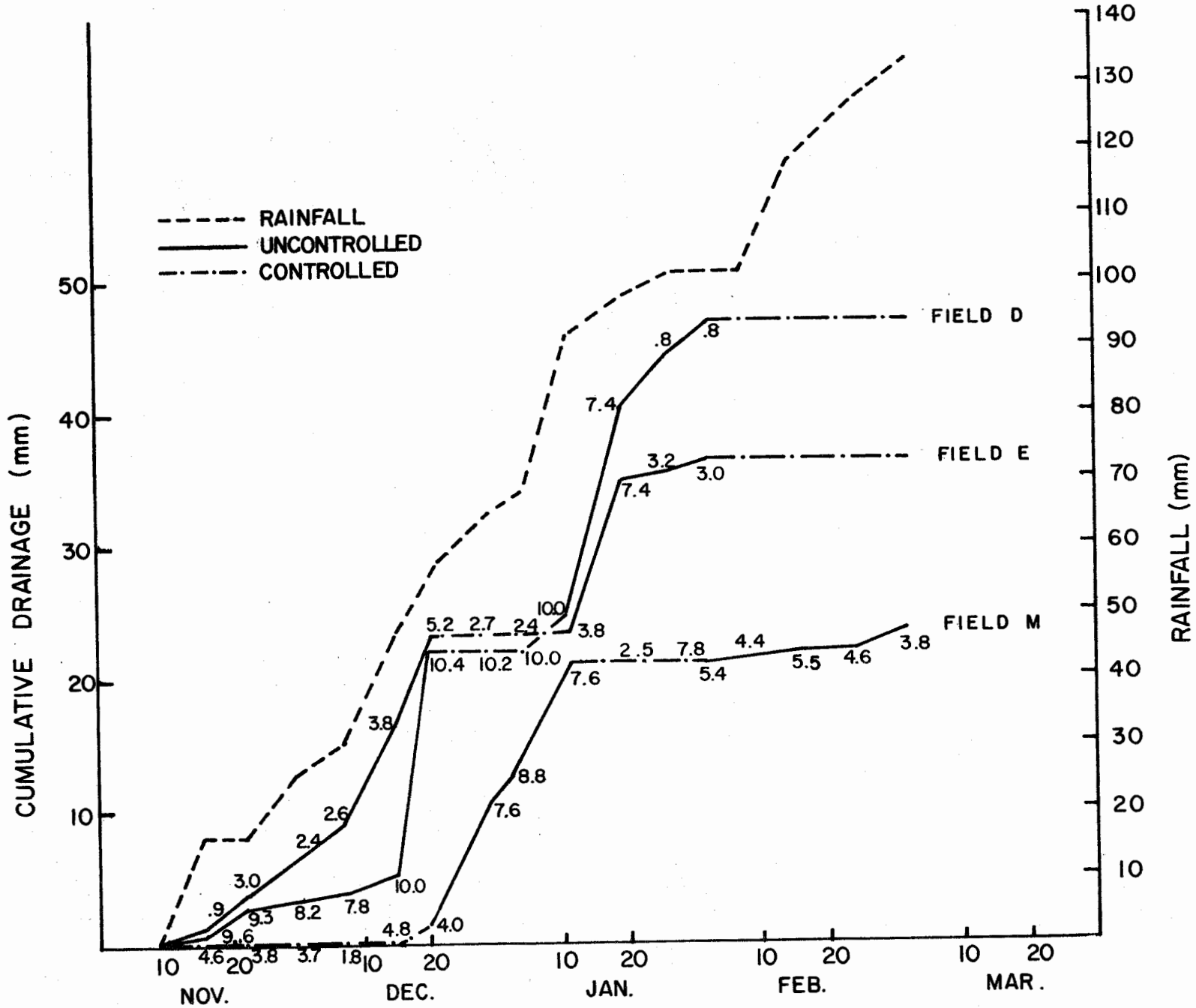

Figure 19. Cumulative drainage volumes in the three collector ditches during periods of alternate and controlled and conventional drainage. The numbers on the lines show NO_3^--N concentration during drainage.

Reduction in drainage water occurred not only during controlled conditions during the winter but also occurred when drainage was controlled during the summer (Fig. 20). Differences between controlled and uncontrolled drainage (from one field during different years) is of limited value because rainfall variations may cause large differences in flow. However, we were not able to control drainage of all fields during the summer for a number of reasons. Thus, no comparison between controlled and uncontrolled fields during the same summer is available. However, the data shown in Figs. 18 and 19 for other seasons help justify the conclusion that the differences noted in Fig. 20 for the summer was a result of drainage control and not rainfall variation.

When the total drainage was summed for a year, the reduction in water moving through the controlled drainage ditches was approximately 50%. Thus, the total NO_3^--N (also P, Cl^- and C) moving through the controlled ditches was approximately half that of the uncontrolled ditches. The total NO_3^--N leaving the conventionally drained fields was 25 to 30 kg/ha-yr and slightly less than half that amount in the controlled fields. During the winters (Dec., Jan., Feb.), the average loss of NO_3^--N through the uncontrolled ditches was approximately 11 kg/ha and approximately 5 kg/ha under controlled conditions.

Since less water moved in drainage ditches from the controlled fields than from the uncontrolled fields and since these ditches were removing both surface and some subsurface water, the question arises as to what happened to the water from the controlled fields. There are three apparent possibilities to account for the measured differences in flow for controlled and uncontrolled fields: (1) Control structures may have leaked or were by-passed and water was simply not measured. However, the amount of water which would have to by-pass the structure to account for the measured differences and the lack of evidence of leaks below the structures lead us to conclude that this could not have accounted for the observed differences in outflow. (2) Evapotranspiration may have increased in the fields with a controlled water table. This mechanism probably does account for a portion of the difference in flow, particularly during the summer months. However, this would not explain the differences noted during the winters. (3) More of the water left the area via deep seepage. The soils at this site generally have a sandy loam surface (0-0.7 m), a sandy clay loam B (0.7-1.5 m) and loamy sand or sandy loam below to a depth of approximately 5 m. Below the sandy horizon is a much more compact zone which serves as an aquiclude.[2] Much of the difference in the measured flows in the ditches during controlled conditions is probably a result of an increase in lateral flow from the controlled fields through the sandy layers below the B horizon and above the aquiclude. This increased deep seepage would result from the greater head during controlled conditions as a result of the higher water table (Fig. 6-10). This would explain the differences noted in Fields M and E. However, we were not able to measure any significant difference in the water table in Field D between controlled and uncontrolled drainage. There was definitely a higher water level in the collection ditch under controlled conditions. It is possible that there was a relatively large flow of water from the ditch into the sandy loam layer which extends to a

[2] Soils were drilled and described by R. B. Daniels and E. E. Gamble to whom appreciation is expressed.

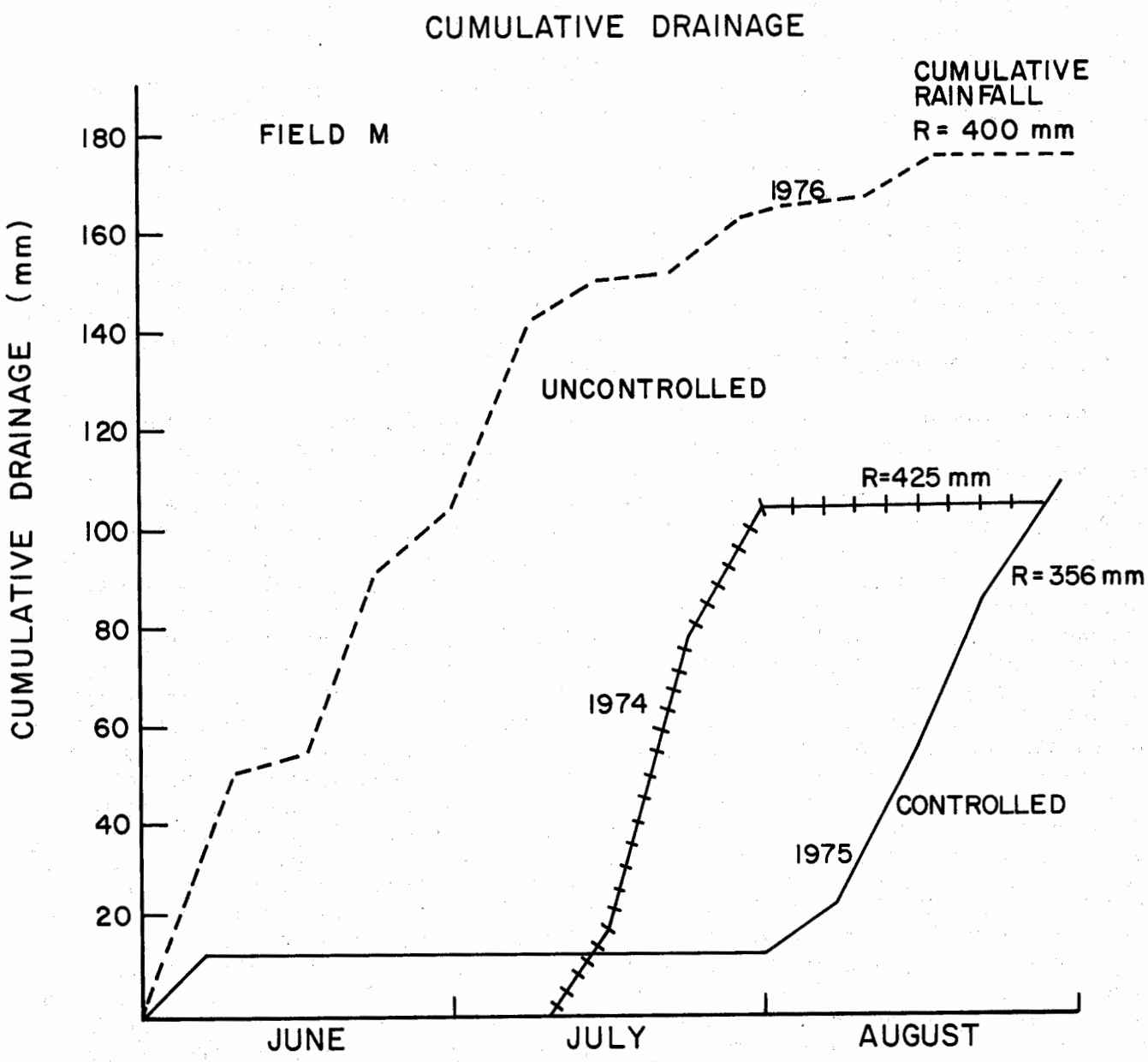

Figure 20. Cumulative drainage volumes from Field M at the Tidewater Research Station during summers of controlled and conventional drainage.

depth of approximately 5 m. Even though there was not an observed difference in the field water table level, reduction in flow through the collector ditch was about the same as in the other fields.

As discussed earlier, essentially all of the NO_3^- which moves into the soil horizon below 1 m is believed to be denitrified. The water table control resulted in approximately 50% less NO_3^--N leaving the area in surface runoff. Much of this NO_3^--N is believed to have moved into subsurface horizons where it was denitrified. The increased amount of denitrification did not occur in the surface 30-60 cm as we envisaged during the design of this experiment but the decrease in movement to the surface waters was real and due to an increase in denitrification.

Loss of Total P, Kjeldahl N, Cl^- and Organic C

The primary purpose of these experiments was to determine if water control could be used to reduce the NO_3^--N content of drainage waters from drained fields but we also measured other nutrients. Since the primary mechanism by which loss of NO_3^--N was reduced was the decrease in flow of water through the tile lines or collector ditches, there was also a reduction in apparent loss of other nutrients through this mechanism. The flux of total P, Kjeldahl N, Cl^- and organic C for a year of uncontrolled drainage is given in Table 2. There was no indication of a change in concentration of any parameter as a result of drainage control so the approximately 50% reduction in drainage water through the ditches would indicate a 50% reduction in these nutrients also.

Table 2. Flux of selected nutrients through the collector ditches in three fields at the Tidewater Research Station during approximately a year of conventional drainage.

	Flux kg/ha Field and Time Period		
Nutrient	M 01-04-75 To 10-19-76	E 12-28-73 To 12-27-74	D 12-03-75 To 11-30-76
NO_3^--N	17.6	36.3	20.4
NH_4^+-N	<0.01	.06	<0.01
Kjeldahl-N	4.8	10.9	2.5
Total P	0.37	0.24	0.18
Organic C	28.5	27.0	18.3
Cl^-	119.4	79.1	72.2

Although no data are available from these experiments, we can speculate as to what might happen to these nutrients which were not allowed to drain through the surface ditches. Although the annual loss of total P was extremely low, drainage control should have reduced this figure even more because much of the P would have been removed from the increased amount of water which moved down through the soil profile. The same is probably true for organic C and Kjeldahl N. It is improbable that there was any change as a result of control in the amount of Cl^- which ultimately reached surface waters. The consistently higher Cl^- content of the drainage waters from Field M as compared to the other fields is noteworthy. This concentration difference was true throughout the project but we can offer no explanation.

LABORATORY EXPERIMENTS

During the first winter of field studies, the oxidation-reduction potentials measured in the top meter of the soil profiles and the NO_3^--N content of the drainage waters indicated that drainage control was not resulting in a large increase in denitrification in the Ap and B horizons of the soil. Our previous work (Gambrell et al., 1975) had shown that denitrification did occur in poorly drained subsoils during the winter when much of the NO_3^--N was leached. However, since it is well known that low temperatures can limit microbial activity and denitrification, the influence of temperature upon denitrification rates in the topsoils and subsoils from the two field study sites was investigated.

The temperatures in the upper part of the soil profile were 5-15°C during much of the winter (Appendix Table 2). Focht and Chang (1975), in an excellent review on denitrification, concluded from current literature that denitrification rate is affected more below the 10-15°C range than would be predicted by an Arrhenius relationship. Bailey and Beauchamp (1973) found no denitrification in their soil at 5°C, but others (Nommik, 1956; Bremner and Shaw, 1958; Sikora and Keeney, 1975; Stanford, Dzienia and Vander Pol, 1975a) observed denitrification at this temperature. Some of the reported differences in temperature effects on denitrification (published Q_{10} values range from 1.4 to 3.6, Focht and Chang, 1975) may be partially explained by the work of Novak (1974). His studies indicated that the temperature effect on denitrification rate depends largely upon the substrate being used as an energy source by the microorganisms. If this is correct, few studies on temperature effects would be applicable to field soils because most experiments were conducted with energy sources added to soils (Bremner and Shaw, 1958) or in materials such as sludges (Mulbarger, 1971). Recently, Smid and Beauchamp (1976) have shown that addition of an energy source to soils had a large effect upon the temperature influence upon rate of denitrification. The objective of these laboratory experiments was to determine the changes in denitrification rate caused by normal temperature variations encountered in topsoils and subsoils of North Carolina.

MATERIALS AND METHODS

The A and B horizons of the Cape Fear and Goldsboro soils were selected for use. The Cape Fear soil (Typic Umbraquult) is representative of the relatively high organic matter, poorly drained soils which occur in the lower Coastal Plain of North Carolina. The Goldsboro soil (Aquic Paleudult) is representative of the most productive, moderately well drained soils found in the middle and upper Coastal Plain. Some chemical and physical characteristics of both topsoils and subsoils are given in Table 3.

Table 3. Selected chemical and physical characteristics of the soil materials used in the laboratory study.

	Goldsboro		Cape Fear	
	Topsoil	Subsoil	Topsoil	Subsoil
Depth, cm	0-25	35-60	0-25	40-60
Texture	s.l.	c.l.	l.	c.l.
C %	1.2	0.1	5.3	0.9
pH*	6.7	4.6	5.4	4.4
Bulk density (gm/cm)	1.4	1.5	1.0	1.2

*Soil pH was measured in the center of the soil columns near the end of the experiment. The pH's measured at this time were < 0.5 pH unit different from initial pH.

The soil materials were air-dried, passed through a 10-mesh sieve and placed in 3.2-cm (I.D.) plexiglass cylinders to a depth of 20 cm. The materials were placed in the cylinders to give approximately the same bulk densities which occur in the field (Table 3). To prevent the unusually rapid decrease in oxidation-reduction potential and rapid denitrification which commonly occur when air-dried soils are saturated (Yamane and Sato, 1968; Cawse and Sheldon, 1972), the initial water application was sufficient only to moisten the soil. The moistened soil was allowed to stand at room temperature for two days and then the containers were transferred to temperature controlled water baths. After one week in the water baths, KNO_3 solutions were added to each soil to saturate each soil column. The NO_3^- added to each column was calculated to give approximately 10 mg NO_3^--N/l of soil solution which is a common concentration found moving into subsoils of the North Carolina Coastal Plain.

To obtain soil solution samples during the course of the experiment, small (6mm O.D.) porous ceramic cups were placed in the center of each column during the column packing. Tygon tubing extended from the cup to the top of the column. Solution samples were obtained by putting a vacuum on the Tygon tubing and ceramic cup and using a syringe with capillary tubing attached to remove the solution which moved into the cup. Approximately 2 ml of solution were removed at each sampling. Soil solution samples were analyzed for NO_3^--N by determining the NO_3^- absorbance at approximately 206 nm and correcting for the absorbance at this wavelength caused by organic matter (Gambrell et al., 1975a). Nitrite was determined colorimetrically by the procedure described by Lowe and Hamilton (1967).

Each time that soil solution samples were taken, redox measurements were made by inserting two bright Pt electrodes to approximately the middle of the columns. The electrodes were allowed to remain in place for approximately two

hours and the potential at each electrode was determined using a calomel electrode placed in solution at the top of the column as a reference electrode. The values (Eh) reported are the average of 8 determinations and are not corrected to a specific pH.

Four cylinders of each soil material were placed in each of three water baths controlled at 5, 15, or 25°C. These temperatures were chosen because they encompass the temperature range normally encountered in shallow ground water in North Carolina soils.

RESULTS

Changes in soil solution NO_3^--N concentrations with time are shown in Figures 21 and 22. Concentrations of the first soil solution samples taken were significantly greater than the added 10 mg/l in all samples except for the Cape Fear subsoil. The very high NO_3^--N concentration in the Cape Fear topsoil is presumed to be a result of mineralization and nitrification during the 9-day incubation period since field samples were much lower in NO_3^--N concentration. We (Gambrell, Gilliam, and Weed, 1974) have previously measured NO_3^--N concentrations of similar soil in the field of over 100 mg/l but the high concentrations observed in this study were probably a result of the increased microbiological activity subsequent to the moistening of the air-dried soil. Mineralization and nitrification also apparently occurred in the Goldsboro topsoil during incubation.

The high NO_3^--N concentration (greater than 10 mg/l) in the Goldsboro subsoil is a result of NO_3^--N present at the time of soil sample collection. It is unusual to find field samples of the Cape Fear subsoil with a significant NO_3^--N concentration due to the reducing conditions which frequently exist (Gilliam et al., 1974) and this is reflected by NO_3^--N concentration in this subsoil being very close to the 10 mg/l added.

The changes in NO_3^--N with time are depicted on a linear scale as though denitrification was independent of concentration and followed zero order kinetics. However, denitrification rates fit first order and zero order kinetics about the same when zero order and first order rate constants were compared by regression statistics (Table 4) as done by Stanford, Vander Pol, and Dzienia (1975b). During rapid denitrification, first order kinetics were better than zero order kinetics in describing the denitrification rates. Several authors (Nommik, 1956; Bremner and Shaw, 1958; Patrick, 1960) have previously concluded that denitrification rates were independent of concentration (i.e., zero order) while still others (Mulbarger, 1971; Sikora and Keeney, 1975; Stanford et al., 1975b) have concluded that rates were best described by first order kinetics. Bowman and Focht (1974) concluded that zero order or first order kinetics were often just the extreme ends of the standard Michaelis-Menton curves in describing denitrification. There was little difference between zero order and first order correlation coefficients for the subsoils studied. Thus, data are presented on a linear graph. Subsoils are more frequently saturated than topsoils and whether or not denitrification occurs in subsoils has a large influence upon NO_3^--N concentrations of drainage waters from these soils (Gambrell et al., 1975a).

The rate of NO_3^--N loss in the Goldsboro topsoil increased from an average of .53 mg NO_3^--N/l/day at 5°C to 2.4 mg NO_3^--N/l/day at 25° C and increased

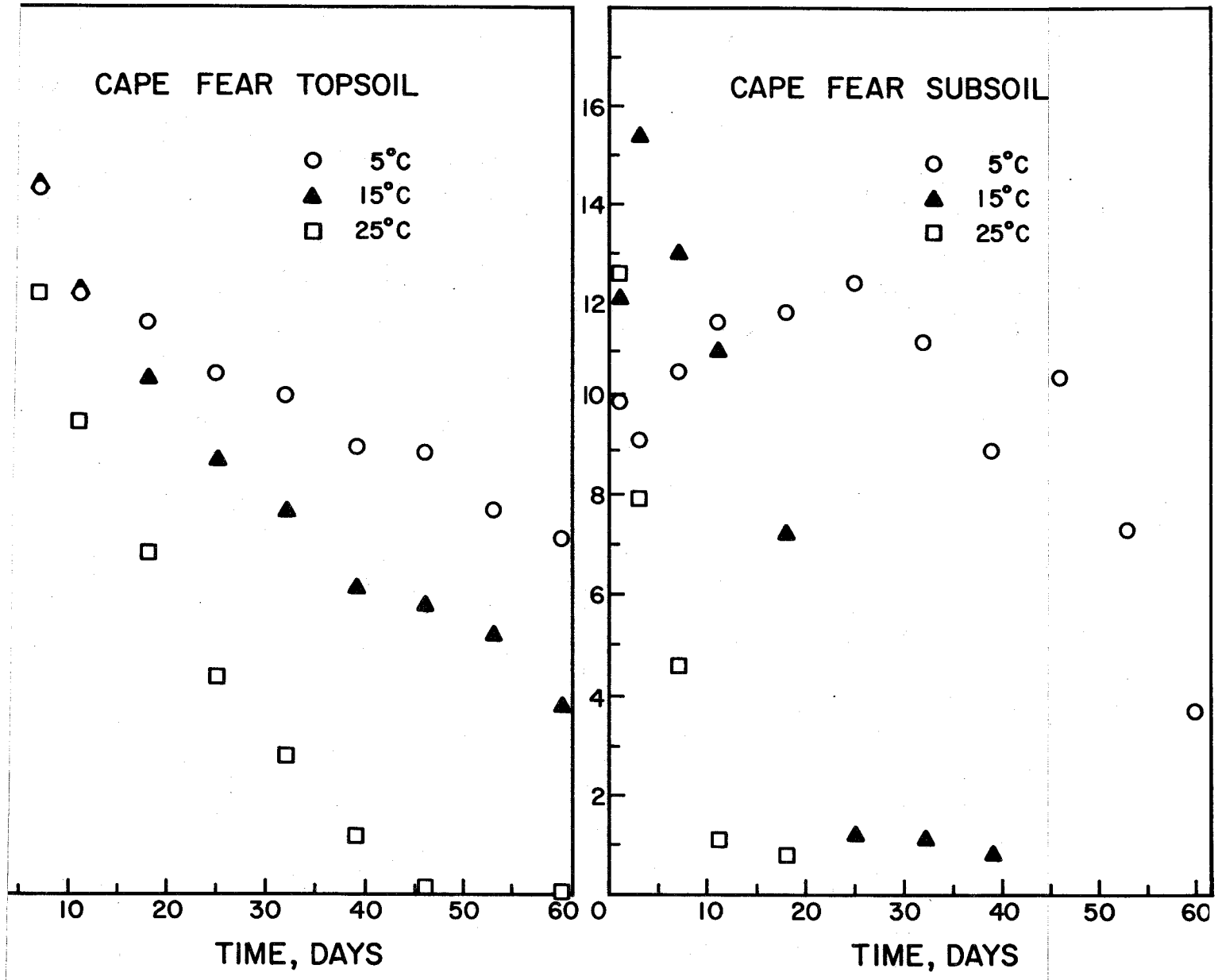

Figure 22. Temperature effects upon change in NO_3^--N concentration in soil solution in saturated Cape Fear soil from Tidewater Research Station.

from 4.3 to 6.8 mg NO_3^--N/l/day for the same temperature range in the Cape Fear topsoil. The differences in NO_3^--N loss rate were not as great between 5 and 15°C as were the differences between 15 and 25°C. The Q_{10} values calculated from first order constants were near 2 for both soils from 5°C to 15°C but values of 4 and 6 were obtained for 15 to 25°C. The only measurable NO_2^--N concentrations observed in this experiment were in the Cape Fear topsoil at 5 and 15°C where concentrations as high as 5 and 3 mg/l, respectively, were measured. It is possible that some NO_2^- was reduced chemically as described by Nelson and Bremner (1970) because the pH in all the soils studied was relatively low.

Table 4. Denitrification rate constants in laboratory study.

Soil	Temperature °C	First Order* k	First Order* r	Zero Order# slope	Zero Order# r
Goldsboro topsoil	5	0.021	.97	0.53	.98
Goldsboro topsoil	15	0.043	.96	0.63	.92
Goldsboro topsoil	25	0.175	.99	2.44	.85
Goldsboro subsoil	5	0.014	.98	0.24	.98
Goldsboro subsoil	15	0.035	.98	0.37	.99
Goldsboro subsoil	25	0.041	.97	0.34	.99
Cape Fear topsoil	5	0.015	.97	4.27	.95
Cape Fear topsoil	15	0.026	.99	5.58	.97
Cape Fear topsoil	25	0.157	.99	6.76	.97
Cape Fear subsoil	5	0.017	.62	0.11	.61
Cape Fear subsoil	15	0.077	.93	0.46	.95
Cape Fear subsoil	25	0.244	.98	1.15	.90

*Units of k are fraction denitrified per day and r is linear correlation coefficient of log NO_3^--N concentration vs. time.

#Slope units are mg NO_3^--N per l of soil solution per day and r is linear correlation coefficient of NO_3^--N concentration vs. time.

Denitrification rates and the effect of temperature on these rates were very different in the subsoils as compared to the topsoils. The Goldsboro subsoil has a very low content of available carbon (Gambrell et al., 1974) and denitrification rates in this material were low at all temperatures. Since energy source was probably the primary limiting factor in denitrification there was little influence of temperature on denitrification rate. A portion of the measured decline in NO_3^--N concentration after 4 weeks is probably a result of diffusion of NO_3^- from the soil into the free water layer above the soil surface. At the start of the experiment there were approximately 20 ml of water above the soil surface. As solution samples were removed from the center of soil column, this layer became smaller. After about 4 weeks, 25 ml of water were added to the surface to decrease entry of oxygen into the soil. As a result of NO_3^--N removal by sampling, a decline in NO_3^--N concentration of approximately 25% would have occurred at the conclusion of the experiment if there had been no denitrification and the system achieved a uniform concentration throughout by diffusion.

Temperature changes had a much larger effect on loss of NO_3^--N in the Cape Fear subsoil than on the Goldsboro subsoil which had much less available carbon. Denitrification rate was relatively rapid at 25°C (1.1 mg NO_3^--N/l/day) and at 15°C (0.5 mg NO_3^--N/l/day). However, the rate at 5°C was very low. NO_3^--N appeared to increase during the first four weeks at 5°C and the concentration at the end of 6 weeks was the same as at the start of the experiment. However, NO_3^--N concentration began to decrease at this time and eventually reached a low value. Since this pattern of reduction seemed unusual, NO_3^--N was added to similar reduced (low Eh) samples equilibrated at the higher temperatures and these were transferred to the 5°C water bath. A slow but steady decline in NO_3^--N concentration was observed so NO_3^- will definitely be reduced in this subsoil at 5°C.

