CORNELL CROPWARE 2.0 HELP

CROPWARE DEVELOPMENT TEAM

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Nutrient Management Spear Program

http://nmsp.css.cornell.edu

1. INTRODUCTION

1.1 ACKNOWLEDGMENTS

Cornell Cropware version 2 is the product of a cooperative effort by individuals from Cornell University, Cornell Cooperative Extension, USDA Natural Resources Conservation Service, New York State Soil and Water Conservation Districts, New York State Department of Agriculture and Markets, New York State Department of Environmental Conservation, and private industry.

Vegetable nutrient guidelines were provided by Steve Reiners (Geneva Horticultural Science) and Don Halseth (Horticulture Department). We gratefully thank all our beta testers. In addition to the authors below, on-line help and documentation contributions were made by Peter Wright (Cornell University), Barb Bellows, and Paul Cerosaletti (Delaware County Cooperative Extension).

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1.2 COMPUTER REQUIREMENTS

Cornell Cropware requires Windows 98, Windows 2000, Windows NT, or Windows XP and 40 megabytes of mass storage and 16 megabytes of RAM. Additional documentation and program updates are available on the Nutrient Management Spear Program web site at http://nmsp.css.cornell.edu/software/cropware.asp.

1.3 CROPWARE DEVELOPMENT

Determining economically appropriate levels of applied nutrients has always been a goal of agronomists. In the 1970's this goal was expanded to include environmental constraints as federal and state governments passed legislation intended to reduce water pollution (Federal Water Pollution Control Act, Safe Drinking Water Act, Coastal Zone Management Act). In the 1980's, the need for farms to consider their impact on the environment came to the forefront of the agricultural communities consciousness. Cities with surface water drinking supplies came under pressure to comply with EPA regulations. The Southview versus CARE lawsuit demonstrated that many farms would come under the jurisdiction of laws regulating "point-source" polluters (DiMura, 2000).

In response to these concerns, in 1993, an interdisciplinary group of Cornell faculty, staff, students, extension agents and farmers formed to explore environmental and economic concerns on New York State Dairy Farms. In this project, two dairy farms were used as case studies to develop a process for developing whole farm nutrient management plans (Fox et al., 1996; Klausner et al., 1993; Hutson et al., 1996; Rasmussen et al., 1996; Klausner et al., 1998; Hutson et al. 1998). On these two farms, animal and agronomic nutrient management plans, which decrease the net excess of nutrients on the farm (Hutson et al. 1996; Klausner et al., 1996), increased predicted farm profitability (Rasmussen et al., 1996). Partial budgets predicted that net farm income would increase because of more efficient use of nutrients both by the animals and crops.

In the course of this project, it became evident that a large number of calculations had to be made to obtain the data needed to make accurate nutrient management decisions. Accurate nutrient management decisions require accurate predictions of animal and crop requirements, surface and groundwater nutrient losses, and the economic impact of the management decisions on the farm. Most of the tools available to do this were workbooks or stand-alone software programs that were not linked or were incomplete.

Thus, the next logical step was to develop a family of computerized decision aid tools which develop and evaluate nutrient management options considering animals, soils, crops and farm profitability. This collection of software tools is called the Cornell University Nutrient Management Planning System (*cu*NMPS). In cooperation with the New York City Watershed Project Phase 2, four Excel based programs were developed: 1) Mass Nutrient Balance; 2) Nutrient Management Planning for Crop Production; 3) Crop Rotations; and 4) Animal Nutrient Management.

In 1996, the Mass Nutrient Balance and Nutrient Management Planning for Crop Production components were released in the form of Excel based programs. Stuart Klausner was responsible for development of equations and interface for these two programs. These programs were distributed to Cooperative Extension Agents, New York City Watershed Project Planners, and Private Crop Consultants around New York State. Tom Kilcer developed and distributed an Excel based program for evaluating crop rotations. The objective of the Crop Rotation software was to aid in developing crop production plans which match available land resources and livestock feed needs given feed storage and soil quality maintenance constraints.