The redox potentials are shown in Figure 23 for the 2 topsoils. The redox potentials at 25°C decreased very rapidly in the Goldsboro topsoil. The decrease in the Cape Fear topsoil at 25°C was more gradual and continued to decline throughout the experiment. There was no indication of buffering of redox potential caused by the presence of NO_3^- (Bailey and Beauchamp, 1973) in any samples in this experiment. One observation in several denitrification experiments for which we have no explanation is that moderately well drained soils such as the Goldsboro which have a relatively low organic matter content become reduced when water saturated much faster than poorly drained soils with higher organic matter contents.

The measured Eh of the Cape Fear topsoil maintained at 5°C never reached values as low as those commonly considered necessary for denitrification (Patrick, 1960). However, there was a very steady loss of NO_3^- from this soil which had mineralized significant amounts of N when moist. Although approximately 350 mV has been generally accepted as a "critical" potential for denitrification, Van Cleemput and Patrick (1974) reported denitrification at 400 mV and Turner and Patrick (1968) found significant losses of NO_3^- from saturated soils before the measured potential reached 400 mV. Bohn (1971) concluded that redox potential measurements in soils are qualitative and that their utility depended upon their interpretation by a knowledgeable observer. In the many experiments run in this laboratory, we have never measured low Eh values (<300 mV) where deni-

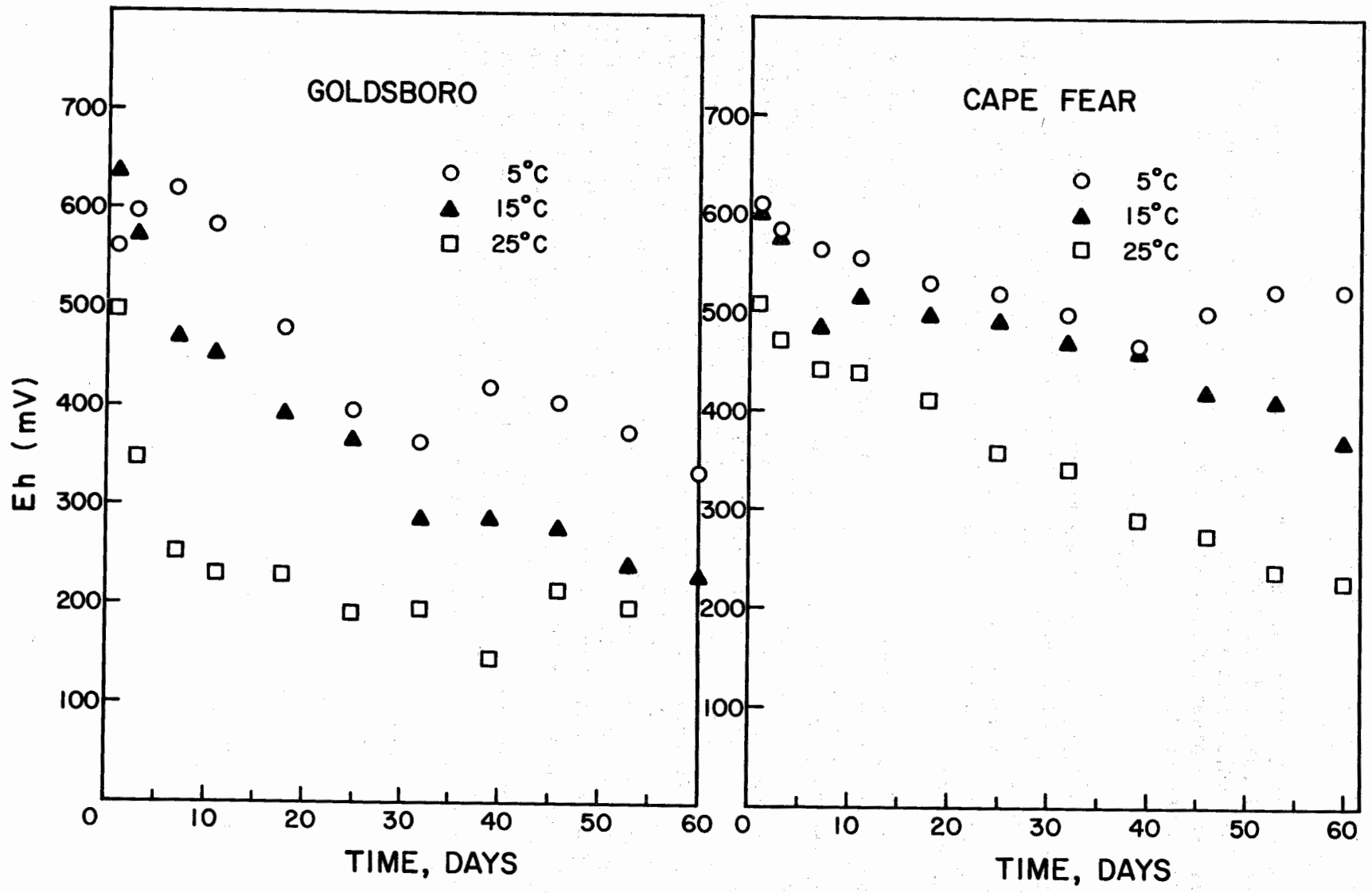

Figure 23. Oxidation-reduction potentials in the Goldsboro and Cape Fear topsoils used in the laboratory study.

trification did not occur. However, Bailey and Beauchamp (1973) reported that they obtained no denitrification in soils at 5°C in which they measured potentials of -200 mV.

The measured Eh values in the subsoils (data not shown) indicate they were always well oxidized (Eh>500 mV) with the exception of the Cape Fear subsoil at 25°C which reached values of 350 mV. The relatively high Eh values measured in other subsoil samples appear to be related to the slow loss of NO_3^--N measured.

DISCUSSION

There is no doubt that the temperatures of 5 to 15°C which exist in the shallow ground water of Atlantic Coastal Plain soils, during a portion of the winter, limits the rate of denitrification. Denitrification definitely can occur in these soils at temperatures of 5°C. However, the rate is significant only when a relatively large amount of available carbon is present as an energy source.

The relatively slow rate of denitrification at low temperatures places rather severe limitations upon use of ground water control during the winter to induce denitrification in some soils. For example, the very slow loss of NO_3^--N from the Goldsboro B horizon which has a low content of available carbon indicates that little denitrification is likely to occur below the topsoil. This is particularly true under field conditions where the frequent rains during the winter are continually adding oxygenated water. The very acid pH found in these subsoils may also be a limitation upon denitrification rates. Subsoils which are below topsoils with a high organic matter content can be expected to reduce significant amounts of NO_3^--N. Field observations in the Cape Fear soil have shown that Eh continually declines with depth to approximately 3 meters and no nitrate is found in the ground water below 2 m. This certainly does not mean that all of the leached NO_3^--N is lost from this soil by denitrification because much of it can flow through tile drains or ditches to surface waters before it can be denitrified. This is particularly true during winter months when, as this laboratory study shows, low temperatures significantly reduce denitrification rates. However, even at 5°C, significant reduction can occur and evidence indicates that it does occur in field situations.

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Appendix A: Soil classification and profile description at a typical site at the Lower Coastal Plain Tobacco Research Station and at the Tidewater Research Station.

A_1. Lower Coastal Plain Tobacco Research Station.

LOCATION: Lenoir County, approximately 11 Km N of Kinston, North Carolina

DATE OF SAMPLING: 6/8/72

DESCRIBED BY: R. B. Daniels and E. E. Gamble

ALTITUDE: About 21 m MSL

SOIL SERIES NAME: Goldsboro

SOIL FAMILY NAME: Aquic Paleudult, fine-loamy, siliceous, thermic

BORE HOLE DESCRIPTION:

Depth, m	Description
0-0.3	Ap horizon--sandy loam-
0.3-1.1	B horizon--brownish yellow (10YR 6/6) fine clay loam to sandy clay loam; clear-
1.1-2.6	Mottled light red (2.5YR 6/6), reddish yellow (5YR 6/8), and very pale brown (10YR 7/3) tough medium fine clay loam; gradual-
2.6-3.0	Light yellowish brown (10YR 6/4) medium sandy loam; clear-
3.0-3.8	Reddish yellow (7.5YR 6/6) very coarse sand to loamy sand; abrupt-
	Base of Wicomico MSU. Begin Cretaceous Pee Dee.
3.8-4.4	Reddish yellow (5YR 6/8 and 7.5YR 7/8) medium to medium fine loam to sandy loam; abrupt-
4.4-5.2	Dark greenish gray (10Y 4/1) fine loam; one 3 cm angular phosphate pebble; gradual-
5.2-8.5	Dark gray (5Y 4/1) medium coarse loam to sandy clay loam; grades to very dark greenish gray (darker than 5G 4/1) tough calcareous light loam.
	Base of hole at 8.5 m.

Comments: 4.3-5.2 m looks very much like Yorktown. Below 5.2 m looks more like Pee Dee, but there is no contract, only a gradation.

A_2. Tidewater Research Station.

LOCATION: Southeast corner Field M, Section 3

DATE OF SAMPLING: 12/05/72

DESCRIBED BY: R. B. Daniels and E. E. Gamble

ALTITUDE: ~4.9 M

SOIL SERIES NAME: Cape Fear

SOIL FAMILY NAME: Typic Umbraquult, clayey, mixed, thermic

BORE HOLE DESCRIPTION:

Depth, m	Description
0-.3	Very dark brown (10YR 2/2) very fine sandy loam; clear boundary-
.3-1.2	Dark grayish brown (10YR 4/2) clay with common fine yellowish red (5YR 4/8) mottles; common fine mica; grades-
1.2-1.8	Very pale to pale brown (10YR 7/3-6/3) with brownish yellow (10YR 6/6) mottles sandy clay loam; bedded clayey and sandy material grading to medium fine light sandy loam at 1.8 m; grades-
1.8-2.6	Gray (10YR 6/1) medium fine sandy loam-loamy sand to sandy loam; grading to gray (5Y 5/1)
2.6-5.2	Gray (5Y 5/1) light sandy loam grading to gray (10Y 5/1) at 4.1-5.2 m, sands are medium fine, gradual boundary-
5.2-5.9	Gray (10Y 4/1) medium coarse sandy loam with few rounded to subangular quartz pebbles to 1.5 cm-
5.9-6.1	Gray (5Y 5/1) medium sand and Black (5Y 2/1-2/2) peaty material, laminated sand and peaty materials with pieces of wood up to 1[3] cm, abrupt boundary-

A_2. Contd.

Depth, m	Description
6.1-6.9	Dark gray (5Y 4/1) coarse sand, abrupt boundary-
6.9-8.8	Dark greenish gray (5GY 4/1) medium fine sandy loam, clear boundary-
8.8-11.7	Greenish gray (5GY 5/1) grading to (5GY 6/1) marly sandy loam to sandy clay loam; common large fossil fragments: not cemented or indurated; gradual boundary-
11.7-16.8	Light greenish gray (5GY 7/1) soft medium fine sandy loam; some fossil fragments; sandy below 12.8 m-
16.8-17.8	No return of material but drill indication is silty material-
	Base of hole 17.8 m.

Comments: 5.9 m is base of Pamlico. Below 5.9 is Small Sequence. 8.8 m is base of Small Sequence unless it continues to 16.8 m. Yorktown begins at base of Small Sequence.

Appendix Table 1. Oxidation-reduction potentials measured in the poorly drained soils at the Tidewater Research Station.

Date	Field D Eh (mV) Soil Depth (m)				Field E Eh (mV) Soil Depth (m)				Field M Eh (mV) Soil Depth (m)			
	0.3	0.6	0.9	1.2	0.3	0.6	0.9	1.2	0.3	0.6	0.9	1.2
06-06-74	552	489	499	582	632	196	354	106	536	524	614	486
06-20-74	562	352	299	209	639	599	559	406	594	449	592	469
07-16-74	597	496	344	472	534	616	429	382	376	362	489	469
07-24-74	559	534	479	412	-	-	-	-	326	466	539	386
08-07-74	-	-	-	-	-	-	-	-	322	274	272	189
08-15-74	322	344	276	4	346	524	614	302	349	374	524	254
09-11-74	602	386	332	506	494	629	686	334	-	-	-	-
11-26-74	652	687	414	344	669	536	664	-	674	409	552	259
12-19-74	-	-	-	-	-	-	-	-	742	504	594	503
01-03-75	486	329	566	279	595	678	542	279	595	442	414	374
01-22-75	464	374	504	294	524	604	604	364	579	344	414	-
01-29-75	519	426	562	379	564	562	282	419	399	374	454	-
02-06-75	559	394	474	239	454	594	624	549	634	459	394	-
02-20-75	524	519	334	274	494	509	494	494	449	404	399	-
03-06-75	584	414	524	344	564	644	524	539	609	374	524	-
03-28-75	604	464	449	349	519	639	524	524	574	364	499	-
05-07-75	554	514	434	414	519	609	584	324	639	424	489	-
07-15-75	484	344	349	314	-	-	-	-	-	-	-	-
10-01-75	529	414	414	274	424	264	474	294	374	74	244	-
11-04-75	574	334	434	344	409	634	654	454	544	359	544	364
12-03-75	564	349	454	344	404	534	594	654	644	664	444	199
01-06-76	599	304	529	379	434	624	644	524	644	524	544	304
03-24-76	619	359	594	374	474	654	589	604	589	444	728	324
05-19-76	614	324	334	314	504	609	569	544	634	544	474	354
06-25-76	414	284	294	349	439	494	504	504	539	284	484	294
12-21-76	644	504	454	434	574	624	604	184	474	544	489	254
01-11-77	554	514	544	394	594	524	404	239	564	374	484	-
02-02-77	684	399	494	269	529	234	514	204	534	404	474	214
03-10-77	174	164	594	34	624	464	634	184	629	464	-46	144

Appendix Table 2. Soil and water temperatures measured at the Tidewater Research Station and the Lower Coastal Plain Tobacco Research Station near Kinston.

TIDEWATER RESEARCH STATION

Soil and Water Temperatures °C

Field	Date	SOIL DEPTH .6 cm	30 cm	60 cm	90 cm	120 cm	Drainage Ditch
B	01/17/74	-	15	-	-	-	-
C	01/17/74	-	12.5	-	-	-	-
D	01/17/74	-	12	-	-	-	-
E	01/17/74	-	12	-	-	-	-
D	03/18/74	-	12	-	-	-	-
M	08/02/74	-	24	23.5	23	25.5	22
M	08/07/74	-	23	22.5	22	22	-
M	08/15/74	-	24	23	22	23	-
E	08/15/74	-	24	24	23	23	-
E	10/23/74	-	13	13.5	16	16	-
E	11/06/74	-	18	18.5	18	18	-
M	11/06/74	-	17.5	19	17.5	17	-
M	11/26/74	-	9	11	12	11	-
M	12/04/74	-	8	9	9.5	11	-
M	12/11/74	-	8.5	9	11	11	-
M	12/19/74	5	8.5	8.5	10.5	10	-
C	12/19/74	-	-	-	-	-	5
M	12/29/74	-	8.5	8.5	10.5	10.5	-
E	01/03/75	-	11	9	10	9	-
M	01/08/75	9	8	-	-	8	-
M	01/15/75	-	8	8	11	10.5	-
E	01/15/75	-	-	-	-	-	9
M	01/22/75	-	-	-	-	-	9.5
M	01/29/75	-	11	10	11	11	-
E	01/29/75	-	-	-	-	-	11.5
M	02/06/75	-	9.5	10.5	10.5	10.5	10
E	02/06/75	-	-	-	-	-	10
B	02/12/75	-	-	-	-	-	11.5
E	02/12/75	15	13	10.5	10	10.5	-
M	03/06/75	-	9	9	10	10.5	11
M	03/14/75	-	15	12.5	12	12	15
M	03/28/75	-	12	-	13	12	-
M	04/10/75	-	12	12	12	12	13
E	04/23/75	25.5	24.5	21.5	19	19	-
M	04/30/75	-	-	-	-	-	16
D	07/15/75	29	-	25	-	24	-
D	08/06/75	-	26.5	25.5	25	23	31
M	10/08/75	23	22	22	21	21	22
C	10/14/75	25	-	-	23	21	-
M	10/29/75	23	21	20	20	20	-
M	11/12/75	24	21	20	19	19	-
E	01/06/76	-	7	8	8	8	5

Appendix Table 2 Cont'd.

LOWER COASTAL PLAIN TOBACCO RESEARCH STATION

Soil and Water Temperatures °C

Field	Date	SOIL DEPTH .6 cm	30 cm	60 cm	90 cm	120 cm	Drainage Ditch
D	02/14/74	-	-	10	-	-	-
A	12/04/74	8.5	-	-	-	-	11
A	12/19/74	4	9	-	-	-	-
A	01/03/75	1	8	-	-	-	4
A	01/09/75	15	-	10	-	-	-
A	01/15/75	3.5	-	8	-	-	-
C	01/15/75	-	-	-	-	-	11
B	01/23/75	-	-	-	-	-	10.5
C	01/29/75	16	-	12	-	-	12
A	02/06/75	16	10	-	-	-	-
C	02/06/75	-	-	-	-	-	10.5
D	02/12/75	-	-	-	-	-	11.5

Appendix Table 3. Weekly rainfall, water flows, nutrient concentration and fluxes from each research site. (In this table, comp. refers to a composite sample, g refers to a grab sample, and a "c" or "u" before weir depth indicates controlled (c) or uncontrolled (u) drainage.

FIELD D - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
12/28/73	c 0.49	3.60	0.71	0.71	9.3	0.67	0.67	8.8	g 14.0
01/09/74	c 0.49	6.68	2.13	2.84	7.8	1.67	2.34	8.6	g 14.3
01/17/74	c 0.49	0.00	0.61	3.45	8.2	0.50	2.84	8.2	g 12.4
01/23/74	c 0.49	2.43	0.33	3.78	9.1	0.30	3.14	7.9	g 12.1
01/31/74	c 0.49	4.09	1.68	5.46	8.3	1.41	4.55	8.3	g 13.2
02/06/74	c 0.49	3.94	1.50	6.96	9.8	1.47	6.02	7.3	g 9.9
02/14/74	c 0.49	1.22	0.53	7.49	7.2	0.38	6.40	7.1	g 12.3
02/21/74	c 0.49	5.46	1.52	9.01	7.4	1.14	7.54	5.8	g 9.5
02/27/74	c 0.49	0.84	0.41	9.42	-	0.28 g	7.82	6.9	g 10.2
03/06/74	c 0.49	0.00	0.00	9.42	-	0.00 g	7.82	6.2	g 10.1
03/13/74	c 0.49	1.35	0.00	9.42	-	0.00 g	7.82	4.6	g 11.4
03/19/74	c 0.49	3.63	0.05	9.47	7.4	0.11	7.93	6.6	g 13.9
03/27/74	u 1.15	5.23	1.73	11.20	6.4	1.11	9.04	6.8	g 12.4
04/02/74	u 1.15	3.28	2.16	13.36	8.3	1.79	10.83	6.8	g 12.0
04/11/74	u 1.15	4.67	2.18	15.54	6.8	1.48	12.31	7.0	g 14.8
04/16/74	u 1.15	5.59	1.83	17.37	7.2	1.31	13.62	8.0	g 12.3
04/22/74	u 1.15	0.00	0.43	17.80	7.0	0.30	13.92	5.9	g 13.6
04/30/74	u 1.15	0.58	0.23	18.03	-	0.09 g	14.01	3.8	g 15.2
05/07/74	u 1.15	3.43	0.28	18.31	2.8	0.08	14.09	3.9	g 15.7
05/15/74	u 1.15	1.73	0.20	18.51	3.4	0.07	14.16	2.7	g 14.5
05/22/74	u 1.15	2.26	0.18	18.69	1.5	0.02	14.18	2.3	g 15.3
05/30/74	u 1.15	8.13	2.31	21.00	7.5	1.72	15.90	-	g 15.1
06/06/74	u 1.15	3.18	0.84	21.84	11.3	0.94	16.84	10.8	g 15.8
06/13/74	c 0.53	0.81	0.00	21.84	-	0.00	16.84	-	-
06/19/74	c 0.53	0.08	0.00	21.84	-	0.00	16.84	-	-
06/26/74	c 0.53	1.78	0.00	21.84	-	0.00	16.84	-	-
07/03/74	c 0.53	2.89	0.00	21.84	-	0.00	16.84	-	-
07/10/74	c 0.53	5.21	0.00	21.84	-	0.00	16.84	-	-
07/16/74	c 0.53	0.02	0.00	21.84	-	0.00	16.84	-	-
07/24/74	c 0.53	0.00	0.00	21.84	-	0.00	16.84	-	-
07/31/74	c 0.53	9.09	0.00	21.84	-	0.00	16.84	-	-
08/07/74	c 0.53	10.34	0.64	22.48	5.2	0.32	17.16	8.7	g 9.7
08/15/74	c 0.53	0.96	0.15	22.63	9.8	0.13	17.29	-	-
08/21/74	c 0.53	3.35	1.42	24.05	-	1.28 g	18.57	9.0	g 8.7
08/29/74	c 0.53	4.80	1.30	25.35	-	0.73 g	19.30	5.6	g 8.7
09/04/74	c 0.53	0.89	0.00	25.35	-	0.00 g	19.30	3.0	g 9.2
09/11/74	c 0.53	5.16	0.99	26.34	-	0.41 g	19.71	4.2	g 11.3
09/18/74	c 0.53	1.93	0.00	26.34	3.5	0.00	19.71	-	-

Appendix Table 3, Cont'd. Field D - Tidewater Research Station at Plymouth.

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
12/28/73	g<.1	-	-	0.00	-	0.03	0.24	-	6.4
01/09/74	g<.1	-	-	0.00	-	0.02	0.43	-	-
01/17/74	-	-	-	-	-	-	-	-	-
01/23/74	-	-	-	-	-	-	-	-	-
01/31/74	-	-	-	-	-	-	-	-	-
02/06/74	g<.1	-	2.01	0.30	-	0.08	1.21	-	-
02/14/74	g<.1	-	-	0.00	-	-	-	-	-
02/21/74	-	-	2.25	0.35	-	0.06	0.93	-	-
02/27/74	-	-	-	-	-	-	-	-	-
03/06/74	-	-	1.03	0.00	-	0.08	0.00	-	-
03/13/74	g<.1	-	0.91	0.01	-	0.06	0.00	-	7.1
03/19/74	g<.1	-	1.27	0.00	-	0.02	0.04	-	3.4
03/27/74	g<.1	-	1.22	0.21	-	0.02	0.32	-	-
04/02/74	g<.1	-	0.49	0.10	-	0.01	0.24	-	-
04/11/74	g<.1	-	1.30	0.28	-	0.02	0.43	-	4.9
04/16/74	g<.1	-	1.79	0.32	-	0.04	0.75	-	5.8
04/22/74	g0.3	-	5.72	0.25	-	0.28	1.21	-	7.1
04/30/74	g0.3	-	2.23	0.04	-	0.04	0.09	-	7.7
05/07/74	g0.3	-	1.11	0.03	-	0.11	0.28	-	6.5
05/15/74	-	-	-	-	-	0.08	0.19	-	6.7
05/22/74	g<.1	-	1.26	0.02	-	0.06	0.09	-	8.1
05/30/74	g<.1	-	0.95	0.22	-	0.01	0.24	-	5.0
06/06/74	g0.1	-	0.95	0.08	-	0.06	0.52	-	7.6
06/13/74	-	-	-	-	-	-	-	-	-
06/19/74	-	-	-	-	-	-	-	-	-
06/26/74	-	-	-	-	-	-	-	-	-
07/03/74	-	-	-	-	-	-	-	-	-
07/10/74	-	-	-	-	-	-	-	-	-
07/16/74	-	-	-	-	-	-	-	-	-
07/24/74	-	-	-	-	-	-	-	-	-
07/31/74	-	-	-	-	-	-	-	-	-
08/07/74	g<.1	-	-	-	-	-	-	-	-
08/15/74	-	-	-	-	-	-	-	-	-
08/21/74	g<.1	-	1.74	0.25	-	0.03	0.43	-	-
08/29/74	-	-	1.43	0.19	-	0.02	0.28	-	6.0
09/04/74	g<.1	-	2.23	0.00	-	0.47	0.00	-	7.7
09/11/74	g0.2	-	0.31	0.03	-	0.06	0.60	-	5.2
09/18/74	-	-	-	-	-	-	-	-	-

FIELD D - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
09/26/74	c 0.53	0.20	0.00	26.34	1.7	0.00	19.71	-	12.0
10/01/74	c 0.53	0.53	0.00	26.34	-	0.00	19.71	-	-
10/08/74	c 0.53	0.13	0.00	26.34	-	0.00	19.71	-	-
10/16/74	c 0.53	1.83	0.00	26.34	-	0.00	19.71	-	-
10/23/74	c 0.53	3.38	0.00	26.34	-	0.00	19.71	-	-
10/31/74	c 0.53	0.00	0.00	26.34	-	0.00	19.71	-	-
11/06/74	c 0.53	0.00	0.00	26.34	-	0.00	19.71	-	-
11/12/74*	c 0.53	0.38	0.00	26.34	-	0.00	19.71	-	-
11/20/74*	c 0.53	2.29	0.00	26.34	-	0.00	19.71	-	-
11/26/74*	c 0.53	0.86	0.00	26.34	-	0.00	19.71	-	-
12/04/74*	c 0.53	2.13	0.00	0.00	-	0.00	0.00	-	-
12/11/74	c 0.53	1.37	0.00	0.00	-	0.00	0.00	-	-
12/19/74	c 0.53	0.61	0.00	0.00	-	0.00	0.00	3.1	g 14.8
12/27/74	c 0.53	2.26	0.00	0.00	-	0.00	0.00	-	-
01/03/75	c 0.53	2.01	0.15	0.15	5.3	0.08	0.08	5.3	14.0
01/08/75	c 0.53	1.80	0.38	0.53	-	0.24 g	0.32	6.1	14.0
01/15/75	c 0.53	5.92	2.41	2.94	7.5	1.81	2.13	7.1	13.8
01/22/75	c 0.53	2.08	0.91	3.85	6.8	0.62	2.75	7.4	13.8
01/29/75	c 0.53	2.54	1.14	4.99	5.9	0.68	3.43	5.6	12.7
02/06/75	c 0.53	2.67	0.53	5.52	4.8	0.26	3.69	5.2	13.2
02/12/75	c 0.53	0.08	0.10	5.62	5.2	0.06	3.75	-	13.7
02/20/75	c 0.53	5.51	1.57	7.19	4.8	0.76	4.51	4.8	12.8
02/26/75*	c 0.53	1.88	0.15	7.34	6.3	0.10	4.61	-	14.5
03/06/75*	c 0.53	0.71	0.00	7.34	-	0.00	4.61	-	-
03/14/75*	c 0.53	2.74	0.00	7.34	-	0.00	4.61	-	-
03/21/75*	c 0.53	7.54	1.02	8.36	5.2	0.53	5.14	3.4	14.6
03/28/75*	c 0.53	0.78	0.25	8.61	3.3	0.08	5.22	-	12.9
04/04/75*	c 0.53	1.44	0.00	8.61	-	0.00	5.22	-	-
04/10/75*	c 0.53	0.71	0.00	8.61	-	0.00	5.22	-	-
04/17/75*	c 0.53	8.13	0.08	8.69	-	0.03 g	5.25	4.9	g 24.1
04/23/75*	c 0.53	0.51	0.00	8.69	-	0.00	5.25	-	-
04/30/75*	u 1.61	0.43	0.00	8.69	-	0.00	5.25	1.7	g 16.1
05/07/75	u 1.32	1.29	0.15	8.84	0.9	0.01	5.26	1.7	16.9
05/15/75	u 1.32	0.20	0.08	8.92	0.5	0.00	5.26	0.0	17.4
05/22/75	u 1.32	1.37	0.08	9.00	0.6	0.00	5.26	0.6	17.9
05/27/75	u 1.32	3.02	0.05	9.05	0.7	0.00	5.26	1.2	18.0

Appendix Table 3, Cont'd. Field D - Tidewater Research Station at Plymouth.