The Animal Nutrient Management Program was converted to an Excel based program from a stand alone program (CNCPS version 3.0). Animal nutrition is a critical but commonly overly overlooked aspect of whole farm nutrient management. Nutrients concentrate on livestock farms because more are brought onto the farm than leave as products sold. Because, typically, the largest source of imported nutrients is in the form of purchased feeds (Klausner 1993), ration formulation has a significant impact on a farm's nutrient status. The goal of the whole herd cattle nutrition program is to easily develop site specific feeding programs that accurately match available home grown feeds with cattle requirements to improve animal performance while reducing imported nutrients.

In 1999, the USDA and EPA released guidelines for developing comprehensive nutrient management plans (CNMP) for animal feeding operations (AFO) to protect water quality from these non point sources of pollution. Governmental agencies (NRCS, Soil and Water Conservation Districts, NY Department. of Agriculture and Markets and the Department of Environmental Conservation), herd nutritionists and crop advisors agreed that the *cu*NMPS needed to be developed into a field usable software system for use as a common standard in developing whole farm nutrient management plans. With input from representatives of these groups, components of the four Excel based programs were revised and re-programmed into two stand-alone Windows programs. These two initial modules are: 1) Herd Nutrient Management; and 2) Crop and Manure Nutrient Management Planning (Cornell Cropware). The herd nutrient management program (the Cornell Net Carbohydrate and Protein System version 5.0), in addition to least cost ration balancing, includes allocation of home grown feeds across the herd for optimum use of home grown nutrients, and the prediction of nutrient excretion from purchased and home grown sources, herd feed requirements, and returns over feed costs. The nutrition model has been tested and validated on dairy farms with excellent results (www.cncps.cornell.edu.)

This first version of the Cornell Cropware was primarily a revision of the Nutrient Management Planning program with some key components of the Mass Balance and Rotation software included. An oversight committee comprised of NRCS, S&WCD, Cooperative Extension and University personnel, private consultants and farmers (see acknowledgements) directed and reviewed program development. The nutrient requirement algorithms were essentially the same as those in the Excel-based Nutrient Management Planning program. These algorithms in turn were based on those used by the Cornell Nutrient Analysis Laboratories (CNAL).

The first version of Cornell Cropware was released in August, 2001. Good communication between the Cornell Cropware development team and users has helped prioritize version 2 program enhancements. Cropware version 2 include a new data storage structure, nutrient guidelines for major vegetable crops, improvements for nutrient management on grazing farms, and numerous other changes in response to user requests to help enhance nutrient management planning in NYS. A detailed list of the version 2 program enhancements is presented in Modifications in Current Version.

1.4 PURPOSE

Cornell Cropware is a decision aid for farmers and consultants creating site specific nutrient management plans which will promote nutrient recycling and limit environmental degradation. In addition, Cornell Cropware provides supporting documentation for development of CAFO compliant Comprehensive Nutrient Management Plans.

In recent years, state and federal regulatory agencies have defined some livestock farms as a potential source of "point-source" pollution. Concentrated Animal Feeding Operations (CAFOs) are considered "point sources" under the Federal Clean Water Act. For all practical purposes, farms in New York State with more than 200 dairy cows, or concentrated housing of other livestock species, will be required to have a State Pollution Discharge Elimination System (SPDES) permit. The New York State Department of Environmental Conservation has developed a General SPDES Permit for CAFOs. This General Permit requires a certified site specific Agricultural Waste Management Plan (AWMP) be conducted and implemented for each CAFO. The principle component of an AWMP is a Comprehensive Nutrient Management Plan (CNMP). Necessary components of a CNMP (see Figure 1.1) are defined in the Natural Resources Conservation Service Conservation Practice Standard, "312-NY – Waste Management System".