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
09/26/74	<.1	-	-	-	-	-	-	6.8	-
10/01/74	-	-	-	-	-	-	-	-	-
10/08/74	-	-	-	-	-	-	-	-	-
10/16/74	-	-	-	-	-	-	-	-	-
10/23/74	-	-	-	-	-	-	-	-	-
10/31/74	-	-	-	-	-	-	-	-	-
11/06/74	-	-	-	-	-	-	-	-	-
11/12/74	-	-	-	-	-	-	-	-	-
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	-	-	-	-	-	-	-	-	-
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	-	-	0.20	0.00	-	0.07	0.00	-	5.1
12/27/74	-	-	-	-	-	-	-	-	-
01/03/75	<.1	0.60	0.40	0.01	0.01	0.08	0.00	5.3	5.7
01/08/75	<.1	0.50	0.40	0.02	0.01	0.01	0.05	4.5	6.3
01/15/75	.1	0.70	0.40	0.17	0.04	0.06	0.99	4.2	4.9
01/22/75	<.1	0.80	0.10	0.07	0.03	0.06	0.28	-	-
01/29/75	<.1	-	1.45	0.17	0.03	0.02	0.32	5.0	5.1
02/06/75	-	2.65	0.15	0.15	0.02	0.16	0.09	-	-
02/12/75	-	2.60	-	0.02	0.00	-	0.00	-	-
02/20/75	<.1	1.65	1.45	0.26	-	0.05	0.80	7.6	7.8
02/26/75	-	0.90	-	0.01	0.06	-	0.09	-	-
03/06/75	-	-	-	-	-	-	-	-	-
03/14/75	-	-	-	-	-	-	-	-	-
03/21/75	0.1	3.30	1.10	0.34	-	0.14	1.40	5.4	8.8
03/28/75	0.2	5.00	-	0.12	-	-	-	8.0	-
04/04/75	-	-	-	-	-	-	-	-	-
04/10/75	-	-	-	-	-	-	-	-	-
04/17/75	-	-	1.30	0.01	-	-	-	-	-
04/23/75	-	-	-	-	-	-	-	-	-
04/30/75	<.1	-	1.69	0.00	-	0.04	0.00	-	6.2
05/07/75	-	1.69	0.00	0.02	0.12	0.04	0.19	-	-
05/15/75	-	-	-	-	0.06	0.14	0.05	-	-
05/22/75	-	-	1.86	0.01	0.44	0.20	0.32	-	-
05/27/75	<.1	0.51	1.69	0.00	0.17	0.11	0.09	10.5	12.0

Appendix Table 3, Cont'd.

FIELD D - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
06/03/75	u 1.32	1.68	0.08	9.13	0.8	0.00	5.26	0.7	18.2
06/11/75	u 1.32	0.00	0.00	9.13	0.8	0.00	5.26	-	g 17.9
06/18/75	u 1.32	1.35	0.00	9.13	0.1	0.00	5.26	0.1	23.8
06/25/75*	u 1.32	0.00	0.00	9.13	-	0.00	5.26	-	-
07/01/75*	u 1.32	3.99	0.00	9.13	-	0.00	5.26	-	-
07/09/75*	u 1.32	5.13	0.15	9.28	1.2	0.02	5.28	-	-
07/15/75*	u 1.32	11.56	0.38	9.66	1.2	0.05	5.33	6.7	65.0
07/23/75*	u 1.32	8.61	0.25	9.91	3.7	0.09	5.42	1.5	18.1
07/29/75*	u 1.32	3.50	0.25	10.16	1.3	0.03	5.45	1.7	19.7
08/06/75*	u 1.32	0.00	0.05	10.21	0.2	0.00	5.45	0.0	33.9
08/13/75	u 1.32	0.84	0.00	10.21	-	0.00	5.45	-	-
08/20/75	u 1.32	0.00	0.00	10.21	-	0.00	5.45	-	-
08/27/75	u 1.32	0.00	0.00	10.21	-	0.00	5.45	-	-
09/03/75	u 1.32	2.44	0.00	10.21	-	0.00	5.45	-	-
09/10/75	u 1.32	4.95	0.00	10.21	-	0.00	5.45	-	-
09/17/75	u 1.32	2.79	0.00	10.21	0.6	0.00	5.45	0.0	30.5
09/24/75	u 1.32	5.18	0.13	10.34	1.2	0.01	5.46	1.4	30.3
10/01/75	u 1.32	2.26	0.20	10.54	5.2	0.10	5.56	4.8	23.0
10/08/75	u 1.32	0.66	0.03	10.57	2.7	0.01	5.57	1.6	23.3
10/15/75	u 1.32	0.79	0.03	10.60	0.0	0.00	5.57	1.0	22.5
10/22/75	u 1.32	4.57	0.25	10.85	1.4	0.03	5.60	5.8	21.0
10/29/75	u 1.32	2.26	0.23	11.08	4.1	0.09	5.69	6.0	18.0
11/04/75	u 1.32	0.13	0.05	11.13	3.9	0.02	5.71	3.2	19.7
11/12/75	u 1.08	0.36	0.00	11.13	-	0.00	5.71	-	-
11/19/75	u 1.08	0.56	0.00	11.13	-	0.00	5.71	-	-
11/25/75	u 1.08	2.39	0.00	11.13	-	0.00	5.71	-	-
12/03/75	u 1.08	0.66	0.08	0.08	0.0	0.00	0.00	0.0	21.4
12/10/75	u 1.08	4.27	0.99	1.07	1.6	0.16	0.16	4.6	23.0
12/17/75	u 1.08	0.51	0.97	2.04	3.4	0.32	0.48	4.0	21.9
12/23/75	u 1.08	0.99	0.61	2.65	4.2	0.26	0.74	-	-
12/30/75	u 1.08	4.11	1.70	4.35	5.0	0.85	1.59	6.2	24.3
01/06/76	u 1.08	3.15	2.67	7.02	-	1.65 g	3.24	6.2	g 22.7
01/14/76	u 1.08	2.16	1.42	8.44	5.2	0.74	3.98	5.7	25.1
01/21/76	u 1.08	2.18	0.94	9.38	5.9	0.55	4.53	5.4	25.0
01/28/76	u 1.08	3.86	1.30	10.68	6.0	0.78	5.31	6.4	19.6
02/04/76*	u 1.08	3.30	0.38	11.06	3.0	0.11	5.42	1.9	15.0

Appendix Table 3, Cont'd. Field D - Tidewater Research Station at Plymouth.

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
06/03/75	-	0.00	3.22	0.00	-	0.19	0.13	-	-
06/11/75	-	1.69	-	0.00	0.05	-	0.00	-	-
06/18/75	1.1	3.56	5.25	0.00	0.24	0.45	0.00	-	-
06/25/75	-	-	-	-	-	-	-	-	-
07/01/75	-	-	-	-	-	-	-	-	-
07/09/75	-	-	-	-	-	-	-	-	-
07/15/75	-	1.49	1.95	0.06	-	0.00	0.00	-	-
07/23/75	-	1.80	0.60	0.04	0.00	0.00	0.00	-	-
07/29/75	<.1	0.60	1.80	0.01	0.00	0.40	1.03	-	14.5
08/06/75	-	0.40	0.50	0.00	0.30	0.70	0.13	-	-
08/13/75	-	-	-	-	-	-	-	-	-
08/20/75	-	-	-	-	-	-	-	-	-
08/27/75	-	-	-	-	-	-	-	-	-
09/03/75	-	-	-	-	-	-	-	-	-
09/10/75	-	-	-	-	-	-	-	-	-
09/17/75	-	5.60	2.20	0.00	0.70	0.10	0.00	-	-
09/24/75	0.7	2.90	1.50	0.04	0.90	0.00	1.21	21.1	22.0
10/01/75	-	3.20	3.20	0.07	0.10	0.17	0.19	10.6	10.2
10/08/75	-	-	2.41	0.01	0.07	0.31	0.00	-	-
10/15/75	-	-	1.34	0.00	0.04	0.04	0.00	-	-
10/22/75	<.1	-	0.69	0.02	0.14	0.15	0.37	-	-
10/29/75	-	-	0.69	0.01	0.26	0.16	0.60	4.9	4.3
11/04/75	-	-	1.31	0.00	0.08	0.02	0.04	-	-
11/12/75	-	-	-	-	-	-	-	-	-
11/19/75	-	-	-	-	-	-	-	-	-
11/25/75	-	-	-	-	-	-	-	-	-
12/03/75	-	-	2.68	0.02	0.02	0.05	0.00	-	-
12/10/75	<.1	0.62	0.94	0.07	0.00	0.02	0.00	5.2	5.3
12/17/75	-	-	0.88	0.09	0.01	0.00	0.09	-	-
12/23/75	-	-	-	-	-	-	-	-	-
12/30/75	-	-	0.06	0.01	0.07	0.01	1.16	-	-
01/06/76	-	-	0.23	0.06	-	0.00	0.00	-	-
01/14/76	<.1	1.02	1.11	0.15	0.10	0.04	1.44	5.2	5.3
01/21/76	-	-	0.83	0.08	0.14	0.57	1.31	-	-
01/28/76	-	-	0.64	0.08	0.09	0.05	1.16	-	-
02/04/76	-	0.13	0.78	0.00	0.03	0.01	0.09	-	-

FIELD D - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
02/11/76*	u 1.08	0.15	1.73	12.79	7.5	1.30	6.72	5.0	11.3
02/19/76*	u 1.08	0.94	0.79	13.58	-	0.08 g	6.80	1.0	g 24.4
02/25/76*	u 1.08	0.36	0.41	13.99	0.8	0.03	6.83	0.7	g 12.5
03/02/76*	u 1.08	0.00	0.20	14.19	0.3	0.01	6.84	0.3	12.4
03/08/76*	u 1.08	1.65	0.15	14.34	0.4	0.01	6.85	0.7	13.5
03/16/76	u 1.08	4.37	0.58	14.92	3.7	0.21	7.06	4.0	14.6
03/24/76	u 1.08	0.25	0.46	15.38	5.2	0.24	7.30	5.6	17.4
04/01/76	u 1.08	3.43	0.13	15.51	3.6	0.04	7.34	3.1	18.5
04/07/76	u 1.08	0.20	0.08	15.59	2.1	0.01	7.35	1.7	16.6
04/14/76	u 1.08	0.76	0.08	15.67	1.3	0.01	7.36	1.1	19.5
04/21/76	u 1.08	0.00	0.03	15.70	1.2	0.00	7.36	0.0	19.0
04/28/76	u 1.08	1.52	0.00	15.70	-	0.00	7.36	-	-
05/04/76	u 1.08	1.93	0.00	15.70	-	0.00	7.36	0.1	g 19.9
05/11/76	u 1.08	1.37	0.00	15.70	0.3	0.00	7.36	0.0	g 19.2
05/17/76	u 1.08	4.24	0.33	16.03	1.9	0.07	7.43	4.8	20.0
05/24/76	u 1.08	0.91	0.48	16.51	3.8	0.18	7.61	-	-
06/02/76	u 1.08	10.24	2.34	18.85	5.6	1.31	8.92	11.2	19.3
06/09/76	u 1.08	3.61	2.38	21.23	9.5	2.26	11.18	12.5	21.7
06/16/76	u 1.08	1.42	0.08	21.31	8.1	0.06	11.24	6.4	20.5
06/23/76	u 1.08	9.96	1.63	22.94	10.5	1.70	12.94	14.0	20.5
06/30/76	u 1.08	0.28	0.79	23.73	13.2	1.02	13.96	10.2	20.0
07/08/76	u 1.08	7.51	2.54	26.27	12.4	3.14	17.10	11.1	16.3
07/14/76	u 1.08	0.23	0.33	26.60	10.0	0.34	17.44	7.0	17.1
07/21/76	u 1.08	0.81	0.00	26.60	6.7	0.01	17.45	-	-
07/28/76	u 1.08	8.66	1.63	28.23	-	1.23 g	18.68	7.6	g 16.2
08/02/76	u 1.08	1.14	0.08	28.31	3.4	0.02	18.70	3.0	16.3
08/10/76	u 1.08	2.71	0.00	28.31	3.8	0.00	18.70	0.3	17.6
08/17/76	u 1.08	2.13	0.25	28.56	-	0.02 g	18.72	0.9	g 16.4
08/24/76	u 1.08	0.28	0.00	28.56	-	0.00	18.72	-	-
08/31/76	u 1.08	0.00	0.00	28.56	-	0.00	18.72	-	-
09/07/76	u 1.08	1.09	0.00	28.56	-	0.00	18.72	-	-
09/13/76	u 1.08	2.95	0.51	29.07	3.8	0.20	18.92	-	-
09/21/76*	u 1.08	6.68	1.34	30.41	3.8	0.52	19.44	3.6	34.8
09/28/76	u 1.08	0.64	0.33	30.74	0.4	0.01	19.45	-	98.8
10/05/76	u 1.08	2.74	0.28	31.02	5.8	0.16	19.61	5.8	37.8
10/12/76	u 1.08	1.50	0.46	31.48	3.0	0.13	19.74	3.0	72.4
10/19/76	u 1.08	0.86	0.05	31.53	-	0.00 g	19.74	0.9	g 65.6
10/26/76	u 1.08	2.44	0.10	31.63	5.4	0.04	19.78	-	25.7

Appendix Table 3, Cont'd. Field D - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
02/11/76	<.1	0.48	0.50	0.08	0.07	0.07	1.21	6.3	2.8
02/19/76	-	-	0.55	0.04	-	-	-	-	-
02/25/76	-	-	0.42	0.02	0.09	0.02	0.37	-	-
03/02/76	-	0.42	0.59	0.01	0.05	0.06	0.09	-	-
03/08/76	-	0.44	0.94	0.01	0.03	0.04	0.04	-	-
03/16/76	<.1	0.51	0.70	0.03	0.07	0.08	0.43	7.0	4.2
03/24/76	-	0.45	0.66	0.02	0.06	0.06	0.28	-	-
04/01/76	-	0.64	0.81	0.01	0.01	0.02	0.00	-	-
04/07/76	<.1	0.65	0.92	0.00	0.02	0.03	0.00	4.2	6.6
04/14/76	g<.1	0.45	0.90	0.03	0.01	0.01	0.00	-	-
04/21/76	<.1	0.77	1.04	0.00	0.01	0.01	0.00	-	-
04/28/76	-	-	-	-	-	-	-	-	-
05/04/76	g<.1	-	0.60	0.00	-	0.04	0.00	-	-
05/11/76	g<.1	-	0.53	0.00	-	0.02	0.00	-	-
05/17/76	<.1	0.60	0.50	0.02	0.09	0.03	0.28	-	-
05/24/76	-	-	-	-	-	-	-	-	-
06/02/76	<.1	0.45	0.00	0.10	0.04	0.36	0.93	5.1	4.4
06/09/76	<.1	1.67	0.00	0.39	0.11	0.02	2.61	-	-
06/16/76	-	2.53	0.56	0.01	0.13	0.10	0.09	-	-
06/23/76	-	2.39	0.00	0.39	0.12	0.02	1.96	-	-
06/30/76	<.1	0.07	0.48	0.00	0.15	0.02	1.16	7.4	7.0
07/08/76	-	0.27	0.29	0.07	0.02	0.03	0.52	-	-
07/14/76	-	0.20	0.66	0.00	0.02	0.04	0.04	-	-
07/21/76	-	-	-	-	-	-	-	-	-
07/28/76	-	-	0.90	0.15	-	0.05	0.80	-	-
08/02/76	0.2	0.74	0.88	0.00	0.07	0.04	0.04	4.5	6.2
08/10/76	-	1.12	0.81	0.00	0.02	0.04	0.00	-	-
08/17/76	-	-	0.90	0.02	-	0.04	0.09	-	-
08/24/76	-	-	-	-	-	-	-	-	-
08/31/76	-	-	-	-	-	-	-	-	-
09/07/76	-	-	-	-	-	-	-	-	-
09/13/76	-	-	-	-	-	-	-	-	-
09/21/76	-	1.04	1.09	0.14	0.01	0.02	0.13	-	-
09/28/76	-	0.90	-	0.02	0.04	-	0.13	-	-
10/05/76	0.1	0.22	0.67	0.00	0.01	0.01	0.04	2.2	3.9
10/12/76	-	0.76	-	0.03	0.01	0.03	0.04	-	-
10/19/76	-	-	1.20	0.00	-	0.03	0.00	-	-
10/26/76	-	0.42	-	0.00	0.03	-	0.04	-	-

FIELD D - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
11/02/76	u 1.08	1.07	0.00	31.63	2.9	0.00	19.78	-	45.1
11/09/76	u 1.08	0.05	0.00	31.63	-	0.00	19.78	-	-
11/19/76	u 1.08	4.11	0.23	31.86	-	0.22 g	20.00	9.6	g 19.3
11/22/76	u 1.08	0.00	0.46	32.32	9.3	0.43	20.34	8.4	20.6
11/30/76	u 1.08	2.49	0.15	32.47	8.2	0.02	20.36	8.1	21.0
12/07/76	u 1.08	1.27	0.15	0.15	7.8	0.11	0.11	8.0	20.3
12/15/76	u 1.08	4.03	1.65	1.80	10.0	1.64	1.75	10.8	20.7
12/21/76	u 1.08	2.69	2.95	4.75	10.4	9.41	11.16	6.3	17.9
12/29/76	c 0.30	1.90	0.00	4.75	-	0.00 g	11.16	10.2	g 18.4
01/04/77	c 0.30	0.81	0.00	4.75	-	0.00 g	11.16	10.0	g 20.2
01/11/77	c 0.30	5.97	0.71	5.46	10.0	0.72	11.88	8.8	34.2
01/19/77	u 1.08	1.55	3.89	9.35	7.4	2.92	14.80	2.8	17.3
01/26/77	u 1.08	0.91	1.02	10.37	0.8	0.08	14.88	0.6	11.9
02/02/77	u 1.08	0.00	0.66	11.03	0.8	0.06	14.94	0.3	15.3
02/09/77	c 0.30	0.00	0.00	11.03	-	0.00	14.94	-	-
02/16/77	c 0.30	4.06	0.00	11.03	-	0.00	14.94	-	-
02/24/77	c 0.30	2.51	0.00	11.03	-	0.00	14.94	-	-
03/02/77	c 0.30	1.47	0.00	11.03	-	0.00	14.94	-	-

Appendix Table 3, Cont'd. Field D - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
11/02/76	0.4	-	3.22	0.00	0.10	-	0.00	11.2	-
11/09/76	-	-	-	-	-	-	-	-	-
11/16/76	-	-	6.55	0.16	-	0.05	0.09	-	-
11/22/76	-	0.73	0.00	0.03	0.03	0.07	0.13	-	-
11/30/76	<.1	0.20	0.00	0.00	0.01	0.02	0.00	2.8	4.1
12/07/76	-	0.08	0.06	0.00	0.03	0.02	0.04	-	-
12/15/76	-	0.06	0.08	0.01	0.02	0.02	0.32	-	-
12/21/76	-	0.42	0.50	0.54	0.02	0.02	1.81	-	-
12/29/76	-	-	0.00	0.00	-	0.06	0.00	-	-
01/04/77	g<.1	-	0.03	0.00	-	0.02	0.00	-	2.0
01/11/77	<.1	1.12	2.10	0.08	0.16	0.13	1.12	-	-
01/19/77	0.2	0.14	0.98	0.06	0.08	-	3.17	-	-
01/26/77	<.1	0.42	0.28	0.04	0.06	0.08	0.60	-	-
02/02/77	<.1	1.20	0.64	0.08	0.04	0.04	0.28	5.9	2.8
02/09/77	-	-	-	-	-	-	-	-	-
02/16/77	-	-	-	-	-	-	-	-	-
02/24/77	-	-	-	-	-	-	-	-	-
03/02/77	-	-	-	-	-	-	-	-	-

* Indicates some problem with flow measurement during this period.

11/12/74 to 12/04/74 - Ditch was used for irrigation so no flow measurement.
02/22/75 to 04/30/75 - Leak, flow estimated.
06/25/75 to 08/06/75 - Irrigation.
02/04/76 to 03/08/76 - Leak into ditch from other land area.
09/15/76 - Large rain - weir submerged.

FIELD E - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
12/28/73	u 1.35	3.60	2.21	2.21	7.3	1.62	1.62	5.5	g 17.8
01/09/74	u 1.35	6.68	3.86	6.07	5.8	2.23	3.85	7.8	g 15.4
01/17/74	u 1.35	0.00	1.40	7.47	7.3	1.03	4.88	6.0	g 16.9
01/23/74	u 1.35	2.43	0.91	8.38	7.5	0.68	5.56	7.1	g 15.4
01/31/74	u 1.35	4.09	2.82	11.20	8.4	2.37	7.93	7.8	g 15.7
02/06/74	u 1.35	3.94	3.00	14.20	8.5	2.55	10.48	7.3	g 15.5
02/14/74	u 1.35	1.22	1.27	15.47	-	0.76 g	11.24	6.0	g 16.6
02/21/74	u 1.35	5.46	3.12	18.59	7.0	2.18	13.42	6.1	g 11.2
02/27/74	u 1.35	0.84	1.12	19.71	-	0.71 g	14.13	6.3	g 15.0
03/06/74	u 1.35	0.00	0.41	20.12	7.2	0.29	14.42	3.6	g 14.3
03/13/74	u 1.35	1.35	0.23	20.35	4.4	0.10	14.52	3.0	g 17.4
03/19/74	u 1.35	3.63	1.04	21.39	3.6	0.38	14.90	6.1	g 14.6
03/27/74	u 1.35	5.23	2.01	23.40	7.0	1.41	16.31	8.0	g 13.9
04/02/74	u 1.35	3.28	2.97	26.37	11.2	3.30	19.61	7.1	g 14.5
04/11/74	u 1.35	4.67	1.83	28.20	7.8	1.41	21.02	6.8	g 15.5
04/16/74	u 1.35	5.59	3.22	31.42	8.2	2.64	23.66	6.6	g 11.8
04/22/74	u 1.35	0.00	0.76	32.18	8.2	0.62	24.28	5.3	g 15.6
04/30/74	u 1.35	0.58	0.46	32.64	5.0	0.22	24.50	2.3	g 16.2
05/07/74	u 1.35	3.43	0.38	33.02	4.2	0.17	24.67	5.4	g 17.9
05/15/74	u 1.35	1.73	0.48	33.50	5.4	0.26	24.93	3.8	g 15.6
05/22/74	u 1.35	2.26	0.41	33.91	4.0	0.16	25.09	4.4	g 16.0
05/30/74	u 1.35	8.13	3.50	37.41	6.6	2.32	27.41	7.7	g 14.3
06/06/74	u 1.35	3.18	1.17	38.58	10.2	1.20	28.61	7.2	g 15.1
06/13/74	u 1.25	0.81	0.20	38.78	8.4	0.18	28.79	6.6	g 18.3
06/19/74	u 1.25	0.08	0.05	38.83	-	0.00	28.79	2.4	g 22.4
06/26/74*	u 1.25	1.78	0.00	38.83	-	0.00	28.79	1.1	g 56.5
07/03/74*	u 1.25	2.89	0.00	38.83	-	0.00	28.79	1.0	g 47.4
07/10/74*	u 1.25	5.21	0.02	38.85	-	0.00	28.79	0.6	g 18.6
07/16/74*	u 1.25	0.02	0.00	38.85	-	0.00	28.79	-	-
07/24/74*	u 1.25	0.00	0.00	38.85	-	0.00	28.79	0.4	g 14.4
07/31/74*	u 1.25	9.09	0.00	38.85	-	0.00	28.79	-	-
08/07/74*	u 1.25	10.34	2.44	41.29	5.3	1.29	30.08	6.9	g 13.8
08/15/74	u 1.25	0.96	1.45	42.74	6.0	0.86	30.94	1.0	g 16.1
08/21/74	u 1.25	3.35	2.95	45.69	-	1.78 g	32.72	6.0	g 11.0
08/29/74	u 1.25	4.80	4.06	49.75	6.5	2.64	35.36	3.7	g 13.4
09/04/74	u 1.25	0.89	0.30	50.05	1.7	0.04	35.40	1.3	g 15.6
09/11/74	u 1.25	5.16	1.98	52.03	-	0.47 g	35.87	2.4	g 14.4
09/18/74	u 1.25	1.93	0.23	52.26	-	0.02 g	35.89	1.0	g 15.5

Appendix Table 3, Cont'd. Field E - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
12/28/73	g0.1	-	-	-	-	0.02	0.47	-	4.6
01/09/74	g<.1	-	-	-	-	0.02	0.75	-	-
01/17/74	-	-	-	-	-	-	-	-	-
01/23/74	-	-	-	-	-	-	-	-	-
01/31/74	-	-	-	-	-	-	-	-	-
02/06/74	g<.1	-	2.98	0.90	-	0.04	1.21	-	-
02/14/74	g<.1	-	-	-	-	-	-	-	-
02/21/74	-	-	2.61	0.82	-	0.03	0.93	-	-
02/27/74	-	-	-	-	-	-	-	-	-
03/06/74	-	-	0.91	0.03	-	0.04	1.25	-	-
03/13/74	g<.1	-	0.55	0.01	-	0.03	0.04	-	5.8
03/19/74	g<.1	-	2.01	0.21	-	0.03	0.32	-	3.9
03/27/74	g<.1	-	1.30	0.26	-	0.01	0.19	-	-
04/02/74	g<.1	-	1.55	0.46	-	0.03	0.88	-	-
04/11/74	g<.1	-	1.30	0.24	-	0.03	0.56	-	4.0
04/16/74	g<.1	-	0.98	0.31	-	0.02	0.65	-	4.8
04/22/74	g0.4	-	1.58	0.12	-	0.22	1.68	-	5.3
04/30/74	g0.1	-	1.74	0.08	-	0.05	0.23	-	8.2
05/07/74	g0.2	-	2.86	0.11	-	0.09	0.37	-	5.0
05/15/74	-	-	-	-	-	-	-	-	4.8
05/22/74	g<.1	-	0.78	0.03	-	0.06	0.23	-	6.0
05/30/74	g<.1	-	0.78	0.27	-	0.03	1.03	-	5.4
06/06/74	g<.1	-	1.90	0.22	-	0.19	2.24	-	6.0
06/13/74	g<.1	-	-	-	-	-	-	-	8.1
06/19/74	g<.1	-	1.90	0.01	-	0.06	0.04	-	10.7
06/26/74	-	-	3.49	0.00	-	0.25	0.00	-	-
07/03/74	-	-	-	-	-	-	-	-	-
07/10/74	-	-	-	-	-	-	-	-	-
07/16/74	-	-	-	-	-	-	-	-	-
07/24/74	-	-	-	-	-	-	-	-	-
07/31/74	-	-	-	-	-	-	-	-	-
08/07/74	g<.1	-	-	-	-	-	-	-	4.8
08/15/74	g<.1	-	-	-	-	-	-	-	3.8
08/21/74	g<.1	1.43	1.43	0.43	-	0.04	1.16	-	7.2
08/29/74	-	1.43	1.43	0.58	-	0.07	2.84	-	6.2
09/04/74	-	2.06	2.06	0.07	-	0.25	0.75	-	9.2
09/11/74	g<.1	-	2.21	0.44	-	0.09	1.77	-	3.8
09/18/74	g<.1	-	3.10	0.07	-	0.13	0.28	-	4.4

Appendix Table 3, Cont'd.

FIELD E - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
09/26/74	u 1.25	0.20	0.20	52.46	0.0	0.00	35.89	0.3	16.2
10/01/74	u 1.25	0.53	0.05	52.51	-	0.00 g	35.89	0.0	g 17.8
10/08/74	u 1.25	0.13	0.02	52.53	0.0	0.00	35.89	0.0	18.7
10/16/74	u 1.25	1.83	0.00	52.53	0.3	0.00	35.89	1.1	19.4
10/23/74	u 1.25	3.38	0.43	52.96	1.7	0.07	35.96	2.5	12.3
10/31/74	u 1.25	0.00	0.10	53.06	1.3	0.01	35.97	0.6	14.2
11/06/74	u 1.25	0.00	0.05	53.11	0.0	0.00	35.97	0.0	16.3
11/12/74	u 1.25	0.38	0.02	53.13	0.0	0.00	35.97	0.0	78.9
11/20/74	u 0.95	2.29	0.00	53.13	-	0.00	35.97	-	-
11/26/74	u 0.95	0.86	0.00	53.13	-	0.00	35.97	-	-
12/04/74	u 0.95	2.13	0.02	0.02	0.0	0.00	0.00	1.4	g 45.4
12/11/74	u 0.95	1.37	0.18	0.20	2.0	0.03	0.03	2.2	26.6
12/19/74	u 0.95	0.61	0.10	0.30	2.3	0.02	0.05	2.1	17.3
12/27/74	u 0.95	2.26	0.81	1.11	2.3	0.19	0.24	4.9	16.4
01/03/75	u 0.95	2.01	0.86	1.97	5.7	0.49	0.73	5.4	15.2
01/08/75	u 0.95	1.80	0.79	2.76	4.9	0.38	1.11	5.4	14.0
01/15/75	u 0.95	5.92	4.83	7.59	7.1	3.43	4.54	9.4	13.2
01/22/75	u 0.95	2.08	1.88	9.47	8.2	1.54	6.08	9.2	14.4
01/29/75	u 0.95	2.54	2.01	11.48	8.2	1.66	7.74	9.4	14.7
02/06/75	u 0.95	2.67	1.62	13.10	6.2	1.01	8.75	7.0	14.7
02/12/75	u 0.95	0.08	1.40	14.50	6.8	0.95	9.70	6.3	15.8
02/20/75	u 0.95	5.51	3.00	17.50	6.7	2.00	11.70	7.8	16.7
02/26/75	u 0.95	1.88	1.52	19.02	7.0	1.06	12.76	7.0	15.8
03/06/75	u 0.95	0.71	0.71	19.73	6.7	0.47	13.23	6.3	16.3
03/14/75	u 0.95	2.74	0.18	19.91	6.1	0.11	13.34	5.1	16.1
03/21/75	u 0.95	7.54	7.57	27.48	6.3	4.76	18.10	6.3	13.2
03/28/75	u 0.95	0.78	1.07	28.55	7.2	0.76	18.86	7.5	15.7
04/04/75	u 0.95	1.44	0.23	28.78	6.8	0.16	19.02	4.8	16.6
04/10/75	u 0.95	0.71	0.02	28.80	3.9	0.01	19.03	3.3	16.9
04/17/75	u 0.95	8.13	3.00	31.80	5.0	1.50	20.53	7.6	15.8
04/23/75	u 0.95	0.51	0.91	32.71	7.6	0.70	21.23	6.1	17.5
04/30/75	u 0.95	0.43	0.30	33.01	5.4	0.17	21.40	5.4	17.7
05/07/75	u 0.95	1.29	0.18	33.19	3.4	0.06	21.46	2.8	16.7
05/15/75	u 0.95	0.20	0.13	33.32	1.6	0.02	21.48	0.7	17.7
05/22/75	u 0.95	1.37	0.02	33.34	0.8	0.00	21.48	-	16.8
05/27/75	u 0.95	3.02	0.02	33.36	0.5	0.00	21.48	1.0	33.6

Appendix Table 3, Cont'd. Field E - Ticewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
09/26/74	g<.1	-	4.00	0.08	-	0.17	0.37	6.6	6.2
10/01/74	g<.1	-	3.33	0.02	-	0.06	0.04	-	4.6
10/08/74	<.1	0.78	1.90	0.00	0.03	0.06	0.00	5.2	5.0
10/16/74	<.1	0.95	1.58	0.00	0.06	0.19	0.00	6.2	5.3
10/23/74	<.1	2.21	0.63	0.09	0.06	0.08	0.24	5.8	2.6
10/31/74	<.1	-	-	-	-	-	-	5.5	5.9
11/06/74	<.1	-	-	-	-	-	-	-	-
11/12/74	0.1	-	-	-	0.02	0.08	0.00	7.4	7.0
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	<.1	1.11	3.18	0.00	0.20	0.07	0.09	15.2	8.8
12/11/74	<.1	0.78	0.63	0.01	0.04	0.02	0.04	7.4	6.6
12/19/74	<.1	0.00	0.00	0.00	0.02	0.01	0.00	7.1	5.3
12/27/74	<.1	-	-	-	-	-	-	5.0	5.0
01/03/75	<.1	0.00	0.10	0.00	0.02	0.02	0.19	5.1	4.4
01/08/75	<.1	0.10	0.00	0.01	0.01	0.02	0.09	4.7	5.8
01/15/75	<.1	0.30	0.60	0.15	0.03	0.05	1.44	2.4	4.4
01/22/75	<.1	0.40	0.60	0.08	0.02	0.01	0.37	-	-
01/29/75	<.1	1.55	1.25	0.31	0.02	0.04	0.43	3.4	3.6
02/06/75	-	1.25	1.35	0.20	0.03	0.01	0.47	-	-
02/12/75	-	1.85	0.75	0.26	0.02	0.02	0.28	-	-
02/20/75	<.1	1.65	1.25	0.49	-	0.02	0.60	4.2	5.0
02/26/75	-	0.45	1.75	0.07	0.08	0.04	1.21	-	-
03/06/75	<.1	-	-	-	-	-	-	3.3	3.8
03/14/75	-	0.70	1.60	0.01	-	0.09	0.19	-	-
03/21/75	<.1	0.70	7.40	0.53	-	0.50	37.80	7.8	7.4
03/28/75	<.1	2.00	0.00	0.21	-	0.04	0.43	5.0	4.5
04/04/75	-	2.00	1.70	0.04	-	0.04	0.09	-	-
04/10/75	-	2.00	1.70	0.00	0.05	0.10	0.00	-	-
04/17/75	-	1.10	0.70	0.32	0.15	0.05	4.48	-	-
04/23/75	-	0.40	0.40	0.03	0.04	0.04	0.37	-	-
04/30/75	0.1	1.69	0.68	0.06	0.04	0.14	0.13	7.7	5.1
05/07/75	-	0.34	1.02	0.00	0.16	0.12	0.28	-	-
05/15/75	-	-	1.36	0.02	0.26	0.16	0.32	-	-
05/22/75	-	0.17	-	0.00	0.06	-	0.00	9.0	7.4
05/27/75	<.1	0.00	1.10	0.00	0.10	0.11	0.00	0.0	1.1

FIELD E - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
06/03/75	c 0.43	1.68	0.00	33.36	-	0.00	21.48	-	-
06/11/75	c 0.43	0.00	0.00	33.36	-	0.00	21.48	-	-
06/18/75	c 0.43	1.35	0.00	33.36	-	0.00	21.48	-	-
06/23/75	c 0.43	0.00	0.00	33.36	-	0.00	21.48	-	-
07/02/75	c 0.43	3.99	0.00	33.36	-	0.00	21.48	-	-
07/09/75	c 0.43	5.13	0.00	33.36	-	0.00	21.48	-	-
07/15/75	c 0.43	11.56	1.50	34.86	0.5	0.08	21.56	-	-
07/23/75	c 0.43	8.61	5.28	40.14	0.5	0.27	21.83	-	
07/30/75	c 0.43	3.50	2.29	42.43	0.5	0.11	21.94	-	-
08/06/75	c 0.43	0.00	0.00	42.43	-	0.00	21.94	-	-
08/13/75	c 0.43	0.84	0.00	42.43	-	0.00	21.94	-	-
08/20/75	c 0.43	0.00	0.00	42.43	-	0.00	21.94	-	-
08/27/75	c 0.43	0.00	0.00	42.43	-	0.00	21.94	-	-
09/03/75	c 0.43	2.44	0.00	42.43	-	0.00	21.94	-	-
09/10/75	c 0.43	4.95	0.00	42.43	-	0.00	21.94	-	-
09/17/75	c 0.43	2.79	0.02	42.45	-	0.00	21.94	0.4	g 99.8
09/24/75	c 0.43	5.18	0.05	42.50	-	0.00	21.94	0.7	g 57.9
10/01/75	c 0.43	2.26	0.36	42.86	-	0.03 g	21.97	1.0	g 117.6
10/08/75	c 0.43	0.66	0.00	42.86	-	0.00	21.97	0.0	g 129.9
10/15/75	c 0.43	0.79	0.00	42.86	-	0.00	21.97	-	-
10/22/75	c 0.43	4.57	0.15	43.01	-	0.00	21.97	-	-
10/29/75	c 0.43	2.26	0.46	43.47	-	0.00	21.97	-	-
11/04/75	c 0.43	0.13	0.00	43.47	-	0.00	21.97	-	-
11/12/75	c 0.43	0.36	0.00	43.47	-	0.00	21.97	-	-
11/19/75	c 0.43	0.56	0.00	43.47	-	0.00	21.97	-	-
11/26/75	c 0.43	2.39	0.00	43.47	-	0.00	21.97	-	-
12/03/75	c 0.43	0.66	0.00	0.00	-	0.00	0.00	-	-
12/10/75	c 0.43	4.27	0.00	0.00	-	0.00	0.00	-	-
12/17/75	c 0.43	0.51	0.00	0.00	-	0.00	0.00	7.7	g 27.1
12/23/75	c 0.43	0.99	-	-	-	-	-	-	-
12/30/75	c 0.43	4.11	0.00	0.00	-	0.00	0.00	6.2	g 29.7
01/06/76	c 0.74	3.15	0.00	0.00	-	0.00	0.00	15.5	g 30.5
01/14/76	c 0.74	2.16	0.48	0.48	16.2	0.80	0.80	11.8	29.6
01/21/76	c 0.74	2.18	0.36	0.84	12.5	0.44	1.24	12.5	25.2
01/28/76	c 0.74	3.86	0.53	1.37	10.7	0.58	1.82	10.7	23.1
02/04/76	c 0.74	3.30	1.73	3.10	-	1.76 g	3.58	10.2	22.0
02/11/76	c 0.74	0.15	0.33	3.43	11.5	0.39	3.97	12.4	23.5

Appendix Table 3, Cont'd. Field E - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
06/03/75	-	-	-	-	-	-	-	-	-
06/11/75	-	-	-	-	-	-	-	-	-
06/18/75	-	-	-	-	-	-	-	-	-
06/23/75	-	-	-	-	-	-	-	-	-
07/02/75	-	-	-	-	-	-	-	-	-
07/09/75	-	-	-	-	-	-	-	-	-
07/15/75	-	-	-	-	-	-	-	-	-
07/23/75	-	-	-	-	-	-	-	-	-
07/30/75	-	-	-	-	-	-	-	-	-
08/06/75	-	-	-	-	-	-	-	-	-
08/13/75	-	-	-	-	-	-	-	-	-
08/20/75	-	-	-	-	-	-	-	-	-
08/27/75	-	-	-	-	-	-	-	-	-
09/03/75	-	-	-	-	-	-	-	-	-
09/10/75	-	-	-	-	-	-	-	-	-
09/17/75	-	-	0.80	0.00	-	0.50	0.13	-	-
09/24/75	g0.3	-	2.40	0.01	-	-	-	-	25.3
10/01/75	-	-	2.40	0.09	-	0.25	0.88	-	14.3
10/08/75	-	-	0.86	0.00	-	0.22	0.00	-	-
10/15/75	-	-	-	-	-	-	-	-	-
10/22/75	-	-	-	-	-	-	-	-	-
10/29/75	-	-	-	-	-	-	-	-	-
11/04/75	-	-	-	-	-	-	-	-	-
11/12/75	-	-	-	-	-	-	-	-	-
11/19/75	-	-	-	-	-	-	-	-	-
11/26/75	-	-	-	-	-	-	-	-	-
12/03/75	-	-	-	-	-	-	-	-	-
12/10/75	-	-	-	-	-	-	-	-	-
12/17/75	-	-	0.09	0.00	-	0.05	0.00	-	-
12/23/75	-	-	-	-	-	-	-	-	-
12/30/75	-	-	0.15	0.00	-	0.04	0.00	-	-
01/06/76	-	-	0.19	0.00	-	0.01	0.00	-	-
01/14/76	0.2	0.05	0.00	0.00	0.12	0.05	0.60	7.0	4.5
01/21/76	-	-	-	-	0.03	0.02	0.09	-	-
01/28/76	-	-	0.09	0.00	0.34	0.09	1.87	-	-
02/04/76	-	-	0.04	0.01	0.04	0.02	0.69	-	-
02/11/76	<.1	0.00	0.00	0.00	0.02	0.02	0.04	4.2	3.0

Appendix Table 3, Cont'd.

FIELD E - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
02/19/76	c 0.74	0.94	0.00	3.43	-	0.00 g	3.97	10.2	g 24.4
02/25/76	c 0.74	0.36	0.00	3.43	-	0.00	3.97	12.4	-
03/02/76	c 0.74	0.00	0.00	3.43	-	0.00	3.97	10.2	-
03/08/76	c 0.74	1.65	0.00	3.43	-	0.00	3.97	-	-
03/16/76	c 0.74	4.37	0.00	3.43	-	0.00	3.97	-	-
03/24/76	c 0.74	0.25	0.00	3.43	-	0.00	3.97	-	-
04/01/76	c 0.74	3.43	0.00	3.43	-	0.00	3.97	-	-
04/07/76	c 0.74	0.20	0.00	3.43	-	0.00	3.97	-	-
04/14/76	c 0.74	0.76	0.00	3.43	-	0.00	3.97	-	-
04/21/76*	c 0.74	0.00	0.00	3.43	-	0.00	3.97	-	-
04/28/76*	c 0.74	1.52	0.00	3.43	-	0.00	3.97	-	-
05/04/76*	c 0.74	1.93	0.00	3.43	-	0.00	3.97	-	-
05/11/76*	c 0.74	1.37	0.00	3.43	-	0.00	3.97	-	-
05/17/76*	c 0.74	4.24	0.00	3.43	-	0.00	3.97	-	-
05/24/76*	c 0.74	0.91	0.00	3.43	-	0.00	3.97	-	-
06/02/76*	c 0.74	10.24	0.00	3.43	-	0.00	3.97	-	-
06/09/76*	c 0.74	3.61	0.00	3.43	-	0.00	3.97	-	-
06/16/76*	c 0.74	1.42	0.00	3.43	-	0.00	3.97	-	-
06/23/76*	c 0.74	9.96	0.02	3.45	4.9	0.01	3.98	-	21.2
06/30/76*	c 0.74	0.28	0.00	3.45	-	0.00	3.98	-	-
07/08/76*	c 0.74	7.51	0.15	3.60	3.8	0.07	4.05	-	21.5
07/14/76*	c 0.74	0.23	0.00	3.60	-	0.00	4.05	-	-
07/21/76*	c 0.74	0.81	0.00	3.60	-	0.00	4.05	-	-
07/28/76*	c 0.74	8.66	0.00	3.60	-	0.00	4.05	-	-
08/02/76*	c 0.74	1.14	0.00	3.60	-	0.00	4.05	-	-
08/10/76*	c 0.74	2.71	0.00	3.60	-	0.00	4.05	-	-
08/17/76*	c 0.74	2.13	0.00	3.60	-	0.00	4.05	-	-
08/24/76*	c 0.74	0.28	0.00	3.60	-	0.00	4.05	-	-
08/31/76*	u 0.74	0.00	0.00	3.60	-	0.00	4.05	-	-
09/07/76*	u 0.74	1.09	0.00	3.60	-	0.00	4.05	-	-
09/13/76*	u 0.74	2.95	0.00	3.60	-	0.00	4.05	-	-
09/21/76*	u 0.74	6.68	0.00	3.60	-	0.00	4.05	-	-
09/28/76*	u 0.74	0.64	0.00	3.60	-	0.00	4.05	-	-
10/05/76*	u 0.74	2.74	0.00	3.60	-	0.00	4.05	-	-
10/12/76*	u 0.74	1.50	0.00	3.60	-	0.00	4.05	-	-
10/19/76*	u 0.74	0.86	0.00	3.60	-	0.00	4.05	-	g117.9
10/26/76	u 1.17	2.44	0.38	3.98	2.8	0.11	4.16	2.5	45.8

Appendix Table 3, Cont'd. Field E - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N	Organic + NH_4-N			Total P			C	
	Conc. comp. ppm	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha 10^{-2}	Conc. comp. ppm	Conc. grab ppm
02/19/76	-	0.00	-	0.00	-	0.02	0.00	-	-
02/25/76	-	-	-	-	-	-	-	-	-
03/02/76	-	-	-	-	-	-	-	-	-
03/08/76	-	-	-	-	-	-	-	-	-
03/16/76	-	-	-	-	-	-	-	-	-
03/24/76	-	-	-	-	-	-	-	-	-
04/01/76	-	-	-	-	-	-	-	-	-
04/07/76	-	-	-	-	-	-	-	-	-
04/14/76	-	-	-	-	-	-	-	-	-
04/21/76	-	-	-	-	-	-	-	-	-
04/28/76	-	-	-	-	-	-	-	-	-
05/04/76	-	-	-	-	-	-	-	-	-
05/11/76	-	-	-	-	-	-	-	-	-
05/17/76	-	-	-	-	-	-	-	-	-
05/24/76	-	-	-	-	-	-	-	-	-
06/02/76	-	-	-	-	-	-	-	-	-
06/09/76	-	-	-	-	-	-	-	-	-
06/16/76	-	-	-	-	-	-	-	-	-
06/23/76	-	0.92	-	0.00	0.05	-	0.00	-	-
06/30/76	-	-	-	-	-	-	-	-	-
07/08/76	-	0.95	-	0.01	0.03	-	0.04	-	-
07/14/76	-	-	-	-	-	-	-	-	-
07/21/76	-	-	-	-	-	-	-	-	-
07/28/76	-	-	-	-	-	-	-	-	-
08/02/76	-	-	-	-	-	-	-	-	-
08/10/76	-	-	-	-	-	-	-	-	-
08/17/76	-	-	-	-	-	-	-	-	-
08/24/76	-	-	-	-	-	-	-	-	-
08/31/76	-	-	-	-	-	-	-	-	-
09/07/76	-	-	-	-	-	-	-	-	-
09/13/76	-	-	-	-	-	-	-	-	-
09/21/76	-	-	-	-	-	-	-	-	-
09/28/76	-	-	-	-	-	-	-	-	-
10/05/76	-	-	-	-	-	-	-	-	-
10/12/76	-	-	-	-	-	-	-	-	-
10/19/76	-	-	0.78	0.00	-	0.03	0.00	-	-
10/26/76	-	1.06	1.06	0.04	0.02	0.08	0.09	-	-

FIELD E - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
11/02/76	u 1.17	1.07	0.10	4.08	-	0.01 g	4.17	1.5	g 31.4
11/09/76	u 1.17	0.05	0.02	4.10	1.3	0.00	4.17	1.1	31.5
11/16/76	u 1.17	4.11	0.33	4.43	0.9	0.02	4.19	3.4	31.6
11/22/76	u 1.17	0.00	0.64	5.07	3.0	0.19	4.38	2.6	27.8
11/30/76	u 1.17	2.49	0.68	5.75	2.4	0.17	4.55	3.1	27.9
12/07/76	u 1.17	1.27	0.64	0.64	2.6	0.17	0.17	2.4	25.6
12/15/76	u 1.17	4.03	1.98	2.62	3.8	0.75	0.92	5.2	22.5
12/20/76	u 1.17	2.69	1.60	4.22	5.2	0.83	1.75	5.8	18.2
12/29/76	c 0.38	1.90	0.00	4.22	-	0.00	1.75	2.7	g 17.5
01/04/77	c 0.38	0.81	0.00	4.22	-	0.00	1.75	2.4	g 19.0
01/11/77	c 0.38	5.97	0.05	4.27	3.8	0.01	1.76	5.8	20.8
01/19/77	u 1.17	1.55	2.95	7.22	7.4	2.18	3.94	5.2	22.2
01/26/77	u 1.17	0.91	0.20	7.42	3.2	0.07	4.01	2.8	17.6
02/02/77	u 1.17	0.00	0.20	7.62	3.0	0.07	4.08	5.9	17.9
02/07/77	c 0.38	0.00	0.00	7.62	-	0.00	4.08	-	-
02/16/77	c 0.38	4.06	0.00	7.62	-	0.00	4.08	-	-
02/24/77	c 0.38	2.51	0.00	7.62	-	0.00	4.08	-	-
03/02/77	c 0.38	1.47	0.00	7.62	-	0.00	4.08	-	-

Appendix Table 3, Cont'd. Field E - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
11/02/76	g0.1	-	0.73	0.01	-	0.02	0.00	-	3.8
11/09/76	-	0.42	0.42	0.00	0.02	0.02	0.00	-	-
11/16/76	-	1.26	0.53	0.04	0.06	0.02	0.19	-	-
11/22/76	-	0.53	0.67	0.03	0.01	0.01	0.04	-	-
11/30/76	<.1	0.22	0.48	0.01	0.01	0.01	0.04	2.0	1.5
12/07/76	-	0.53	0.64	0.03	0.03	0.04	0.19	-	-
12/15/76	-	0.00	0.42	0.00	0.02	0.02	0.37	-	-
12/20/76	-	0.50	0.84	0.13	0.02	0.02	0.32	-	-
12/29/76	-	-	0.36	0.00	-	0.03	0.00	-	-
01/04/77	g0.1	-	0.73	0.00	-	0.02	0.00	-	2.4
01/11/77	<.1	0.98	0.98	0.46	0.08	0.10	0.04	-	-
01/19/77	<.1	1.54	0.00	0.00	0.07	-	2.05	-	-
01/26/77	.1	0.28	0.70	0.01	0.18	0.12	0.37	-	-
02/02/77	<.1	0.36	1.06	0.00	0.01	0.08	0.00	2.2	2.8
02/07/77	-	-	-	-	-	-	-	-	-
02/16/77	-	-	-	-	-	-	-	-	-
02/24/77	-	-	-	-	-	-	-	-	-
03/02/77	-	-	-	-	-	-	-	-	-

*Indicates problem with flow measurement.

Appendix Table 3, Cont'd.

FIELD M - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
09/26/74	u 0.64	0.20	0.15	37.63	0.0	0.00	16.54	-	33.1
10/01/74	c 0.55	0.53	0.00	37.63	-	0.00	16.54	-	-
10/08/74	c 0.55	0.13	0.00	37.63	-	0.00	16.54	-	-
10/16/74	c 0.55	1.83	0.00	37.63	-	0.00	16.54	-	-
10/23/74	c 0.55	3.38	0.00	37.63	-	0.00	16.54	-	-
10/31/74	c 0.55	0.00	0.00	37.63	-	0.00	16.54	-	-
11/06/74	c 0.55	0.00	0.00	37.63	-	0.00	16.54	-	-
11/12/74	c 0.55	0.38	0.00	37.63	-	0.00	16.54	-	-
11/20/74	c 0.55	2.29	0.00	37.63	-	0.00	16.54	-	-
11/26/74	c 0.55	0.86	0.00	37.63	-	0.00	16.54	-	-
12/04/74	c 0.55	2.13	0.00	0.00	-	0.00	0.00	-	-
12/11/74	c 0.55	1.37	0.00	0.00	-	0.00	0.00	-	-
12/19/74	c 0.55	0.61	0.00	0.00	2.6	0.00	0.00	-	29.6
12/27/74	c 0.55	2.26	0.10	0.10	0.9	0.01	0.01	-	27.2
01/03/75	c 0.55	2.01	0.53	0.63	1.2	0.07	0.08	2.5	27.4
01/08/75	c 0.55	1.80	0.51	1.14	-	0.17 g	0.25	3.4	g 26.1
01/15/75	c 0.55	5.92	2.87	4.01	4.2	1.22	1.47	4.6	21.8
01/22/75	c 0.55	2.08	1.57	5.58	4.4	0.69	2.16	3.6	25.4
01/29/75	c 0.55	2.54	1.62	7.20	3.6	0.59	2.75	3.6	20.6
02/06/75	c 0.55	2.67	0.76	7.96	2.6	0.20	2.95	3.1	21.8
02/12/75	c 0.55	0.08	0.36	8.32	3.2	0.11	3.06	-	21.1
02/20/75	c 0.55	5.51	2.06	10.38	2.4	0.49	3.55	2.3	19.5
02/26/75	c 0.55	1.88	1.07	11.45	2.4	0.26	3.81	2.2	20.7
03/06/75	u 0.97	0.71	1.32	12.77	2.0	0.27	4.08	1.7	21.9
03/14/75	u 0.97	2.74	0.33	13.10	1.3	0.04	4.12	1.1	-
03/21/75	u 0.97	7.54	6.43	19.53	2.1	1.34	5.46	3.0	17.5
03/28/75	u 0.97	0.78	1.47	21.00	1.9	0.28	5.74	1.9	18.3
04/04/75	u 0.97	1.44	0.33	21.33	1.1	0.03	5.77	0.9	21.8
04/10/75	u 0.97	0.71	0.08	21.41	0.5	0.00	5.77	0.5	23.4
04/17/75	u 0.97	8.13	4.39	25.80	2.0	0.87	6.64	4.4	20.8
04/23/75	u 0.97	0.51	1.60	27.40	2.3	0.37	7.01	2.3	19.2
04/30/75	u 0.97	0.43	0.41	27.81	0.5	0.02	7.03	0.6	20.8
05/07/75	u 0.97	1.29	0.53	28.34	0.5	0.02	7.05	0.7	19.6
05/15/75	u 0.97	0.20	0.15	28.49	0.3	0.00	7.05	0.3	21.4
05/22/75	u 0.97	1.37	0.05	28.54	0.5	0.00	7.05	-	27.9
05/27/75	u 0.97	3.02	0.02	28.56	2.3	0.00	7.05	0.5	21.5

Appendix Table 3, Cont'd. Field M - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
09/26/74	<.1	-	-	-	-	-	-	7.6	-
10/01/74	-	-	-	-	-	-	-	-	-
10/08/74	-	-	-	-	-	-	-	-	-
10/16/74	-	-	-	-	-	-	-	-	-
10/23/74	-	-	-	-	-	-	-	-	-
10/31/74	-	-	-	-	-	-	-	-	-
11/06/74	-	-	-	-	-	-	-	-	-
11/12/74	-	-	-	-	-	-	-	-	-
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	-	-	-	-	-	-	-	-	-
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	<.1	0.60	-	0.00	0.04	-	0.00	8.2	-
12/27/74	<.1	-	-	-	-	-	-	8.6	-
01/03/75	<.1	0.80	1.10	0.04	-	0.03	0.17	8.4	8.2
01/08/75	g0.2	-	0.90	0.04	-	0.03	0.11	-	7.0
01/15/75	<.1	1.00	1.20	0.29	0.06	0.06	1.74	7.9	7.2
01/22/75	<.1	0.80	0.40	0.12	0.06	0.05	0.95	-	-
01/29/75	<.1	1.60	1.55	0.26	-	0.07	1.14	7.6	6.2
02/06/75	-	1.15	1.65	0.09	0.06	0.02	0.45	-	-
02/12/75	-	1.05	-	0.03	0.04	-	0.13	-	-
02/20/75	0.1	1.25	0.65	0.26	-	0.01	0.20	7.4	9.6
02/26/75	-	-	1.65	0.19	0.08	0.26	0.84	-	-
03/06/75	<.1	-	-	-	-	-	-	5.6	5.0
03/14/75	-	2.20	3.10	0.07	0.12	-	0.39	-	-
03/21/75	<.1	1.80	0.80	1.15	-	0.06	3.86	10.0	6.6
03/28/75	<.1	1.30	1.10	0.19	-	0.03	0.45	6.1	5.8
04/04/75	-	1.00	1.20	0.03	0.02	0.05	0.06	-	-
04/10/75	-	2.40	1.60	0.02	-	0.07	0.06	-	-
04/17/75	-	0.90	0.70	0.39	0.18	0.05	7.90	-	-
04/23/75	-	0.40	0.90	0.07	0.05	0.07	0.78	-	-
04/30/75	0.2	1.46	1.02	0.06	0.11	0.11	0.45	8.3	8.6
05/07/75	-	0.00	1.86	0.00	0.06	0.04	0.34	-	-
05/15/75	-	1.69	1.02	0.02	0.10	0.34	0.17	-	-
05/22/75	-	1.02	-	0.00	-	0.08	0.02	-	-
05/27/75	<.1	7.28	3.05	0.01	0.14	0.18	0.02	10.2	10.4