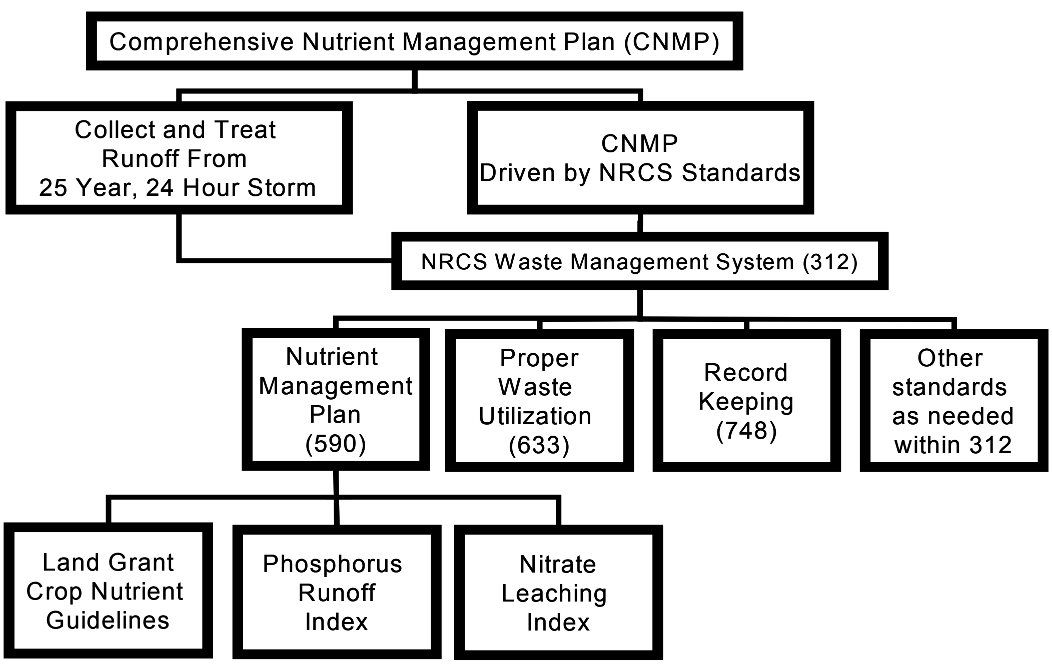


Figure 1.1 CAFO General Permit Requirement Structure.

Specifics concerning the General SPDES Permits are available at the DEC web site: www.dec.state.ny.us.

Cornell Cropware integrates the Cornell University crop nutrient guidelines, the New York State Phosphorus Runoff Index, and the Nitrate Leaching Index to help planners develop Comprehensive Nutrient Management Plans in accordance with the NRCS Nutrient Management Planning Standard (NRCS 590), illustrated in Figure 1.1. The following information is utilized for plan development and delivery with Cropware.

- General Information - farm name, address, planner name and address, county, livestock enterprise, number of animal units and age classes.
- Field Specific Information - field number, acreage, land use, RUSLE, and HSA.
- Soil Management/Erosion Control - soil type, crop rotation, tillage depth, and manure and fertilizer application timing and method.
- Fertility Program Information – Nitrate Leaching Index, Phosphorus Runoff Index, soil tests results including the soil lab and extraction method, soil pH maintenance recommendations, fertilizer recommendations considering manure applications, and nutrients in sod.
- Manure/Waste Utilization – bedding material and quantity, estimate of annual waste production, waste spreading schedule based on the priority nutrient, template available to record manure analysis and applications.
- Manure Transfer and Storage Facilities – capacity calculated and reported in terms of volume and time.

In developing the Cornell Cropware our goal has been to provide common tools and standards for nutritionists, crop planners, NRCS, and producers to use in developing Comprehensive Nutrient Management Plans for livestock farms. Cornell Cropware will also be used by Pro-Dairy to train extension agents and CNMP planners. The system is being used in "Whole Farm Nutrient Management", a capstone course in Animal Science and Crop and Soil Sciences, in which senior dairy fellows, agronomy, plant science and soil science majors, and graduate students learn the principles of improving dairy farm sustainability on farm case studies using Cornell Cropware. Cornell Cropware was developed to aid improving farm sustainability by increasing farm profitability while protecting water quality.

1.5 MODIFICATIONS IN CURRENT VERSION

Cornell Cropware version 2 is a revision and expansion of the Cornell Cropware version 1. Version 1 was released in August 2001. Cropware version 2 differs from version 1 in the following ways:

- Version 2 allows field application from two manure sources. You can now enter field applications from two manure sources with different application timings, incorporation methods and nutrient compositions. This dramatically increases the “real-world” functionality of the program.