FIELD M - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
12/28/73	c 0.49	3.60	1.93	1.93	9.1	1.77	1.77	7.1	g 82.0
01/09/74	c 0.49	6.68	1.52	3.45	6.3	0.96	2.73	6.4	g 31.4
01/17/74	c 0.49	0.00	0.81	4.26	5.5	0.46	3.19	4.4	g 28.8
01/23/74	c 0.49	2.43	0.18	4.44	-	0.08 g	3.27	4.2	g 31.0
01/31/74	c 0.49	4.09	1.35	5.79	5.1	0.68	3.95	6.1	g 30.9
02/06/74	c 0.49	3.94	1.52	7.31	4.9	0.75	4.70	2.2	g 14.2
02/14/74	c 0.49	1.22	0.64	7.95	3.1	0.20	4.90	3.1	g 23.3
02/21/74	c 0.49	5.46	1.40	9.35	5.2	0.73	5.63	2.8	g 19.0
02/27/74	c 0.49	0.84	0.66	10.01	4.8	0.32	5.95	2.5	g 19.5
03/06/74	c 0.49	0.00	0.00	10.01	2.9	0.00	5.95	2.0	g 21.2
03/13/74	c 0.49	1.35	0.00	10.01	-	0.00 g	5.95	2.3	g 28.0
03/19/74	c 0.49	3.63	0.05	10.06	-	0.01 g	5.96	3.3	g 23.9
03/27/74	u 0.90	5.23	2.16	12.22	5.1	1.11	7.07	5.1	g 28.1
04/02/74	u 0.90	3.28	3.05	15.27	5.5	1.69	8.76	5.4	g 24.7
04/11/74	u 0.90	4.67	2.18	17.45	4.8	1.04	9.80	2.4	g 26.8
04/16/74	u 0.90	5.59	2.59	20.04	3.8	0.98	10.78	3.9	g 20.1
04/22/74	u 0.90	0.00	0.64	20.68	3.8	0.25	11.03	3.6	g 25.0
04/30/74	u 0.90	0.58	0.18	20.86	1.8	0.03	11.06	0.9	g 27.5
05/07/74	u 0.90	3.43	0.20	21.06	0.8	0.02	11.08	3.4	g 25.8
05/15/74	u 0.90	1.73	0.61	21.67	1.0	0.07	11.15	1.1	g 26.8
05/22/74	u 0.90	2.26	0.48	22.15	0.7	0.03	11.18	1.6	-
05/30/74	u 0.90	8.13	3.10	25.25	7.5	2.33	13.51	8.2	g 25.6
06/06/74	u 0.90	3.18	1.27	26.52	8.6	1.10	14.61	5.7	-
06/13/74	c 0.31	0.81	0.00	26.52	-	0.00	14.61	-	-
06/19/74	c 0.31	0.08	0.00	26.52	-	0.00	14.61	-	-
06/26/74	c 0.31	1.78	0.00	26.52	-	0.00	14.61	-	-
07/03/74	c 0.31	2.89	0.00	26.52	-	0.00	14.61	-	-
07/10/74	c 0.31	5.21	0.00	26.52	-	0.00	14.61	-	-
07/16/74	c 0.31	0.02	0.00	26.52	2.4	0.00	14.61	-	-
07/24/74	c 0.31	0.00	0.00	26.52	-	0.00	14.61	-	-
07/31/74	c 0.31	9.09	0.00	26.52	0.0	0.00	14.61	0.8	g 86.7
08/07/74	c 0.31	10.34	1.04	27.56	1.2	0.12	14.73	3.4	g 47.0
08/15/74	u 0.64	0.96	3.28	30.84	3.9	1.28	16.01	0.9	g 44.6
08/21/74	c 0.31	3.35	2.95	33.79	0.4	0.11	16.12	1.8	g 24.8
08/29/74	u 0.64	4.80	2.39	36.18	-	0.36 g	16.48	1.5	g 30.4
09/04/74	u 0.64	0.89	0.00	36.18	0.0	0.00	16.48	0.0	g 32.2
09/11/74	u 0.64	5.16	1.22	37.40	0.4	0.06	16.54	0.6	g 30.6
09/18/74	u 0.64	1.93	0.08	37.48	-	0.00 g	16.54	0.7	g 31.0

Appendix Table 3, Cont'd. Field M - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
12/28/73	<.1	-	-	-	-	0.02	0.39	-	4.6
01/09/74	<.1	-	-	-	-	0.02	0.31	-	-
01/17/74	-	-	-	-	-	-	-	-	-
01/23/74	-	-	-	-	-	-	-	-	-
01/31/74	-	-	-	-	-	-	-	-	-
02/06/74	<.1	-	2.98	0.46	-	0.02	0.31	-	-
02/14/74	<.1	-	-	-	-	-	-	-	-
02/21/74	-	-	2.37	0.34	-	0.05	0.69	-	-
02/27/74	-	-	-	-	-	-	-	-	-
03/06/74	-	-	2.01	0.00	-	0.04	0.00	-	-
03/13/74	0.3	-	1.88	0.00	-	0.03	0.00	-	13.2
03/19/74	-	-	1.58	0.01	-	0.06	0.02	-	9.9
03/27/74	<.1	-	1.18	0.26	-	0.03	0.65	-	-
04/02/74	<.1	-	0.98	0.30	-	0.02	0.62	-	-
04/11/74	0.2	-	1.46	0.31	-	0.03	0.65	-	6.1
04/16/74	0.2	-	1.30	0.34	-	0.05	1.29	-	9.8
04/22/74	0.4	-	-	-	-	0.07	0.45	-	7.9
04/30/74	0.3	-	-	-	-	-	-	-	10.6
05/07/74	<.1	-	1.26	0.02	-	0.28	0.58	-	11.3
05/15/74	-	-	-	-	-	-	-	-	9.8
05/22/74	0.4	-	4.44	0.21	-	0.22	1.06	-	13.9
05/30/74	0.2	-	1.26	0.39	-	0.04	1.23	-	7.8
06/06/74	0.2	-	2.79	0.36	-	0.05	0.65	-	9.1
06/13/74	-	-	-	-	-	-	-	-	-
06/19/74	-	-	-	-	-	-	-	-	-
06/26/74	-	-	-	-	-	-	-	-	-
07/03/74	-	-	-	-	-	-	-	-	-
07/10/74	-	-	-	-	-	-	-	-	-
07/16/74	-	-	-	-	-	-	-	-	-
07/24/74	-	-	-	-	-	-	-	-	-
07/31/74	-	-	-	-	-	-	-	-	-
08/07/74	0.1	-	-	-	-	-	-	-	12.4
08/15/74	<.1	-	-	-	-	-	-	-	12.8
08/21/74	<.1	-	1.58	0.47	-	0.18	5.32	-	14.2
08/29/74	-	-	1.43	0.34	-	0.03	0.73	-	12.8
09/04/74	-	-	3.49	0.00	-	0.13	0.00	-	15.0
09/11/74	g<.1	-	3.81	0.47	-	0.02	0.25	-	9.4
09/18/74	<.1	-	-	-	-	-	-	-	8.0

Appendix Table 3, Cont'd.

FIELD M - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
06/03/75	c 0.39	1.68	0.00	28.56	-	0.00	7.05	-	-
06/11/75	c 0.39	0.00	0.00	28.56	-	0.00	7.05	-	-
06/18/75*	c 0.39	1.35	0.00	28.56	-	0.00	7.05	0.5	g 127.5
06/23/75*	c 0.39	0.00	0.00	28.56	-	0.00	7.05	-	-
07/02/75*	c 0.39	3.99	0.00	28.56	-	0.00	7.05	-	-
07/09/75*	c 0.39	5.13	0.00	28.56	-	0.00	7.05	-	-
07/15/75	c 0.39	11.56	1.75	30.31	-	1.67 g	8.72	9.5	g 28.6
07/23/75	u 1.33	8.61	6.04	36.35	-	2.06 g	10.78	3.4	g 32.0
07/30/75	u 1.33	3.50	2.64	38.99	5.6	1.48	12.26	2.5	18.9
08/06/75	c 0.39	0.00	0.00	38.99	-	0.00	12.26	-	-
08/13/75	c 0.39	0.84	0.00	38.99	-	0.00	12.26	-	-
08/20/75	c 0.39	0.00	0.00	38.99	-	0.00	12.26	-	-
08/27/75	c 0.39	0.00	0.00	38.99	-	0.00	12.26	-	-
09/03/75	c 0.39	2.44	0.00	38.99	-	0.00	12.26	-	-
09/10/75	c 0.39	4.95	0.00	38.99	-	0.00	12.26	-	-
09/17/75	c 0.39	2.79	0.00	38.99	-	0.00	12.26	0.4	g 25.2
09/24/75	c 0.39	5.18	0.08	39.07	-	0.06 g	12.32	7.5	g 23.4
10/01/75	c 0.39	2.26	0.41	39.48	0.5	0.02	12.34	0.3	24.3
10/08/75	c 0.39	0.66	0.00	39.48	-	0.00	12.34	-	-
10/15/75	c 0.39	0.79	0.00	39.48	-	0.00	12.34	-	-
10/22/75	c 0.39	4.57	0.18	39.66	0.6	0.01	12.35	-	25.3
10/29/75	c 0.39	2.26	0.53	40.19	1.0	0.06	12.41	2.4	25.7
11/04/75	u 1.33	0.13	1.65	41.84	1.4	0.24	12.65	0.8	26.5
11/12/75	u 1.02	0.36	0.05	41.89	1.1	0.01	12.66	0.6	32.0
11/19/75	u 1.02	0.56	0.05	41.94	0.0	0.00	12.66	0.0	31.8
11/25/75	u 1.02	2.39	0.20	42.14	1.1	0.02	12.68	1.3	32.6
12/03/75	u 1.02	0.66	0.28	0.28	1.1	0.03	0.03	0.0	31.2
12/10/75	u 1.02	4.27	2.97	3.25	1.0	0.29	0.32	4.0	31.2
12/17/75	u 1.02	0.51	1.35	4.60	2.7	0.36	0.68	2.0	29.6
12/23/75	u 1.02	0.99	0.79	5.39	-	0.36	0.68	-	-
12/30/75	u 1.02	4.11	2.24	7.63	2.6	0.78	1.46	3.6	28.3
01/06/76	u 1.02	3.15	4.75	12.38	3.8	1.80	3.26	4.0	26.2
01/14/76	u 1.02	2.16	2.08	14.46	3.7	0.77	4.03	2.8	23.3
01/21/76	u 1.02	2.18	1.04	15.50	2.6	0.27	4.30	5.2	38.5
01/28/76	u 1.02	3.86	1.45	16.95	2.7	0.39	4.69	6.0	18.6
02/04/76	u 1.02	3.30	4.27	21.22	4.2	1.79	6.48	6.2	22.2
02/11/76	u 1.02	0.15	1.37	22.59	3.2	0.44	6.92	3.1	23.0

Appendix Table 3, Cont'd. Field M - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
06/03/75	-	-	-	-	-	-	-	-	-
06/11/75	-	-	-	-	-	-	-	-	-
06/18/75	g1.0	-	3.73	0.00	-	0.14	0.00	-	-
06/23/75	-	-	-	-	-	-	-	-	-
07/02/75	-	-	-	-	-	-	-	-	-
07/09/75	-	-	-	-	-	-	-	-	-
07/15/75	-	-	1.80	0.03	-	0.00	0.00	-	-
07/23/75	-	0.10	0.30	0.06	-	0.20	12.10	-	-
07/30/75	<.1	1.40	1.30	0.37	0.00	0.00	0.00	11.7	14.5
08/06/75	-	-	-	-	-	-	-	-	-
08/13/75	-	-	-	-	-	-	-	-	-
08/20/75	-	-	-	-	-	-	-	-	-
08/27/75	-	-	-	-	-	-	-	-	-
09/03/75	-	-	-	-	-	-	-	-	-
09/10/75	-	-	-	-	-	-	-	-	-
09/17/75	-	-	0.90	0.00	-	0.30	0.00	-	-
09/24/75	<.1	-	1.87	0.01	-	0.07	0.06	-	8.1
10/01/75	-	0.40	-	0.02	0.04	-	0.17	11.5	-
10/08/75	-	-	-	-	-	-	-	-	-
10/15/75	-	-	-	-	-	-	-	-	-
10/22/75	0.1	1.67	-	0.03	0.07	-	0.11	-	-
10/29/75	-	-	1.53	0.08	0.04	0.04	0.22	11.3	0.6
11/04/75	-	-	1.36	0.22	0.22	0.27	3.64	-	-
11/12/75	-	-	1.80	0.01	0.02	0.02	0.00	-	-
11/19/75	-	-	1.60	0.01	0.06	0.03	0.02	-	-
11/25/75	-	-	1.25	0.02	0.06	0.16	0.11	-	-
12/03/75	-	-	1.42	0.04	0.02	0.08	0.06	-	-
12/10/75	<.1	0.55	0.94	0.16	0.01	0.03	0.28	5.8	5.7
12/17/75	-	-	-	-	0.05	0.07	0.67	-	-
12/23/75	-	-	-	-	-	-	-	-	-
12/30/75	-	-	0.85	0.19	0.06	0.01	1.34	-	-
01/06/76	-	-	0.74	0.35	0.12	0.01	5.69	-	-
01/14/76	<.1	0.96	0.72	0.21	0.10	0.03	2.07	5.0	4.4
01/21/76	-	-	-	-	0.10	0.02	1.03	-	-
01/28/76	-	-	0.79	0.11	0.06	0.11	0.87	-	-
02/04/76	-	-	0.72	0.30	0.07	0.04	2.97	-	-
02/11/76	0.1	0.38	0.57	0.06	0.09	0.02	1.23	4.6	4.2

Appendix Table 3, Cont'd.

FIELD M - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
02/19/76	u 1.02	0.94	0.53	23.12	-	0.08 g	7.00	1.5	g 24.3
02/25/76	u 1.02	0.36	0.20	23.32	-	0.02 g	7.02	1.1	g 26.2
03/02/76	u 1.02	0.00	0.05	23.37	-	0.00 g	7.02	0.4	g 27.7
03/08/76	u 1.02	1.65	0.10	23.47	-	0.01 g	7.03	1.6	g 25.2
03/16/76	u 1.02	4.37	0.91	24.38	-	0.22 g	7.25	2.4	g 23.7
03/24/76	u 1.02	0.25	0.51	24.89	2.0	0.10	7.35	2.5	23.2
04/01/76	u 1.02	3.43	0.25	25.14	0.9	0.02	7.37	1.2	26.4
04/07/76	u 1.02	0.20	0.25	25.39	0.9	0.02	7.39	0.6	25.6
04/14/76	u 1.02	0.76	0.13	25.52	1.0	0.01	7.40	-	27.7
04/21/76	u 1.02	0.00	0.00	25.52	-	0.00	7.40	-	-
04/28/76	u 1.02	1.52	0.00	25.52	-	0.00	7.40	-	-
05/04/76	u 1.02	1.93	0.00	25.52	-	0.00	7.40	-	-
05/11/76	u 1.02	1.37	0.00	25.52	-	0.00	7.40	-	-
05/17/76	u 1.02	4.24	1.57	27.09	1.9	0.30	7.70	6.8	33.2
05/24/76	u 1.02	0.91	1.65	28.74	2.6	0.42	8.12	-	-
06/02/76	u 1.02	10.24	1.93	30.67	3.3	0.64	8.76	5.2	21.4
06/09/76	u 1.02	3.61	3.15	33.82	4.6	1.45	10.21	4.8	21.7
06/16/76	u 1.02	1.42	0.41	34.23	1.9	0.08	10.29	2.3	22.4
06/23/76	u 1.02	9.96	3.68	37.91	8.4	3.09	13.38	8.2	20.1
06/30/76	u 1.02	0.28	1.30	39.21	2.9	0.37	13.75	3.7	22.8
07/08/76	u 1.02	7.51	3.81	43.02	5.9	2.25	16.00	5.9	15.5
07/14/76	u 1.02	0.23	0.79	43.81	4.4	0.34	16.34	2.2	20.0
07/21/76	u 1.02	0.81	0.13	43.94	4.1	0.06	16.40	-	-
07/28/76	u 1.02	8.66	1.17	45.11	3.8	0.44	16.84	3.6	20.9
08/02/76	u 1.02	1.14	0.23	45.34	1.8	0.04	16.88	0.8	21.8
08/10/76	u 1.02	2.71	0.13	45.47	1.0	0.01	16.89	0.9	22.8
08/17/76	u 1.02	2.13	0.86	46.33	-	0.03 g	16.92	0.4	g 22.8
08/24/76	u 1.02	0.28	0.02	46.35	0.0	0.00	16.92	-	22.2
08/31/76	u 1.02	0.00	0.00	46.35	-	0.00	16.92	-	-
09/07/76	u 1.02	1.09	0.00	46.35	-	0.00	16.92	-	-
09/13/76	u 1.02	2.95	0.00	46.35	-	0.00	16.92	-	-
09/21/76	u 1.02	6.68	1.35	47.70	3.0	0.40	17.32	1.9	17.9
09/28/76	u 1.02	0.64	0.10	47.80	1.8	0.02	17.34	-	18.5
10/05/76	u 1.02	2.74	0.05	47.85	2.2	0.01	17.35	0.2	18.1
10/12/76	u 1.02	1.50	0.00	47.85	0.2	0.00	17.35	-	18.3
10/19/76	u 1.02	0.86	0.00	47.85	-	0.00	17.35	0.2	g 18.6
10/26/76	c 0.34	2.44	0.00	47.85	-	0.00	17.35	-	-
11/02/76	c 0.34	1.07	0.00	47.85	-	0.00	17.35	-	-

Appendix Table 3, Cont'd. Field M - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
02/19/76	-	-	1.60	0.09	-	0.15	0.81	-	-
02/25/76	-	-	1.21	0.02	-	0.07	0.13	-	-
03/02/76	-	-	2.20	0.01	-	0.17	0.09	-	-
03/08/76	-	-	1.07	0.01	-	0.15	0.13	-	-
03/16/76	<.1	-	0.83	0.08	-	0.10	0.92	-	3.6
03/24/76	-	1.04	1.46	0.06	0.10	0.10	0.50	-	-
04/01/76	-	0.82	1.86	0.02	0.04	0.15	0.11	-	-
04/07/76	<.1	2.26	1.82	0.05	0.12	0.09	0.31	6.3	8.6
04/14/76	0.1	1.00	-	-	0.04	-	0.06	-	-
04/21/76	-	-	-	-	-	-	-	-	-
04/28/76	-	-	-	-	-	-	-	-	-
05/04/76	-	-	-	-	-	-	-	-	-
05/11/76	-	-	-	-	-	-	-	-	-
05/17/76	<.1	4.87	1.78	0.76	0.08	0.08	1.25	-	-
05/24/76	-	-	-	-	-	-	-	-	-
06/02/76	<.1	0.70	2.62	0.14	0.03	0.21	0.58	-	7.3
06/09/76	<.1	0.64	0.77	0.20	0.08	0.03	2.52	-	-
06/16/76	-	1.51	1.25	0.07	0.08	0.05	0.34	-	-
06/23/76	-	0.50	0.67	0.18	0.07	0.05	2.58	-	-
06/30/76	<.1	1.08	1.54	0.13	0.02	0.05	0.25	-	6.1
07/08/76	-	0.50	0.95	0.19	0.07	-	2.67	-	-
07/14/76	-	0.84	1.46	0.07	0.03	0.01	0.22	-	-
07/21/76	-	-	-	-	-	-	-	-	-
07/28/76	-	0.62	0.83	0.07	0.06	0.05	0.69	-	-
08/02/76	<.1	0.85	0.77	0.02	0.09	0.04	0.20	4.2	4.5
08/10/76	-	0.95	2.10	0.01	0.18	0.08	0.22	-	-
08/17/76	-	-	0.00	0.00	-	0.04	0.34	-	-
08/24/76	-	3.00	-	0.01	0.10	-	0.02	-	-
08/31/76	-	-	-	-	-	-	-	-	-
09/07/76	-	-	-	-	-	-	-	-	-
09/13/76	-	-	-	-	-	-	-	-	-
09/21/76	-	1.06	1.01	0.15	0.01	0.01	0.13	-	-
09/28/76	-	0.67	-	0.01	0.01	-	0.00	-	-
10/05/76	<.1	1.43	1.04	0.00	0.12	0.02	0.06	4.1	7.4
10/12/76	-	0.62	-	0.00	0.07	-	0.00	-	-
10/19/76	-	-	0.92	0.00	-	0.03	0.00	-	-
10/26/76	-	-	-	-	-	-	-	-	-
11/02/76	-	-	-	-	-	-	-	-	-

Appendix Table 3, Cont'd.

FIELD M - TIDEWATER RESEARCH STATION AT PLYMOUTH

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
11/09/76	c 0.34	0.05	0.00	47.85	-	0.00	17.35	-	-
11/16/76	c 0.34	4.11	0.00	47.85	-	0.00	17.35	4.6	18.2
11/22/76	c 0.34	0.00	0.00	47.85	-	0.00	17.35	3.8	g 27.9
11/30/76	c 0.34	2.49	0.00	47.85	-	0.00	17.35	3.7	g 26.5
12/07/76	c 0.34	1.27	0.00	0.00	-	0.00	0.00	1.8	g 28.0
12/15/76	c 0.34	4.03	0.00	0.00	-	0.00	0.00	4.7	g 30.7
12/20/76	c 0.34	2.69	0.38	0.38	4.0	0.16	0.16	4.0	24.9
12/29/76	u 0.90	1.90	2.36	2.74	7.6	1.80	1.96	8.6	25.3
01/04/77	u 0.90	0.81	0.38	3.12	8.7	0.32	2.28	-	26.4
01/11/77	u 0.90	5.97	2.21	5.33	7.6	1.68	3.96	8.0	28.7
01/19/77	c 0.34	1.55	0.02	5.35	12.5	0.02	3.98	-	34.8
01/26/77	c 0.34	0.91	0.00	5.35	-	0.00	3.98	7.8	g 24.3
02/02/77	c 0.34	0.00	0.00	5.35	-	0.00	3.98	5.4	g 23.6
02/07/77	u 0.90	0.00	1.73	7.08	4.4	0.76	4.74	7.2	17.9
02/16/77	u 0.90	4.06	0.20	7.28	-	0.11	4.85	5.5	g 25.5
02/24/77	u 0.90	2.51	0.02	7.30	4.6	0.01	4.86	4.6	23.5
03/02/77	u 0.90	1.47	0.38	7.68	3.8	0.15	5.01	12.6	34.4

Appendix Table 3, Cont'd. Field M - Tidewater Research Station at Plymouth

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
11/09/76	-	-	-	-	-	-	-	-	-
11/16/76	<.1	-	1.18	0.00	-	0.28	0.00	-	4.5
11/22/76	-	-	1.29	0.00	-	0.05	0.00	-	-
11/30/76	g<.1	-	0.70	0.00	-	0.04	0.00	-	3.9
12/07/76	-	-	1.12	0.00	-	0.04	0.00	-	-
12/15/76	-	-	0.84	0.00	-	0.05	0.00	-	-
12/20/76	-	1.93	1.23	0.08	0.16	0.05	0.62	-	-
12/29/76	-	0.08	0.00	0.02	0.01	-	0.22	-	-
01/04/77	0.2	0.20	0.62	0.01	0.04	0.01	0.13	2.2	1.0
01/11/77	0.1	0.28	1.26	0.07	0.02	0.17	0.45	-	-
01/19/77	<.1	0.70	-	0.00	0.02	-	0.00	-	-
01/26/77	g<.1	-	0.00	0.00	-	0.03	0.00	-	-
02/02/77	g<.1	-	0.08	0.00	-	0.04	0.00	-	2.3
02/07/77	<.1	0.78	0.00	0.13	0.07	0.02	1.21	-	-
02/16/77	g0.3	-	0.20	0.00	-	0.06	0.11	-	-
02/24/77	0.1	0.00	1.10	0.00	0.03	0.02	0.00	-	-
03/02/77	0.1	1.76	1.06	0.07	0.03	0.01	0.11	-	-

*Indicates problem with flow measurement.

Appendix Table 3, Cont'd.

FIELD A - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
12/28/73	u	1.90	0.20	0.20	16.4	4.56	4.56	16.3	g 17.5
01/08/74	u	2.46	0.96	1.16	16.4	1.59	6.15	16.1	g 18.0
01/28/74	u	3.65	0.79	1.95	12.5	0.99	7.14	15.9	g 17.3
02/05/74	u	5.64	2.41	4.36	17.1	4.13	11.27	15.4	g 14.6
02/14/74	u	1.93	1.07	5.43	16.8	1.80	13.07	16.1	g 18.1
02/21/74	u	3.18	1.45	6.88	16.4	2.37	15.44	15.6	g 15.6
02/27/74	u	0.18	0.28	7.16	16.0	0.45	15.89	16.6	g 17.6
03/06/74	u	0.00	0.00	7.16	-	-	-	-	-
03/22/74	u	6.88	0.28	7.44	15.1	0.44	16.33	-	g 14.8
03/27/74	u	4.11	1.85	9.29	14.2	2.62	18.95	15.6	14.4
04/01/74	u	4.14	2.18	11.47	20.1	4.39	23.34	14.7	13.4
04/09/74	u	3.07	1.40	12.87	12.5	1.75	25.09	-	12.4
04/16/74	u	1.80	0.53	13.40	14.9	0.78	25.87	15.9	15.4
04/20/74	u	0.81	0.08	13.48	-	-	-	-	-
05/23/74	u	8.13	0.00	13.48	-	-	-	-	-
06/05/74	u	9.04	0.43	13.91	-	0.94 g	26.81	19.0	13.8
06/13/74	u	0.56	0.05	13.96	18.6	0.08	26.89	-	-
06/19/74	u	0.56	0.00	13.96	-	-	-	-	-
06/26/74	u	0.86	0.00	13.96	-	-	-	-	-
07/03/74	u	2.29	0.00	13.96	-	-	-	-	-
07/10/74	u	4.42	0.00	13.96	-	-	-	-	-
07/16/74	u	0.25	0.00	13.96	-	-	-	-	-
08/02/74	u	9.78	0.33	14.29	-	0.22 g	27.11	6.8	g 11.3
08/08/74	u	10.06	2.77	17.06	8.8	2.43	29.54	10.7	g 16.2
08/15/74	u	8.76	3.84	20.90	10.2	3.92	33.46	9.7	g 15.1
08/28/74	u	12.17	5.66	26.56	5.6	3.18	36.64	10.6	g 15.2
09/05/74	u	2.67	0.36	26.92	7.3	1.05	37.69	-	-
09/11/74	u	4.37	1.45	28.37	9.0	1.30	38.99	10.5	14.8
09/18/74	u	1.14	0.30	28.67	11.0	0.34	39.33	-	-
09/24/74	u	0.20	0.00	28.67	-	-	-	-	-
10/03/74	u	0.20	0.00	28.67	-	-	-	-	-
10/17/74	c 0.76	2.21	0.00	28.67	-	-	-	-	-
10/23/74	c 0.76	1.91	0.00	28.67	-	-	-	-	-

Appendix Table 3, Cont'd. Field A-Lower Coastal Plain Tobacco Research Station

Sampling	NH_4-N	Organic + NH_4-N			Total P			C	
Date	Conc. comp. ppm	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha 10^{-2}	Conc. comp. ppm	Conc. grab ppm
12/28/73	<.1	-	-	-	-	0.02	-	-	2.0
01/08/74	<.1	-	-	-	-	0.01	-	-	-
01/28/74	0.1	-	-	-	-	-	-	-	2.2
02/05/74	-	-	-	-	-	-	-	-	-
02/14/74	0.1	-	-	-	-	-	-	-	2.6
02/21/74	-	-	-	-	-	-	-	-	-
02/27/74	-	-	-	-	-	-	-	-	-
03/06/74	-	-	-	-	-	-	-	-	-
03/22/74	<.1	-	-	-	-	-	-	-	2.4
03/27/74	-	-	-	-	-	-	-	-	-
04/01/74	<.1	-	-	-	-	-	-	-	2.2
04/09/74	-	-	-	-	-	-	-	-	-
04/16/74	0.1	-	-	-	-	-	-	-	2.2
04/20/74	-	-	-	-	-	-	-	-	-
05/23/74	-	-	-	-	-	-	-	-	-
06/05/74	<.1	-	-	-	-	-	-	-	2.8
06/13/74	-	-	-	-	-	-	-	-	-
06/19/74	-	-	-	-	-	-	-	-	-
06/26/74	-	-	-	-	-	-	-	-	-
07/03/74	-	-	-	-	-	-	-	-	-
07/10/74	-	-	-	-	-	-	-	-	-
07/16/74	-	-	-	-	-	-	-	-	-
08/02/74	<.1	-	-	-	-	-	-	-	-
08/08/74	<.1	-	-	-	-	-	-	-	4.0
08/15/74	<.1	-	-	-	-	-	-	-	4.5
08/28/74	<.1	-	-	-	-	-	-	-	4.6
09/05/74	-	-	-	-	-	-	-	-	-
09/11/74	<.1	-	-	-	-	-	-	-	3.2
09/18/74	-	-	-	-	-	-	-	-	-
09/24/74	-	-	-	-	-	-	-	-	-
10/03/74	-	-	-	-	-	-	-	-	-
10/17/74	-	-	-	-	-	-	-	-	-
10/23/74	-	-	-	-	-	-	-	-	-

Appendix Table 3, Cont'd.