- Cropware version 2 data is saved to a database file structure (Microsoft Access). The new data file structure facilitates interfacing with other programs such as NRCS Toolkit, Arc View and other GIS software, and planner developed software and spreadsheets. It provides a more stable data storage format. When there is an error caused by faulty data, it is much easier to find and correct in a data file structure. This makes the program much more flexible for future development work.

- Cropware version 2 includes nutrient guidelines for 45 vegetable crops including garlic.

- The specific amount of manure available from a source for a particular month may now be characterized either on the Manure Screen or the Calendar Screen. This makes the calendar screen much more useful for farms using pasture and other situations that require manure available from sources be variable through the year.

- The capacity to re-order fields has been added to version 2. This allows users to list fields in a logical order. This accommodates splitting, combining, adding and removing fields from the cropping plan.

- Fertilizer materials and rate can now be selected on the Allocation Screen. This saves user time when adjusting the plan fertilizer complement.

- The “Use Calculated Manure Rate” button has been omitted from the Allocation Screen. This button was confusing and was commonly not used or used incorrectly.

- The pre-set columns are removed from Allocation Screen. This allows the user more flexibility when using the Allocation Screen.

- The Phosphorus Index (P Index) is now updated based on timings entered on the Calendar Screen. When the user refines the plan by defining when manure is spread on the Calendar Screen, the program updates the P Index to reflect choices made on the Calendar Screen. This saves user time and makes the plan more accurate.

- The Nitrate Leaching Index (NLI) has been updated to include refined precipitation data. Annual and season precipitation data, used in the NLI, are more accurate because they are linked to township instead of county.

- Cropware version 2 has one added report and several existing reports have been refined. A longer term crop rotation report, requested by planners to predict whole farm feedstuff production shifts and potential shortfalls, has been added. The Fertilizer Shopping List Report includes fertilizer costs per material and totals for each year. More plan data can be queried with the Custom Report Tool. Existing reports have been refined to be easier to read and have a more professional appearance.

- The soil attribute variables, Fe, Mn, Zn, organic matter and nitrate, have been added to the Cropware version 2 database to coordinate with CNAL. Fe is used to generate potato recommendations.

- Manure default compositions and quantities in version 2 are updated to 2001 American Society of Agricultural Engineers standards.

- Soil test analyses from University of Vermont and A&L Canada Laboratories, Inc. are now accepted inputs.

- A data interface to link Cornell Nutrient Analysis Laboratory and Cropware has been added to Cropware.

- Cropware version 2 allows users to choose a program generated or a user defined lime recommendation rate.

- Data columns and order can be specified on the Allocation screen.

- Data can be exported (as .csv files) from the Allocation and Calendar screens.

- All manure sources can be viewed on a single Calendar screen.

- The Cropware Help section has been updated.

1.6 BASIC NUTRIENT MANAGEMENT PLANNING FLOW

Before launching into nutrient management planning with Cropware, it is helpful to consider the overall process. Figure 1.2 outlines the basic steps involved in nutrient management planning, including characterizing farm fields and manure and fertilizer sources, using that information to develop agronomic and environmental nutrient guidelines (performed by Cropware), allocating manure and fertilizer to meet crop and environmental goals (this step is often iterative), and generating a plan for implementation and evaluation. It may be helpful to refer back to this flow as you progress through the nutrient management planning process with Cropware.