FIELD A - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
11/01/74	c 0.76	0.18	0.00	28.67	-	-	-	-	-
11/06/74	c 0.76	0.00	0.00	28.67	-	-	-	-	-
11/14/74	c 0.76	0.30	0.00	28.67	-	-	-	-	-
11/20/74	c 0.76	4.90	0.00	28.67	-	-	-	-	-
11/26/74	c 0.76	0.64	0.00	28.67	-	-	-	-	-
12/04/74	c 0.76	4.60	0.00	0.00	-	-	-	1.4	g 15.2
12/11/74	c 0.76	1.35	0.00	0.00	-	-	-	-	-
12/19/74	c 0.76	0.76	0.00	0.00	-	-	-	-	-
12/27/74	c 0.76	2.34	0.00	0.00	-	-	-	-	-
01/03/75	c 0.76	2.29	0.00	0.00	-	-	-	-	-
01/09/75	c 0.76	1.91	0.00	0.00	-	-	-	11.8	g 12.2
01/15/75	c 0.76	4.65	0.00	0.00	-	-	-	13.4	g 17.4
01/23/75	c 0.76	1.90	0.00	0.00	-	-	-	-	-
01/29/75	c 0.76	2.29	0.00	0.00	-	-	-	-	-
02/06/75	c 0.76	3.25	0.00	0.00	-	-	-	-	-
02/12/75	c 0.76	0.18	0.00	0.00	-	-	-	-	-
02/20/75	c 0.76	6.73	0.00	0.00	11.2	0.01	0.01	10.0	19.4
02/26/75	c 0.76	2.31	0.00	0.00	10.5	0.00	-	-	15.7
03/06/75	c 0.76	0.81	0.00	0.00	-	-	-	-	-
03/14/75	c 0.76	4.06	0.00	0.00	-	-	-	-	-
03/21/75	c 0.76	3.30	0.00	0.00	-	-	-	-	-
03/28/75	c 0.76	1.88	0.00	0.00	-	-	-	-	-
04/04/75	c 0.76	2.38	0.00	0.00	-	-	-	-	-
04/10/75	u	0.69	0.00	0.00	-	-	-	-	-
12/31/75		82.12	-	-	-	-	-	14.2	-
01/08/76	c 0.76	2.29	3.25	3.25	14.0	4.54	4.54	12.5	18.5
01/14/76	c 0.76	0.25	1.37	4.62	12.5	1.72	6.26	12.8	19.0
01/21/76	c 0.76	3.83	0.00	4.62	12.2	0.00	6.26	12.2	18.6
01/28/76	c 0.76	8.64	0.25	4.87	11.6	0.29	6.55	12.8	17.1
02/04/76	c 0.76	4.09	3.02	7.89	12.8	3.89	10.44	12.8	17.1
02/11/76	c 0.76	0.00	0.96	8.85	12.5	1.22	11.66	12.5	16.6
02/19/76	c 0.76	0.00	0.00	8.85	-	-	-	-	-
02/25/76	c 0.76	0.89	0.00	8.85	-	-	-	-	-
03/02/76	c 0.76	0.00	0.00	8.85	-	-	-	-	-
03/08/76	c 0.76	2.54	0.00	8.85	-	-	-	-	-
03/16/76	c 0.76	4.85	0.00	8.85	26.2	-	-	15.0	16.9
03/24/76	c 0.76	0.61	0.38	9.23	26.2	1.02	12.68	-	-

Appendix Table 3, Cont'd. Field A-Lower Coastal Plain Tobacco Research Station

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
11/01/74	-	-	-	-	-	-	-	-	-
11/06/74	-	-	-	-	-	-	-	-	-
11/14/74	-	-	-	-	-	-	-	-	-
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	g0.1	-	-	-	-	-	-	-	2.5
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	-	-	-	-	-	-	-	-	-
12/27/74	-	-	-	-	-	-	-	-	-
01/03/75	-	-	-	-	-	-	-	-	-
01/09/75	<.1	-	-	-	-	-	-	-	1.6
01/15/75	-	-	0.00	-	-	0.04	-	-	2.4
01/23/75	-	-	-	-	-	-	-	-	-
01/29/75	-	-	-	-	-	-	-	-	-
02/06/75	-	-	-	-	-	-	-	-	-
02/12/75	-	-	-	-	-	-	-	-	-
02/20/75	<.1	-	-	-	-	-	-	-	-
02/26/75	-	-	-	-	-	-	-	-	-
03/06/75	-	-	-	-	-	-	-	-	-
03/14/75	-	-	-	-	-	-	-	-	-
03/21/75	-	-	-	-	-	-	-	-	-
03/28/75	-	-	-	-	-	-	-	-	-
04/04/75	-	-	-	-	-	-	-	-	-
04/10/75	-	-	-	-	-	-	-	-	-
12/31/75	-	-	-	-	0.01	-	-	-	4.0
01/08/76	<.1	-	-	-	0.04	0.08	-	2.2	1.8
01/14/76	<.1	-	-	-	0.02	0.03	-	2.2	4.6
01/21/76	<.1	-	-	-	0.10	0.23	-	2.6	2.4
01/28/76	<.1	-	-	-	0.40	0.10	-	-	-
02/04/76	<.1	-	-	-	0.00	0.00	-	-	-
02/11/76	<.1	-	-	-	0.04	0.03	-	1.8	1.6
02/19/76	-	-	-	-	-	-	-	-	-
02/25/76	-	-	-	-	-	-	-	-	-
03/02/76	-	-	-	-	-	-	-	-	-
03/08/76	-	-	-	-	-	-	-	-	-
03/16/76	<.1	-	-	-	0.09	0.03	-	2.1	1.8
03/24/76	-	-	-	-	-	-	-	-	-

FIELD B - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

			FLOW		NO_3-N				Cl
Sampling Date	Weir Depth (m)	Rain cm	cm/wk	cm	Conc. comp. ppm	Loss kg/ha/wk	Loss kg/ha	Conc. grab ppm	Conc. comp. ppm
01/28/74	c 0.76	3.65	0.00	0.00	-	-	-	-	-
02/05/74	c 0.76	5.64	0.00	0.00	-	-	-	14.4	g 14.4
02/14/74	c 0.76	1.93	0.00	0.00	-	-	-	14.0	g 15.2
02/21/74	c 0.76	3.18	0.00	0.00	-	-	-	13.6	g 11.8
03/27/74	c 0.76	11.17	0.00	0.00	-	-	-	13.4	g 12.9
04/01/74	c 0.76	4.14	0.51	0.51	-	0.66	0.66	12.8	g 13.8
04/09/74	c 0.76	3.07	0.00	0.51	13.5	0.00	0.66	14.3	g 13.2
06/05/74	u	19.78	-	-	-	-	-	4.1	g 6.8
08/02/74	u	18.72	-	-	-	-	-	-	-
08/08/74	u	10.06	-	-	-	-	-	14.8	g 16.6
08/15/74	u	8.76	-	-	-	-	-	12.7	g 15.1
08/20/74	u	9.35	-	-	-	-	-	12.3	g 13.6
08/28/74	u	2.82	-	-	-	-	-	13.5	g 12.8
09/11/74	u	7.04	-	-	-	-	-	12.5	g 14.7
10/03/74	u	1.54	0.00	0.51	-	-	-	-	-
11/26/74	u	11.68	0.00	0.51	-	-	-	-	-
12/04/74	u	4.60	0.00	0.00	0.7	0.00	0.00	-	10.2
12/11/74	u	1.35	0.00	0.00	-	-	-	-	-
12/19/74	u	0.76	0.00	0.00	-	-	-	-	-
12/27/74	u	2.34	0.00	0.00	-	-	-	-	-
01/03/75	u	2.29	0.00	0.00	-	-	-	-	-
01/09/75	u	1.91	0.00	0.00	-	-	-	-	-
01/15/75	u	4.65	1.68	1.68	4.9	0.82	0.82	15.9	9.9
01/23/75	u	1.90	1.24	2.92	12.5	1.56	2.38	14.4	14.7
01/29/75	u	2.29	1.62	4.54	9.0	1.46	3.84	9.4	13.8
02/06/75	u	3.25	0.61	5.15	13.3	0.83	4.67	13.8	13.7
02/12/75	u	0.18	0.43	5.58	13.8	0.62	5.29	12.8	14.6
02/20/75	u	6.73	1.88	7.46	10.8	2.03	7.32	13.6	13.1
02/26/75	u	2.31	2.26	9.72	12.9	2.91	10.23	13.3	15.1
03/06/75	u	0.81	0.71	10.43	13.2	0.93	11.16	12.3	13.8
03/14/75	u	4.06	0.00	10.43	12.1	0.01	11.17	-	13.3
03/21/75	u	3.30	0.99	11.42	12.8	1.28	12.45	14.0	14.0
03/28/75	u	1.88	0.46	11.88	13.0	0.60	13.05	13.0	13.4
04/04/75	u	2.38	0.02	11.90	12.2	0.03	13.08	-	14.6

Appendix Table 3, Cont'd. Field B-Lower Coastal Plain Tobacco Research Station

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
01/28/74	-	-	-	-	-	-	-	-	-
02/05/74	-	-	-	-	-	-	-	-	-
02/14/74	g<.1	-	-	-	-	-	-	-	3.0
02/21/74	-	-	-	-	-	-	-	-	-
03/27/74	-	-	-	-	-	-	-	-	-
04/01/74	g<.1	-	-	-	-	-	-	-	3.6
04/09/74	g0.1	-	-	-	-	-	-	-	2.6
06/05/74	g<.1	-	-	-	-	-	-	-	6.9
08/02/74	-	-	-	-	-	-	-	-	-
08/08/74	g<.1	-	-	-	-	-	-	-	2.3
08/15/74	g<.1	-	-	-	-	-	-	-	3.5
08/20/74	g<.1	-	-	-	-	-	-	-	3.5
08/28/74	-	-	-	-	-	-	-	-	2.6
09/11/74	g<.1	-	-	-	-	-	-	-	2.2
10/03/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	0.2	-	-	-	-	-	-	2.8	-
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	-	-	-	-	-	-	-	-	-
12/27/74	-	-	-	-	-	-	-	-	-
01/03/75	-	-	-	-	-	-	-	-	-
01/09/75	-	-	-	-	-	-	-	-	-
01/15/75	<.1	0.40	0.20	-	0.03	0.03	-	6.4	2.1
01/23/75	-	-	-	-	-	-	-	-	-
01/29/75	<.1	-	-	-	-	-	-	2.0	2.0
02/06/75	-	-	-	-	-	-	-	-	-
02/12/75	-	-	-	-	-	-	-	-	-
02/20/75	<.1	-	-	-	-	-	-	-	-
02/26/75	-	-	-	-	-	-	-	-	-
03/06/75	<.1	-	-	-	-	-	-	-	-
03/14/75	-	-	-	-	-	-	-	-	-
03/21/75	<.1	-	-	-	-	-	-	-	-
03/28/75	<.1	-	-	-	-	-	-	2.8	2.6
04/04/75	-	-	-	-	-	-	-	-	-

FIELD B - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

Sampling Date	Weir Depth (m)	Rain cm	FLOW cm/wk	FLOW cm	NO_3-N Conc. comp. ppm	NO_3-N Loss kg/ha/wk	NO_3-N Loss kg/ha	NO_3-N Conc. grab ppm	Cl Conc. comp. ppm
04/10/75	u	0.69	0.00	11.90	-	-	-	-	-
12/31/75	c 0.76	82.12	-	-	-	-	-	-	-
01/08/76	c 0.76	2.29	-	-	-	-	-	16.4	g 16.5
01/14/76	c 0.76	0.25	-	-	-	-	-	-	-
01/21/76	c 0.76	3.83	-	-	-	-	-	-	-
01/28/76	c 0.76	8.64	0.53	0.53	12.0	0.63	0.63	9.4	13.8
02/04/76	c 0.76	4.09	1.27	1.80	16.2	2.05	2.68	12.7	12.3
02/11/76	c 0.76	0.00	-	-	-	-	-	-	-
02/19/76	c 0.76	0.00	-	-	-	-	-	-	-
02/25/76	c 0.76	0.89	-	-	-	-	-	-	-
03/02/76	c 0.76	0.00	-	-	-	-	-	-	-

Appendix Table 3, Cont'd. Field B-Lower Coastal Plain Tobacco Research Station

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
04/10/75	-	-	-	-	-	-	-	-	-
12/31/75	-	-	-	-	-	-	-	-	-
01/08/76	g<.1	-	-	-	-	0.01	-	-	2.1
01/14/76	-	-	-	-	-	-	-	-	-
01/21/76	-	-	-	-	-	-	-	-	-
01/28/76	2.1	-	-	-	0.02	0.04	-	4.0	2.6
02/04/76	<.1	-	-	-	0.05	0.02	-	2.9	1.7
02/11/76	-	-	-	-	-	-	-	-	-
02/19/76	-	-	-	-	-	-	-	-	-
02/25/76	-	-	-	-	-	-	-	-	-
03/02/76	-	-	-	-	-	-	-	-	-

FIELD C - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

			FLOW		NO_3-N				Cl
Sampling Date	Weir Depth (m)	Rain cm	cm/wk	cm	Conc. comp. ppm	Loss kg/ha/wk	Loss kg/ha	Conc. grab ppm	Conc. comp. ppm
12/28/73	u	1.90	4.34	4.34	11.1	4.82	4.82	13.8	13.0
01/08/74	u	2.46	0.00	4.34	-	0.00 g	4.82	16.0	18.7
02/05/74	u	9.29	1.45	5.79	14.1	2.06	6.88	15.1	12.2
02/14/74	u	1.93	0.53	6.32	15.8	0.85	7.73	14.5	18.2
02/21/74	u	3.18	0.79	7.11	14.9	1.18	8.91	14.8	12.0
02/27/74	u	0.18	0.13	7.24	8.4	0.18	9.09	14.9	12.7
03/06/74	u	0.00	0.00	7.24	-	-	-	-	-
03/22/74	u	6.88	0.00	7.24	-	-	-	-	-
03/27/74	u	4.11	0.51	7.75	14.4	0.75	9.84	14.4	12.7
04/01/74	u	4.14	1.98	9.73	15.1	2.99	12.83	14.3	12.8
04/09/74	u	3.07	0.48	10.21	14.7	0.70	13.53	14.7	12.3
04/16/74	u	1.80	0.00	10.21	14.3	0.00	13.53	-	-
05/23/74	u	8.94	0.00	10.21	-	-	-	-	-
06/05/74	u	9.04	0.00	10.21	9.7	0.00	13.53	12.0	11.0
06/19/74	u	1.12	0.00	10.21	-	-	-	-	-
06/26/74	u	0.86	0.00	10.21	-	-	-	-	-
07/03/74	u	2.29	0.00	10.21	-	-	-	-	-
07/10/74	u	4.42	0.00	10.21	-	-	-	-	-
07/16/74	u	0.25	0.00	10.21	-	-	-	-	-
08/02/74	u	9.78	0.00	10.21	10.7	0.01	13.54	-	-
08/08/74	u	10.06	0.86	11.07	12.9	1.11	14.65	13.7	14.0
08/15/74	u	8.76	2.62	13.69	13.5	3.54	18.19	12.5	13.3
08/20/74	u	9.35	3.66	17.35	10.9	3.98	22.17	12.5	12.6
08/28/74	u	2.82	1.47	18.82	-	1.76 g	23.93	13.5	14.6
09/05/74	u	2.67	0.02	18.84	5.8	0.02	23.95	-	-
09/11/74	u	4.37	0.25	19.09	-	0.31 g	24.26	13.0	13.7
09/18/74	u	1.14	0.00	19.09	-	-	-	-	-
09/24/74	u	0.20	0.00	19.09	-	-	-	-	-
10/03/74	u	0.20	0.00	19.09	-	-	-	-	-
10/17/74	c 0.76	2.21	0.00	19.09	-	-	-	-	-
10/23/74	c 0.76	1.91	0.00	19.09	-	-	-	-	-
11/01/74	c 0.76	0.18	0.00	19.09	-	-	-	-	-
11/06/74	c 0.76	0.00	0.00	19.09	-	-	-	-	-
11/14/74	c 0.76	0.30	0.00	19.09	-	-		-	-

Appendix Table 3, Cont'd. Field C-Lower Coastal Plain Tobacco Research Station

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
12/28/73	<.1	-	-	-	-	0.02	-	-	2.6
01/08/74	0.9	-	-	-	-	0.01	-	-	-
02/05/74	<.1	-	-	-	-	0.03	-	-	1.2
02/14/74	0.4	-	-	-	-	0.05	-	-	2.0
02/21/74	<.1	-	-	-	-	0.05	-	-	2.0
02/27/74	<.1	-	-	-	-	0.09	-	-	-
03/06/74	-	-	-	-	-	-	-	-	-
03/22/74	-	-	-	-	-	-	-	-	-
03/27/74	<.1	-	-	-	-	-	-	-	-
04/01/74	<.1	-	-	-	-	-	-	-	2.2
04/09/74	<.1	-	-	-	-	-	-	-	2.0
04/16/74	-	-	-	-	-	-	-	-	-
05/23/74	-	-	-	-	-	-	-	-	-
06/05/74	0.2	-	-	-	-	-	-	-	6.0
06/19/74	-	-	-	-	-	-	-	-	-
06/26/74	-	-	-	-	-	-	-	-	-
07/03/74	-	-	-	-	-	-	-	-	-
07/10/74	-	-	-	-	-	-	-	-	-
07/16/74	-	-	-	-	-	-	-	-	-
08/02/74	<.1	-	-	-	-	-	-	-	-
08/08/74	<.1	-	-	-	-	-	-	-	2.4
08/15/74	<.1	-	-	-	-	-	-	-	3.8
08/20/74	<.1	-	-	-	-	-	-	-	4.1
08/28/74	-	-	-	-	-	-	-	-	2.3
09/05/74	-	-	-	-	-	-	-	-	-
09/11/74	<.1	-	-	-	-	-	-	-	1.4
09/18/74	-	-	-	-	-	-	-	-	-
09/24/74	-	-	-	-	-	-	-	-	-
10/03/74	-	-	-	-	-	-	-	-	-
10/17/74	-	-	-	-	-	-	-	-	-
10/23/74	-	-	-	-	-	-	-	-	-
11/01/74	-	-	-	-	-	-	-	-	-
11/06/74	-	-	-	-	-	-	-	-	-
11/14/74	-	-	-	-	-	-	-	-	-

FIELD C - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

			FLOW		NO_3-N				Cl
Sampling Date	Weir Depth (m)	Rain cm	cm/wk	cm	Conc. comp. ppm	Loss kg/ha/wk	Loss kg/ha	Conc. grab ppm	Conc. comp. ppm
11/20/74	c 0.76	4.90	0.00	19.09	-	-	-	-	-
11/26/74	c 0.76	0.64	0.00	19.09	-	-	-	-	-
12/04/74	c 0.76	4.60	0.00	0.00	-	-	-	-	-
12/11/74	c 0.76	1.35	0.00	0.00	-	-	-	-	-
12/19/74	c 0.76	0.76	0.00	0.00	-	-	-	-	-
12/27/74	c 0.76	2.34	0.00	0.00	-	-	-	-	-
01/03/75	c 0.76	2.29	0.00	0.00	-	-	-	-	-
01/09/75	c 0.76	1.91	0.00	0.00	-	-	-	-	-
01/15/75	c 0.76	4.65	0.91	0.91	15.4	1.40	1.40	15.2	14.3
01/23/75	c 0.76	1.90	0.43	1.34	14.4	0.60	2.00	14.1	13.4
01/29/75	c 0.76	2.29	0.74	2.08	14.1	1.03	3.03	13.8	13.3
02/06/75	c 0.76	3.25	0.20	2.28	13.0	0.28	3.31	13.3	13.0
02/12/75	c 0.76	0.18	0.13	2.41	13.4	0.18	3.49	-	13.4
02/20/75	c 0.76	6.73	1.07	3.48	12.3	1.31	4.80	13.6	10.1
02/26/75	c 0.76	2.31	1.09	4.57	12.5	1.37	6.17	12.9	12.9
03/06/75	c 0.76	0.81	0.13	4.70	12.5	0.16	6.33	-	12.5
03/14/75	c 0.76	4.06	0.00	4.70	-	-	-	-	-
03/21/75	c 0.76	3.30	0.43	5.13	13.4	0.58	6.91	13.4	13.4
03/28/75	c 0.76	1.88	0.13	5.26	13.8	0.18	7.09	-	14.7
04/04/75	c 0.76	2.38	0.00	5.26	-	-	-	-	-
04/10/75	c 0.76	0.69	0.00	5.26	-	-	-	-	-
12/31/75	u	82.12	-	-	-	-	-	18.0	15.5
01/08/76	u	2.29	2.84	2.84	16.4	4.68	4.68	16.4	15.3
01/14/76	u	0.25	1.27	4.11	15.0	1.92	6.60	15.0	15.5
01/21/76	u	3.83	0.71	4.82	15.8	1.14	7.74	15.0	14.9
01/28/76	u	8.64	1.73	6.55	15.0	2.58	10.32	18.0	15.1
02/04/76	u	4.09	3.71	10.26	15.4	5.70	16.02	15.8	13.4
02/11/76	u	0.00	0.76	11.02	14.2	1.08	17.10	14.2	13.7
02/19/76	u	0.00	-	11.02	-	-	-	-	-
02/25/76	u	0.89	-	11.02	-	-	-	-	-
03/02/76	u	0.00	-	11.02	-	-	-	-	-

Appendix Table 3, Cont'd. Field C-Lower Coastal Plain Tobacco Research Station

Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	-	-	-	-	-	-	-	-	-
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	-	-	-	-	-	-	-	-	-
12/27/74	-	-	-	-	-	-	-	-	-
01/03/75	-	-	-	-	-	-	-	-	-
01/09/75	-	-	-	-	-	-	-	-	-
01/15/75	<.1	0.20	0.30	-	0.03	0.02	-	2.4	2.3
01/23/75	<.1	-	-	-	-	-	-	-	-
01/29/75	-	-	-	-	-	-	-	1.7	1.1
02/06/75	-	-	-	-	-	-	-	-	-
02/12/75	-	-	-	-	-	-	-	-	-
02/20/75	<.1	-	-	-	-	-	-	-	-
02/26/75	-	-	-	-	-	-	-	-	-
03/06/75	<.1	-	-	-	-	-	-	-	-
03/14/75	-	-	-	-	-	-	-	-	-
03/21/75	<.1	-	-	-	-	-	-	-	-
03/28/75	<.1	-	-	-	-	-	-	2.5	-
04/04/75	-	-	-	-	-	-	-	-	-
04/10/75	-	-	-	-	-	-	-	-	-
12/31/75	g<.1	-	-	-	-	0.02	-	-	2.0
01/08/76	<.1	-	-	-	0.02	0.02	-	1.5	1.9
01/14/76	<.1	-	-	-	0.02	0.02	-	1.8	2.4
01/21/76	<.1	-	-	-	0.02	0.02	-	1.3	-
01/28/76	<.1	-	-	-	0.01	0.04	-	1.4	1.8
02/04/76	<.1	-	-	-	0.02	0.05	-	-	-
02/11/76	<.1	-	-	-	0.14	0.03	-	1.4	1.5
02/19/76	-	-	-	-	-	-	-	-	-
02/25/76	-	-	-	-	-	-	-	-	-
03/02/76	-	-	-	-	-	-	-	-	-

FIELD D - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

			FLOW		NO_3-N				Cl
Sampling Date	Weir Depth (m)	Rain cm	cm/wk	cm	Conc. comp. ppm	Loss kg/ha/wk	Loss kg/ha	Conc. grab ppm	Conc. comp. ppm
12/18/73		0.41	-	-	-	-	-	-	-
12/20/73		-	-	-	-	-	-	-	-
12/28/73	c 0.76	1.90	0.00	0.00	14.0	0.01	0.01	13.8	g 11.8
01/08/74	c 0.76	2.46	0.00	0.00	-	-	-	14.9	g 18.1
02/05/74	c 0.76	9.29	0.41	0.41	-	0.59	0.60	14.8	g 10.0
02/14/74	c 0.76	1.93	0.05	0.46	15.7	0.07	0.67	14.4	g 11.7
02/21/74	c 0.76	3.18	0.00	0.46	17.9	0.00	0.67	14.4	g 10.3
03/22/74	c 0.76	7.06	0.00	0.46	-	-	-	-	-
03/27/74	c 0.76	4.11	0.43	0.89	-	0.64 g	1.31	14.7	g 10.8
04/01/74	c 0.76	4.14	1.42	2.31	13.7	1.96	3.27	13.7	g 9.6
04/09/74	c 0.76	3.07	-	-	-	-	-	14.0	g 10.4
06/05/74	u	19.78	-	-	-	-	-	1.3	g 11.5
08/02/74	u	18.72	-	-	-	-	-	-	-
08/08/74	u	10.06	-	-	-	-	-	13.7	g 12.0
08/15/74	u	8.76	-	-	-	-	-	14.3	g 11.6
08/28/74	u	12.17	-	-	-	-	-	14.0	g 11.5
09/11/74	u	7.04	-	-	-	-	-	13.5	g 11.6
10/03/74	u	1.54	-	-	-	-	-	-	-
10/17/74	u	2.21	-	-	-	-	-	-	-
10/23/74	u	1.91	-	-	-	-	-	-	-
11/01/74	u	0.18	-	-	-	-	-	-	-
11/06/74	u	0.00	-	-	-	-	-	-	-
11/14/74	u	0.30	-	-	-	-	-	-	-
11/20/74	u	4.90	-	-	-	-	-	-	-
11/26/74	u	0.64	-	-	-	-	-	-	-
12/04/74	u	4.60	0.00	-	-	-	-	-	-
12/11/74	u	1.35	0.00	-	-	-	-	-	-
12/19/74	u	0.76	0.00	-	-	-	-	-	-
12/27/74	u	2.34	0.00	-	-	-	-	-	-
01/03/75	u	2.29	0.36	0.36	-	-	-	14.9	g 12.7
01/09/75	u	1.91	0.05	0.41	13.4	0.06	0.06	14.0	12.3
01/15/75	u	4.65	1.70	2.11	14.1	2.42	2.48	14.9	13.5
01/23/75	u	1.90	0.86	2.97	14.6	1.28	3.76	14.4	14.1
01/29/75	u	2.29	1.12	4.09	14.4	1.60	5.36	14.0	12.2
02/06/75	u	3.25	0.23	4.32	12.7	0.30	5.66	13.4	12.0
02/12/75	u	0.18	0.25	4.57	13.0	0.34	6.00	12.5	13.2

Appendix Table 3, Cont'd. Field D-Lower Coastal Plain Tobacco Research Station

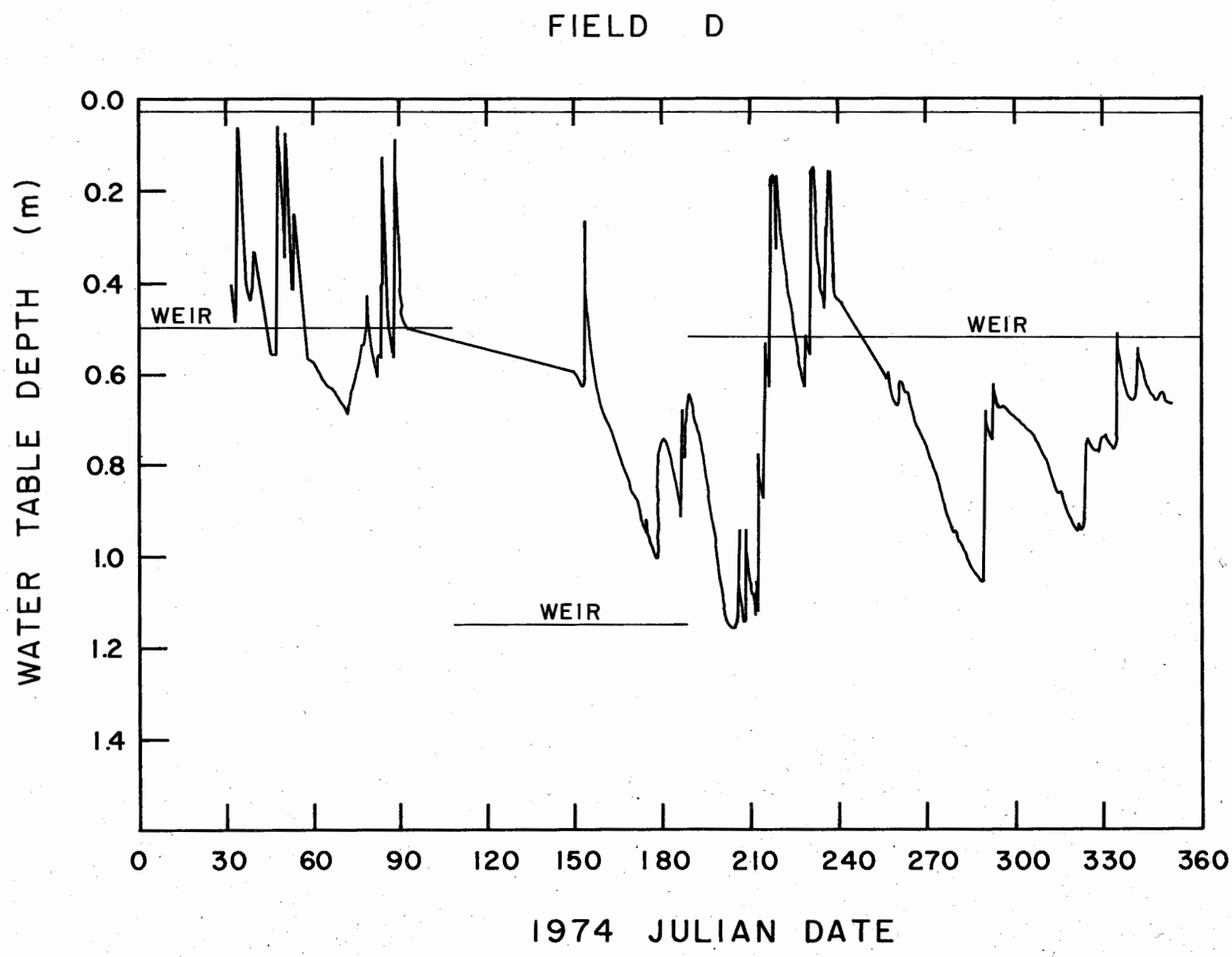
Sampling Date	NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. comp. ppm	Organic + NH_4-N Conc. grab ppm	Organic + NH_4-N Loss kg/ha	Total P Conc. comp. ppm	Total P Conc. grab ppm	Total P Loss kg/ha 10^{-2}	C Conc. comp. ppm	C Conc. grab ppm
12/18/73	-	-	-	-	-	-	-	-	-
12/20/73	-	-	-	-	-	-	-	-	-
12/28/73	g<.1	-	-	-	-	0.02	-	-	3.0
01/08/74	g<.1	-	-	-	-	0.02	-	-	-
02/05/74	-	-	-	-	-	-	-	-	-
02/14/74	g<.1	-	-	-	-	-	-	-	2.4
02/21/74	-	-	-	-	-	-	-	-	-
03/22/74	g<.1	-	-	-	-	-	-	-	1.8
03/27/74	g<.1	-	-	-	-	-	-	-	-
04/01/74	g<.1	-	-	-	-	-	-	-	2.6
04/09/74	g<.1	-	-	-	-	-	-	-	-
06/05/74	g<.1	-	-	-	-	-	-	-	23.2
08/02/74	-	-	-	-	-	-	-	-	-
08/08/74	g<.1	-	-	-	-	-	-	-	3.0
08/15/74	g<.1	-	-	-	-	-	-	-	2.2
08/28/74	g<.1	-	-	-	-	-	-	-	4.4
09/11/74	g<.1	-	-	-	-	-	-	-	1.9
10/03/74	-	-	-	-	-	-	-	-	-
10/17/74	-	-	-	-	-	-	-	-	-
10/23/74	-	-	-	-	-	-	-	-	-
11/01/74	-	-	-	-	-	-	-	-	-
11/06/74	-	-	-	-	-	-	-	-	-
11/14/74	-	-	-	-	-	-	-	-	-
11/20/74	-	-	-	-	-	-	-	-	-
11/26/74	-	-	-	-	-	-	-	-	-
12/04/74	-	-	-	-	-	-	-	-	-
12/11/74	-	-	-	-	-	-	-	-	-
12/19/74	-	-	-	-	-	-	-	-	-
12/27/74	-	-	-	-	-	-	-	-	-
01/03/75	g<.1	-	-	-	-	-	-	-	1.7
01/09/75	<.1	-	-	-	-	-	-	1.8	2.0
01/15/75	<.1	0.00	0.00	-	0.02	0.03	-	1.8	2.1
01/23/75	<.1	-	-	-	-	-	-	-	-
01/29/75	-	-	-	-	-	-	-	1.7	2.3
02/06/75	-	-	-	-	-	-	-	-	-
02/12/75	-	-	-	-	-	-	-	-	-

FIELD D - LOWER COASTAL PLAIN TOBACCO RESEARCH STATION NEAR KINSTON

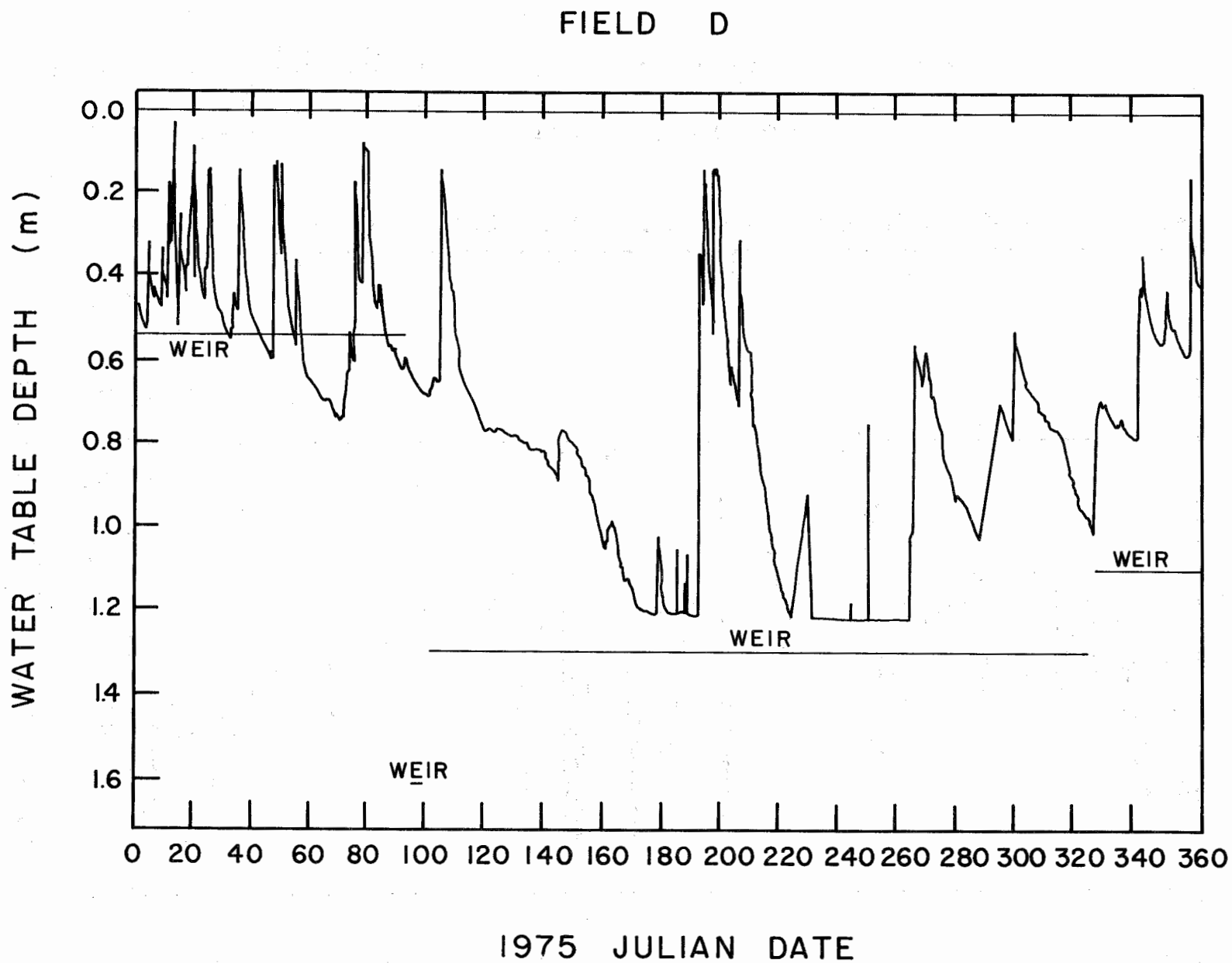
			FLOW		NO_3-N				Cl
Sampling Date	Weir Depth (m)	Rain cm	cm/wk	cm	Conc. comp. ppm	Loss kg/ha/wk	Loss kg/ha	Conc. grab ppm	Conc. comp. ppm
02/20/75	u	6.73	0.53	5.10	11.3	0.60	6.60	12.5	15.0
02/26/75	u	2.31	0.96	6.06	12.3	1.20	7.80	12.3	14.0
03/06/75	u	0.81	0.20	6.26	11.2	0.21	8.01	-	12.6
03/14/75	u	4.06	0.00	6.26	-	-	-	-	-
03/21/75	u	3.30	0.58	6.84	9.8	0.58	8.59	13.4	13.2
03/28/75	u	1.88	0.38	7.22	11.2	0.44	9.03	11.8	12.6
04/04/75	u	2.38	0.00	7.22	8.8	0.00	9.03	-	13.1
04/10/75	u	0.69	0.00	7.22	-	-	-	-	-
12/31/75	c 0.76	82.12	-	-	-	-	-	19.0	g 19.3
01/08/76	c 0.76	2.29	1.47	1.47	17.5	2.55	2.55	15.4	17.9
01/14/76	c 0.76	0.25	0.00	1.47	-	-	-	14.0	g 16.2
01/21/76	c 0.76	3.83	0.00	1.47	-	-	-	13.6	15.6
01/28/76	c 0.76	8.64	1.62	3.09	15.8	2.59	5.14	16.5	16.9
02/04/76	c 0.76	4.09	1.83	4.92	15.0	2.73	7.87	14.5	17.8
02/11/76	c 0.76	0.00	0.10	5.02	14.5	0.16	8.03	-	15.6
02/19/76	c 0.76	0.00	0.00	5.02	-	-	-	-	-
02/25/76	c 0.76	0.89	0.00	5.02	-	-	-	-	-
03/02/76	c 0.76	0.00	-	5.02	-	-	-	-	-

Appendix Table 3, Cont'd. Field D-Lower Coastal Plain Tobacco Research Station

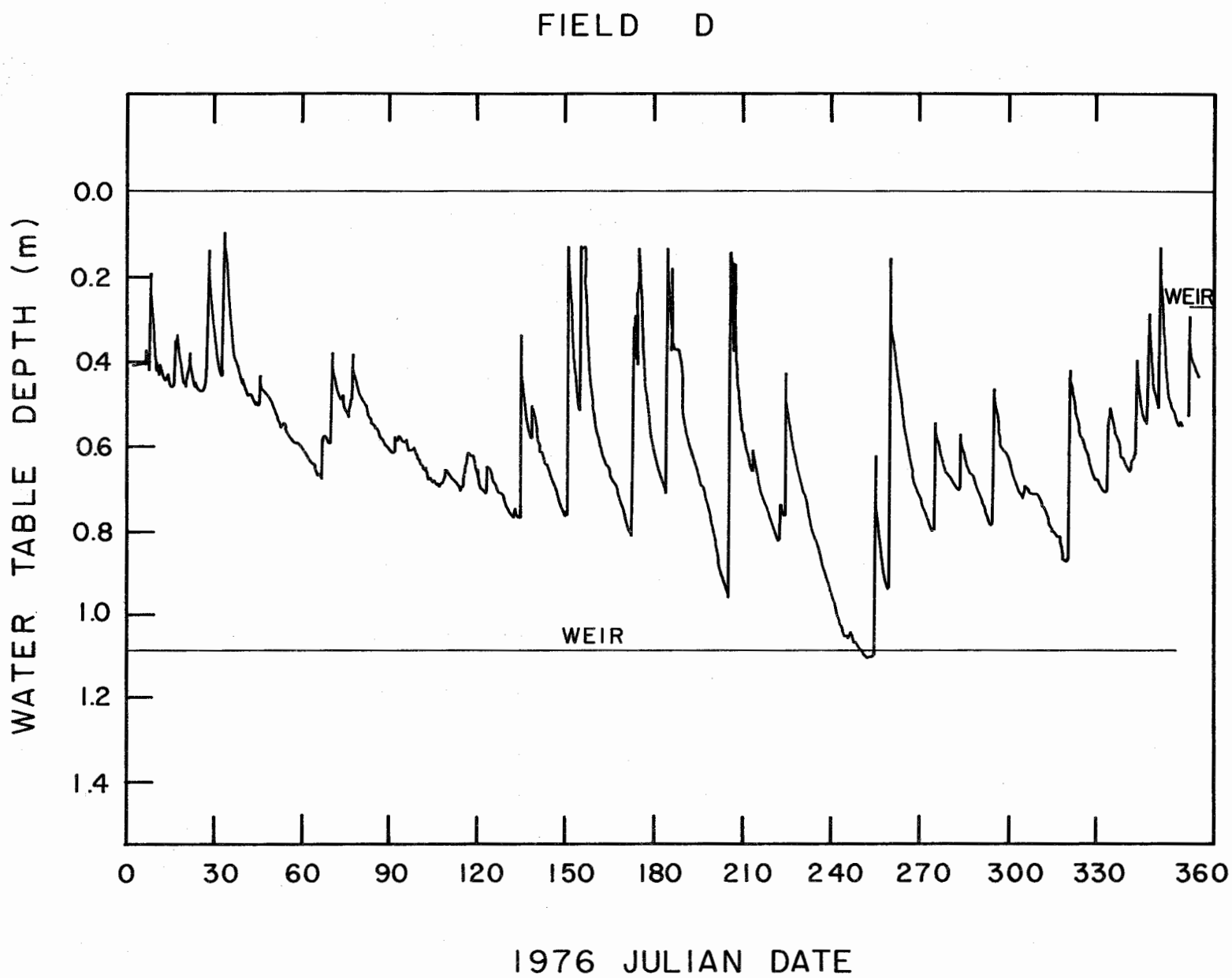
Sampling	NH_4-N	Organic + NH_4-N			Total P			C	
Date	Conc. comp. ppm	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha	Conc. comp. ppm	Conc. grab ppm	Loss kg/ha 10^{-2}	Conc. comp. ppm	Conc. grab ppm
02/20/75	<.1	-	-	-	-	-	-	-	-
02/26/75	-	-	-	-	-	-	-	-	-
03/06/75	<.1	-	-	-	-	-	-	-	-
03/14/75	-	-	-	-	-	-	-	-	-
03/21/75	0.2	-	-	-	-	0.02	-	-	-
03/28/75	0.1	-	1.5	-	-	-	-	3.4	3.0
04/04/75	-	-	-	-	-	-	-	-	-
04/10/75	-	-	-	-	-	-	-	-	-
12/31/75	<.1	-	-	-	-	0.01	-	-	2.4
01/08/76	g<.1	-	-	-	0.05	0.03	-	4.8	1.7
01/14/76	<.1	-	-	-	-	0.02	-	-	1.6
01/21/76	g<.1	-	-	-	-	-	-	-	-
01/28/76	1.6	-	-	-	0.02	0.01	-	2.0	1.8
02/04/76	<.1	-	-	-	0.05	0.00	-	1.8	1.7
02/11/76	<.1	-	-	-	0.09	-	-	-	-
02/19/76	-	-	-	-	-	-	-	-	-
02/25/76	-	-	-	-	-	-	-	-	-
03/02/76	-	-	-	-	-	-	-	-	-



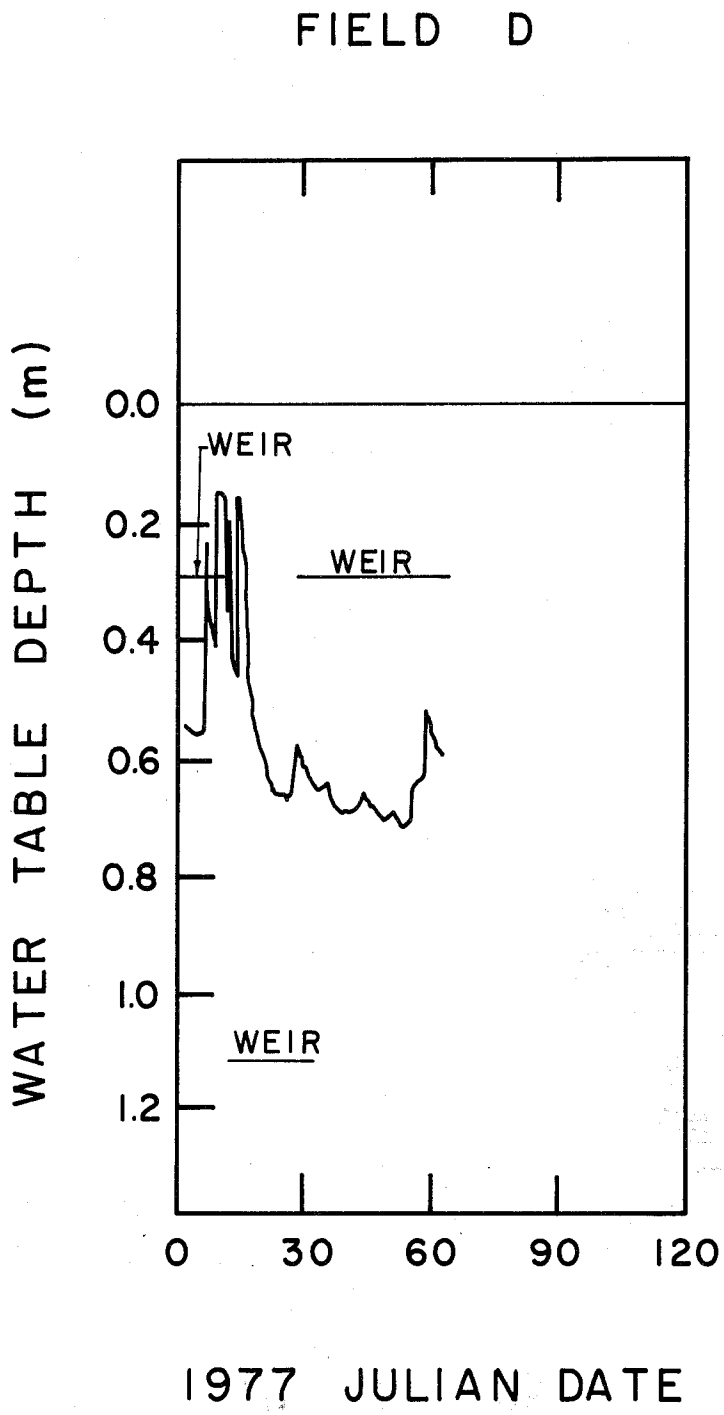
Appendix Figure 1. Water table depth in Field D and weir height at drainage outlet during 1974.



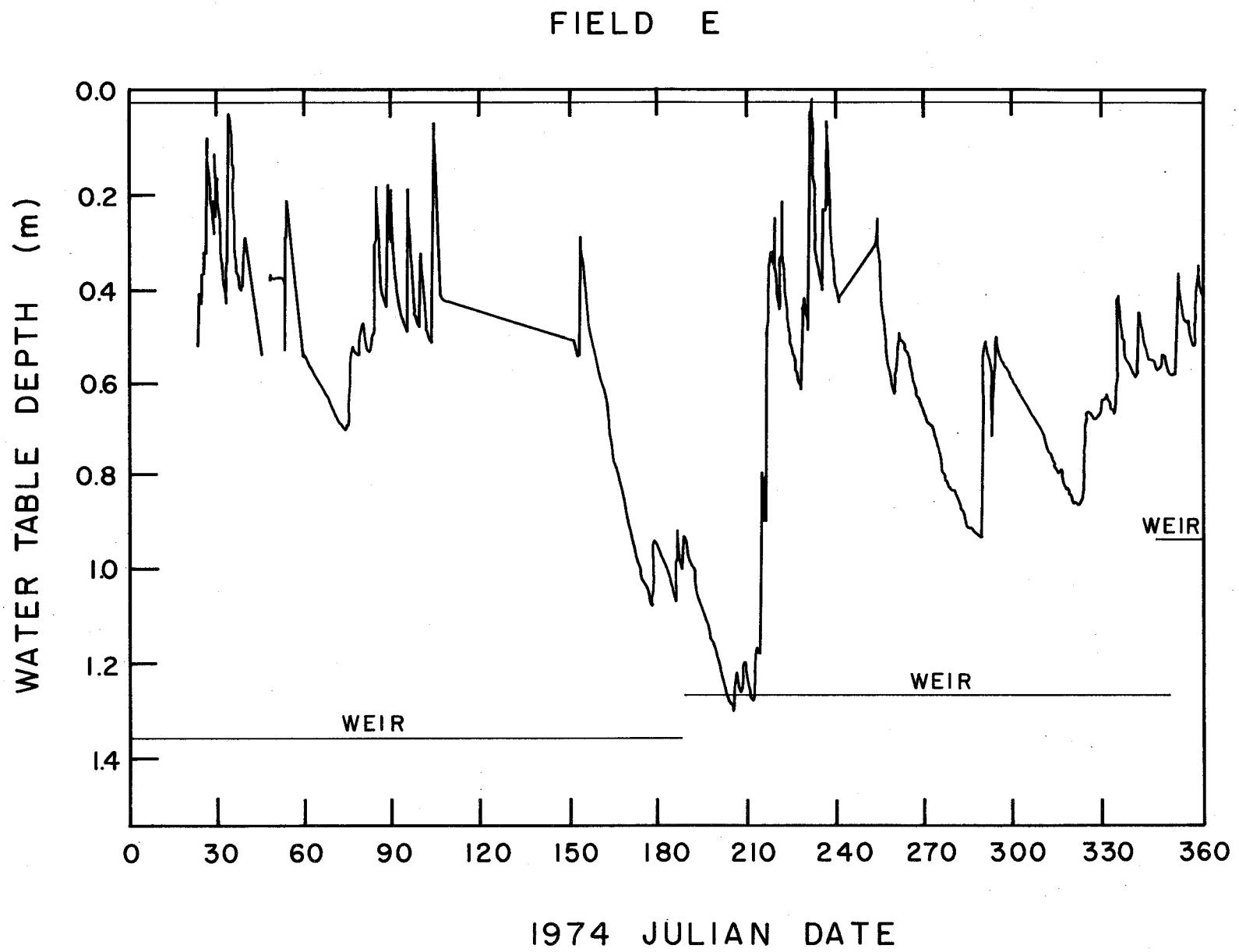
Appendix Figure 2. Water table depth in Field D and weir height at drainage outlet during 1975.



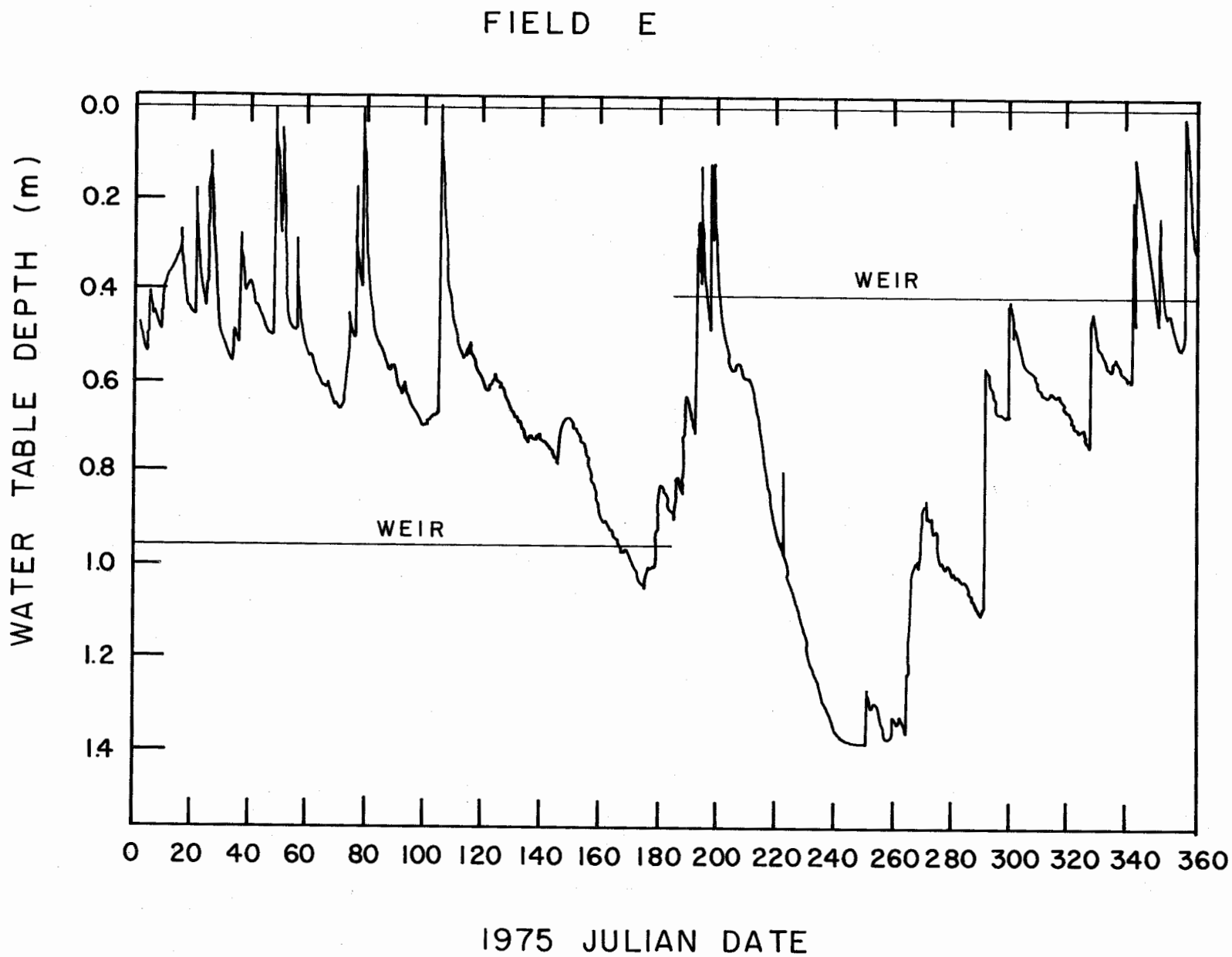
Appendix Figure 3. Water table depth in Field D and weir height at drainage outlet during 1976.



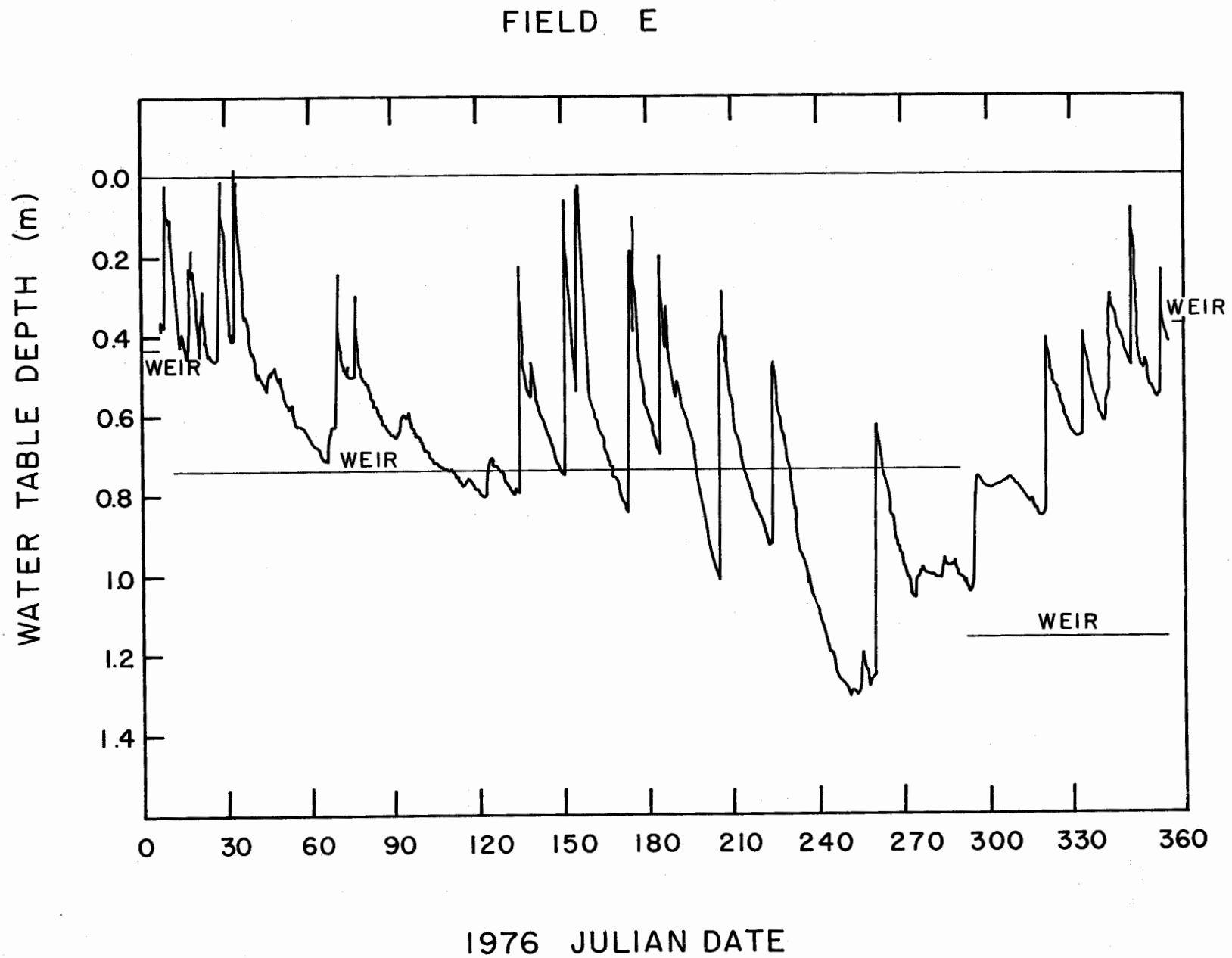
Appendix Figure 4. Water table depth in Field D and weir height at drainage outlet during 1977.



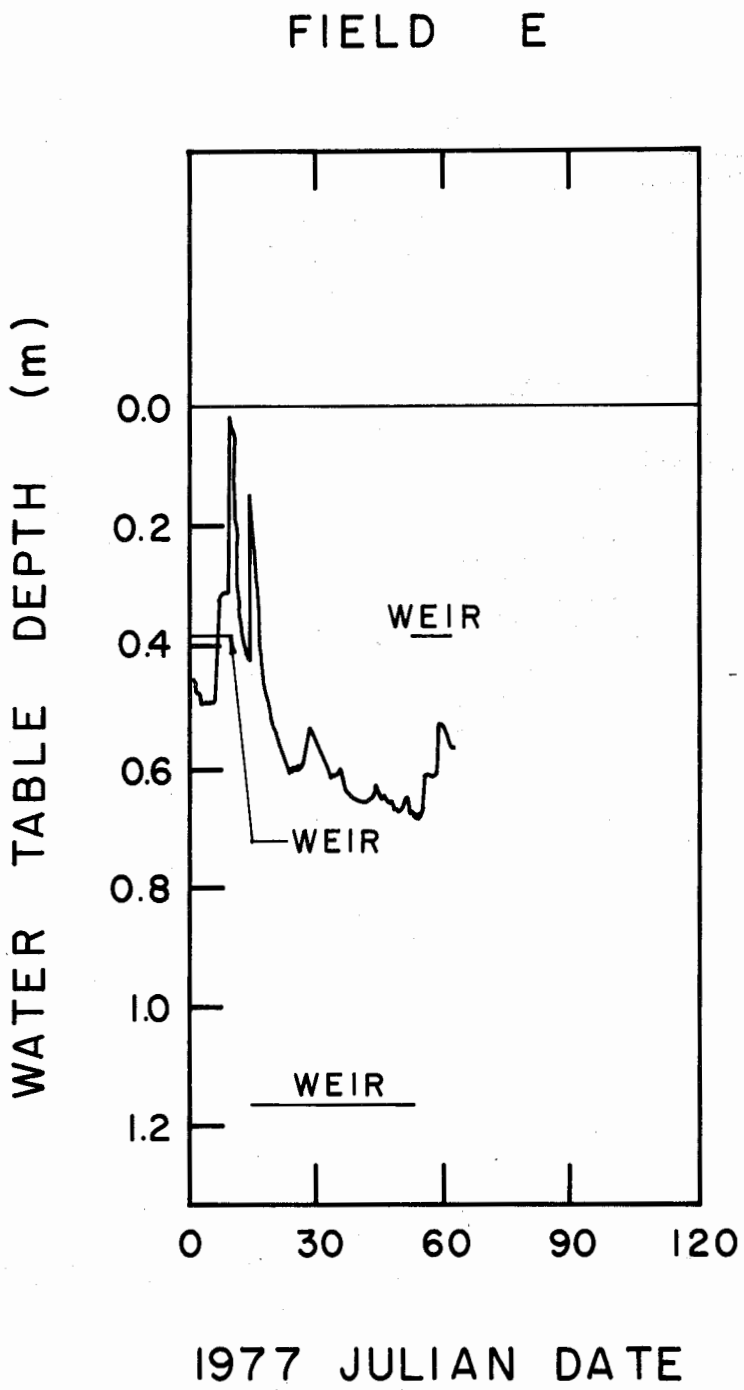
Appendix Figure 5. Water table depth in Field E and weir height at drainage outlet during 1974.



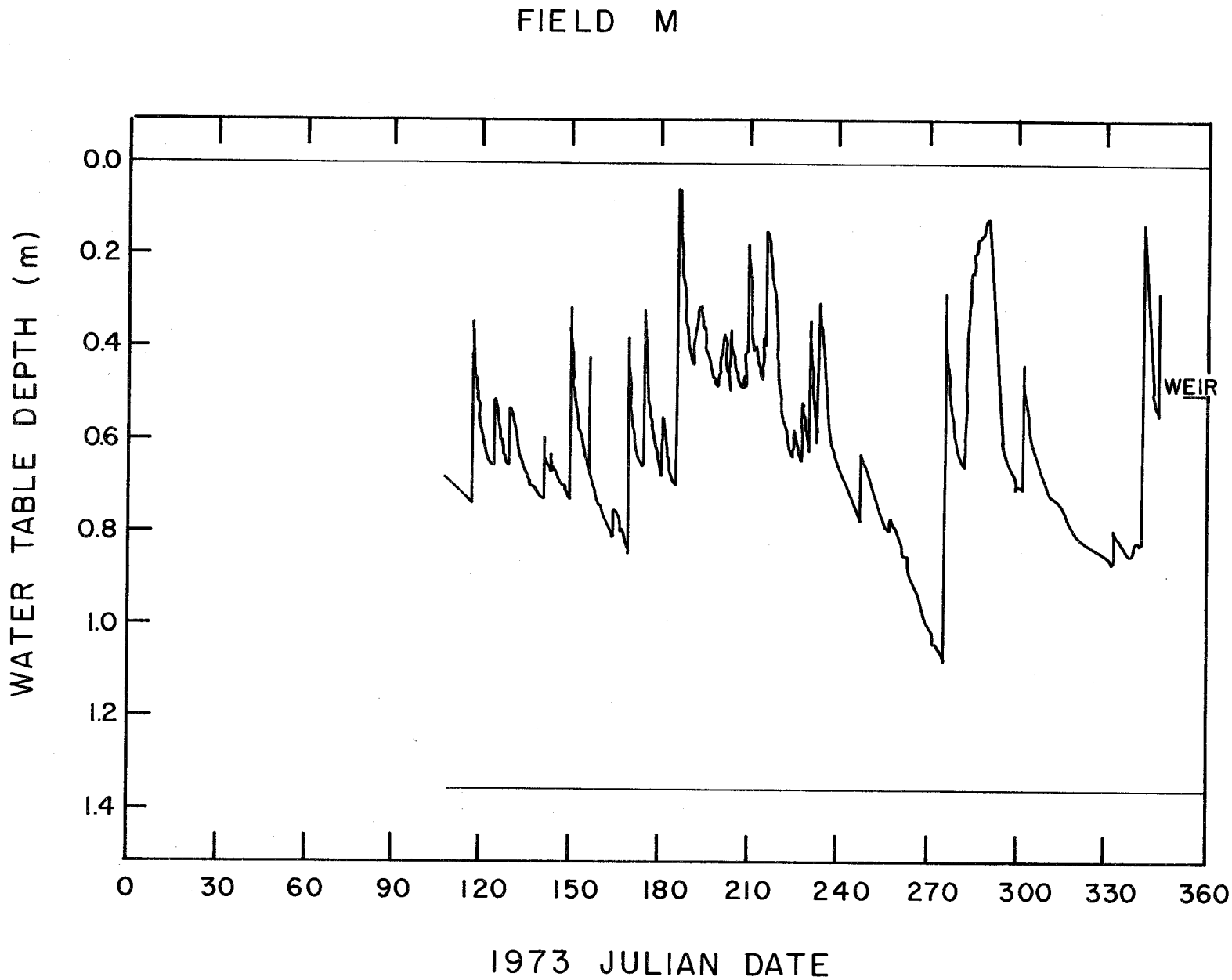
Appendix Figure 6. Water table depth in Field E and weir height at drainage outlet during 1975.



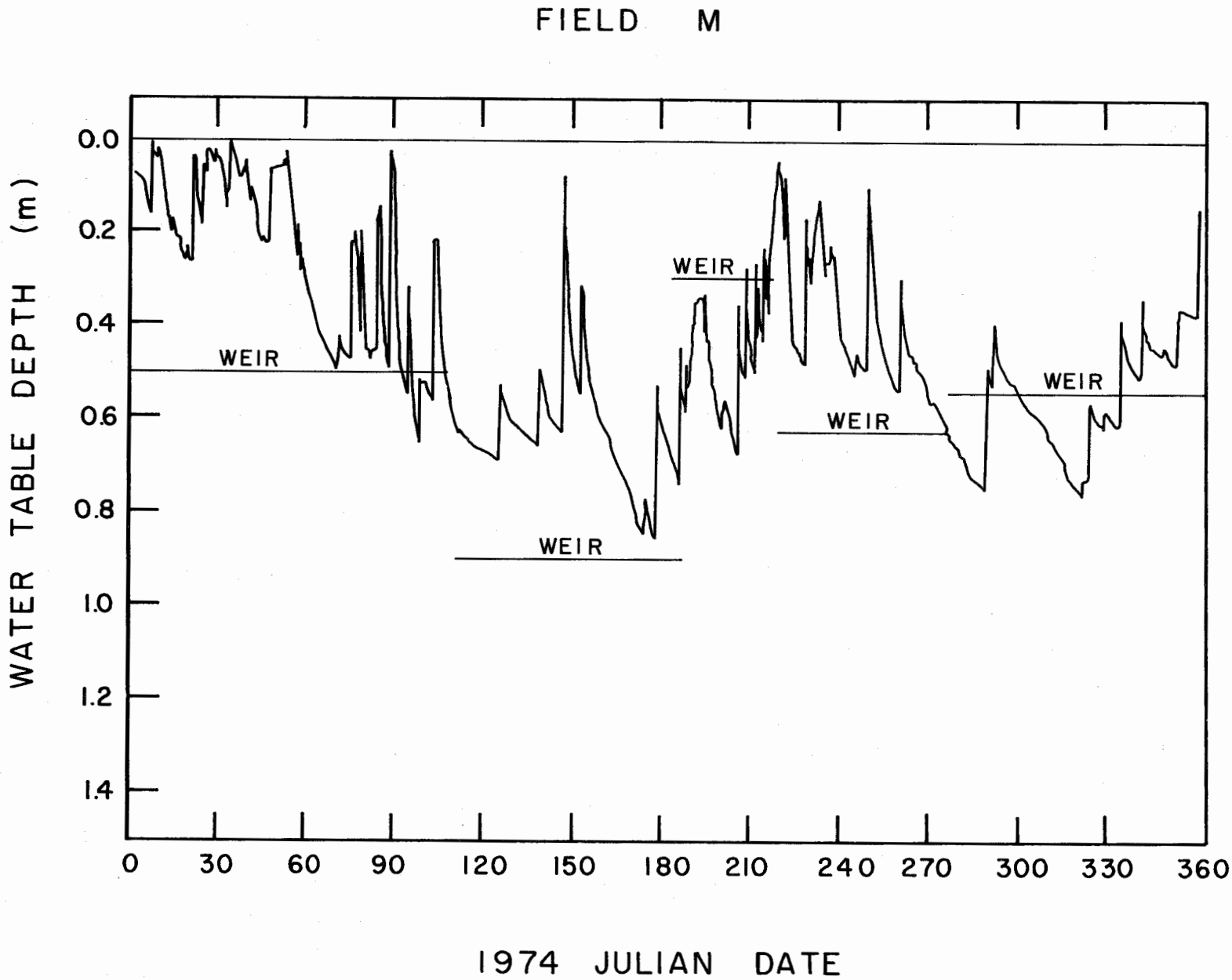
Appendix Figure 7. Water table depth in Field E and weir height at drainage outlet during 1976.



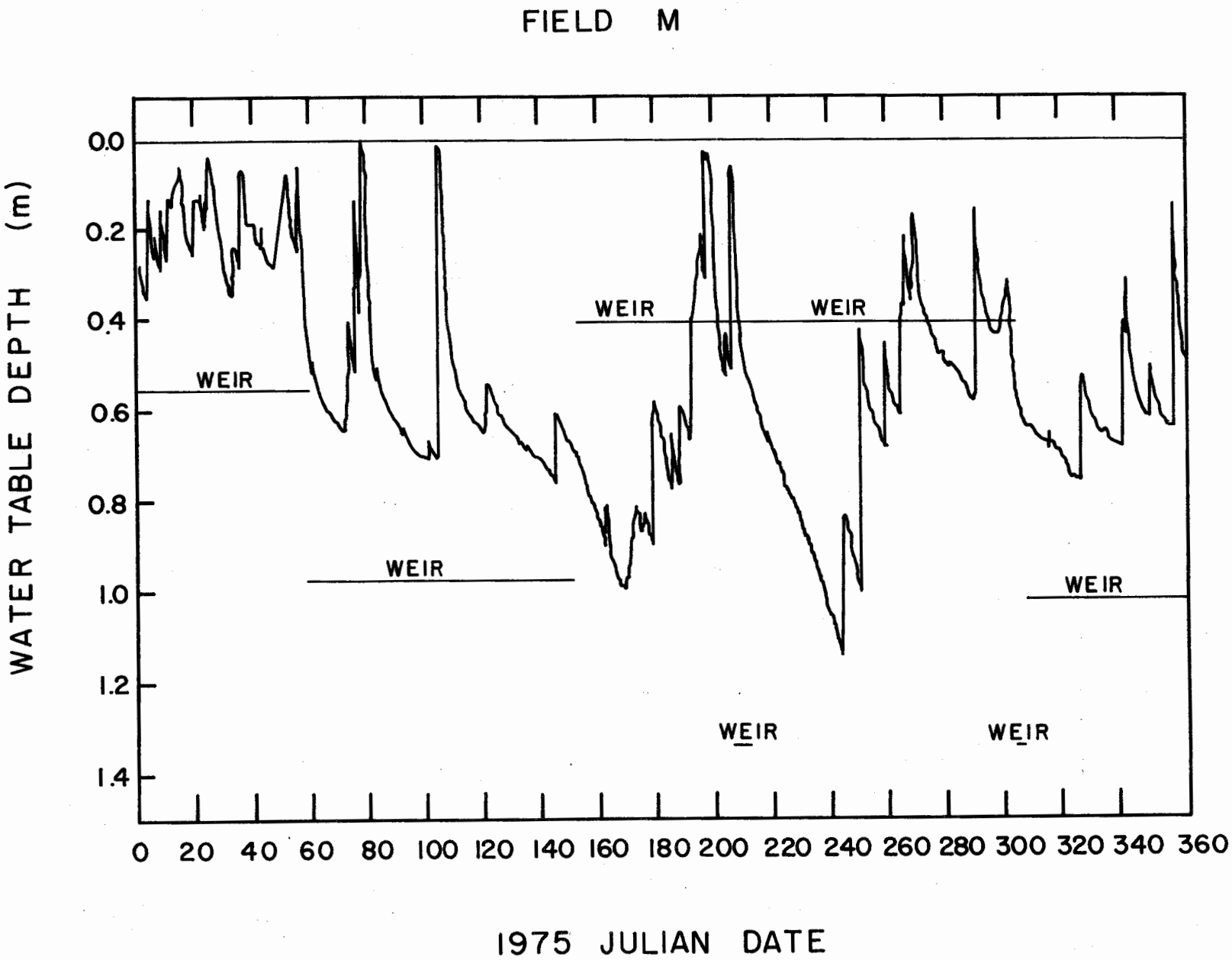
Appendix Figure 8. Water table depth in Field E and weir height at drainage outlet during 1977.



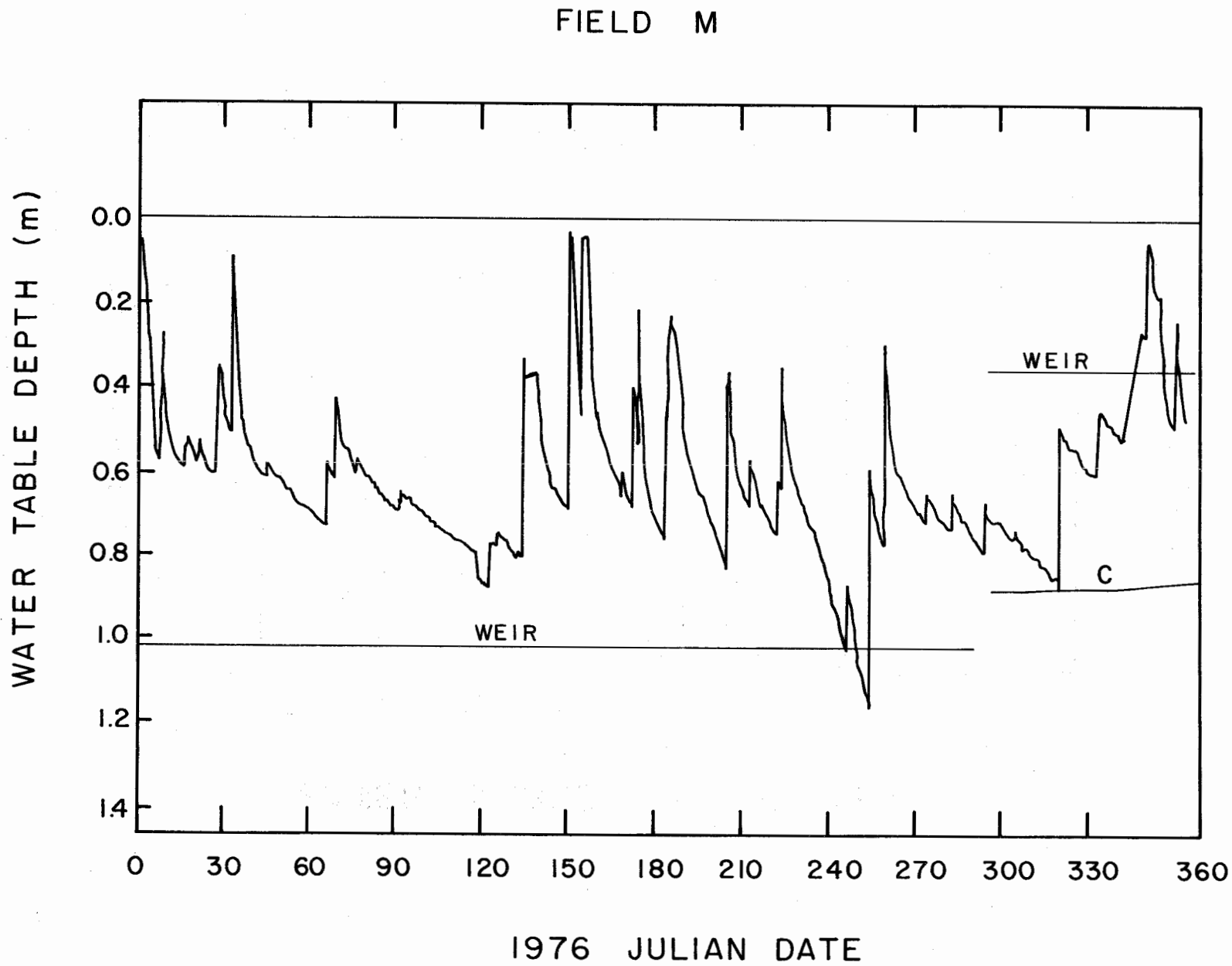
Appendix Figure 9. Water table depth in Field M and weir height at drainage outlet during 1973.



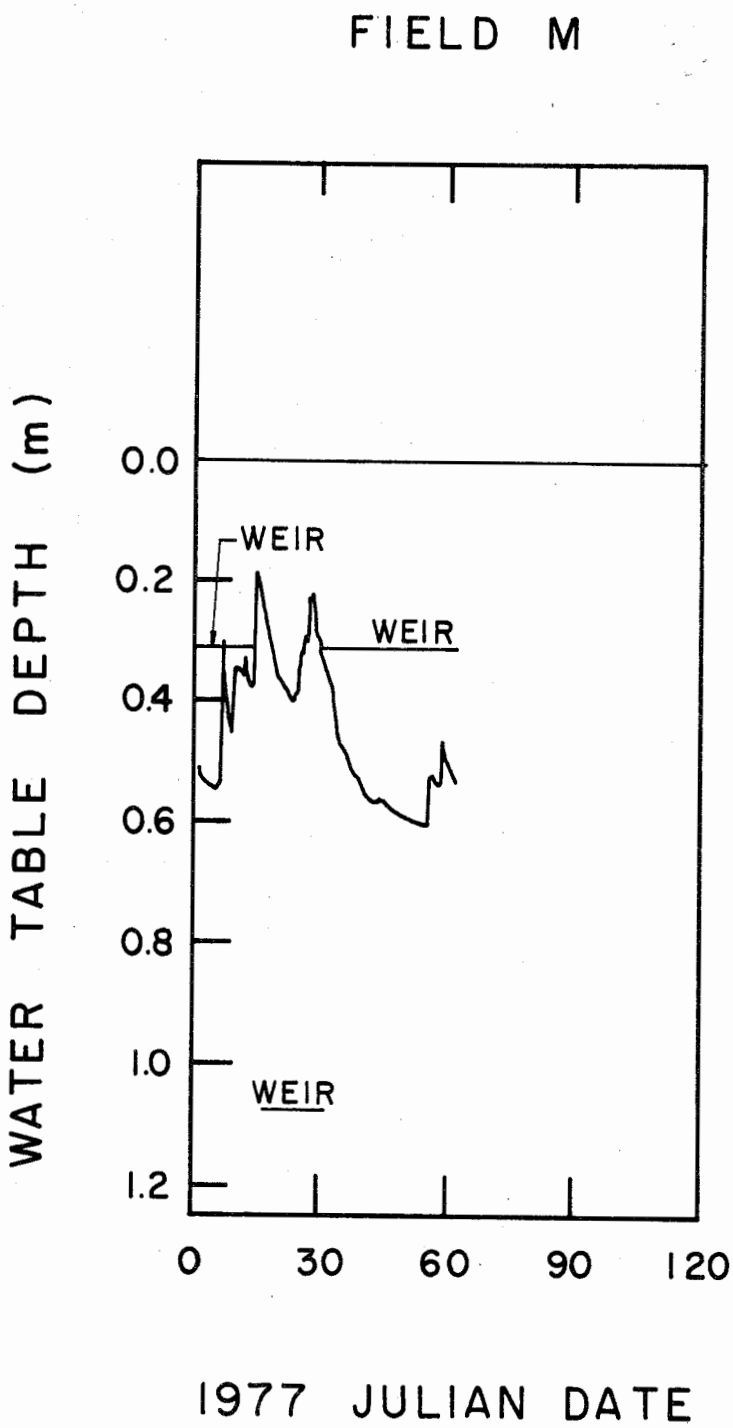
Appendix Figure 10. Water table depth in Field M and weir height at drainage outlet during 1974



Appendix Figure 11. Water table depth in Field M and weir height at drainage outlet during 1975.



Appendix Figure 12. Water table depth in Field M and weir height at drainage outlet during 1976.



Appendix Figure 13. Water table depth in Field M and weir height at drainage outlet during 1977.