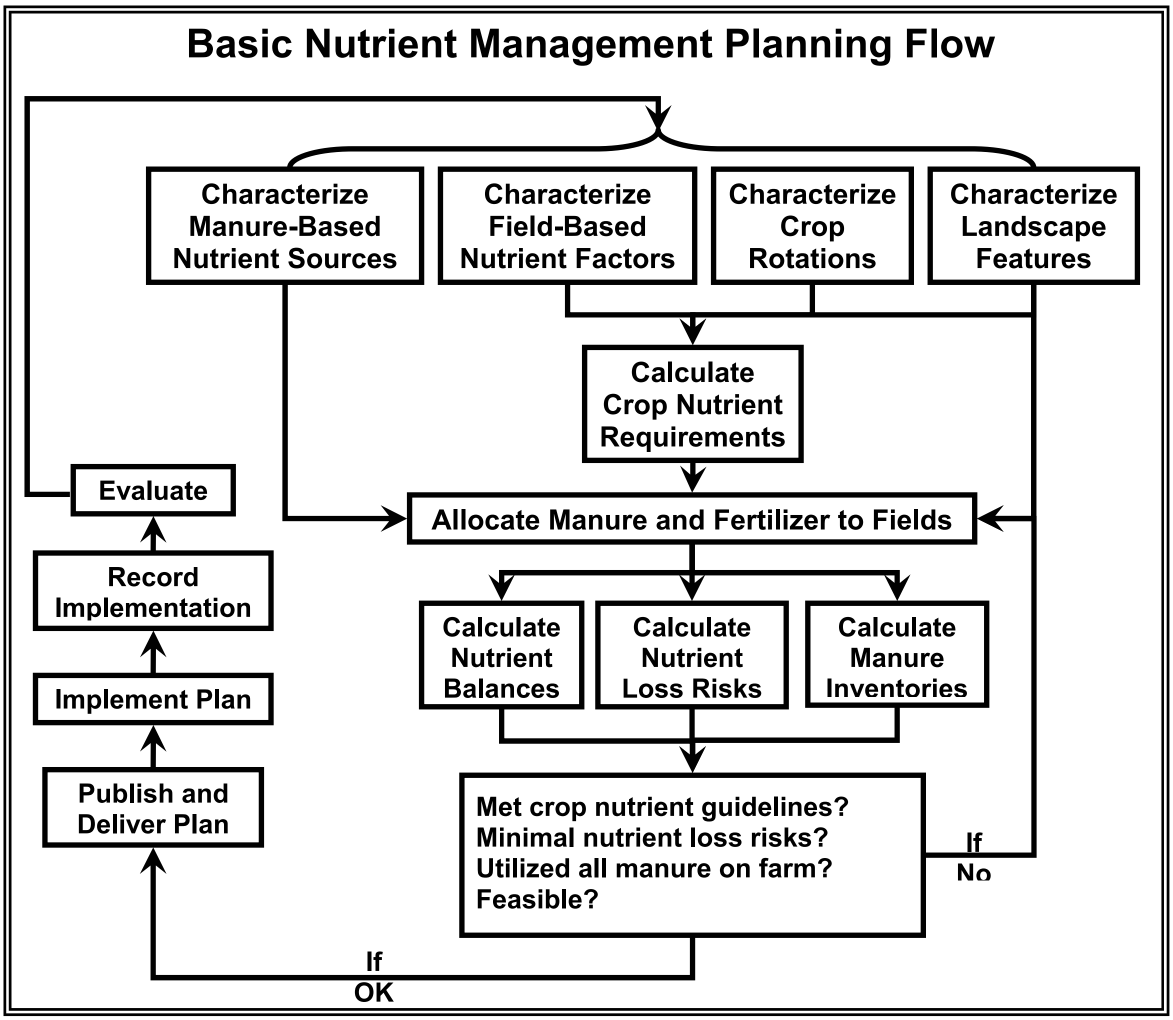


Figure 1.2 Basic Nutrient Management Planning Flow.

2. PROGRAM OPERATION

2.1 DEFAULT DATA

Because the program allows you to jump directly from input to output, it must always have realistic data entered for its inputs. Therefore, the program automatically loads a default data file upon opening. A default data file is placed in the same folder as the program when it is installed and should not be moved or deleted. If for some reason this data file is lost or corrupted, the program will automatically create a new one. However, if this happens, your current default data will be lost.

For safety, the program is set to automatically save the current plan data as the default data upon exiting. This way, if you forget to save the plan you are working on, it will automatically be retrieved the next time you start the program. This feature can be turned off by selecting the appropriate switch in the "File" menu. If you do so, you will have to manually save the default file.

In addition to a default data file, the program also saves the current program settings (the current screen, whether to automatically save the default data file upon exiting, result options, etc.) to a data file upon exiting the program. Again, this file should not be moved. If it is, the program will create new default program settings.

2.2 PROGRAM STRUCTURE

A plan is defined by:

1. Contact information.
2. Farm descriptive information including crop rotations, fertilizers, manure sources and analyses.
3. Field information including the crop rotation, available manure and fertilizer, and hydrological factors.
4. Nutrient allocation – allocating manure and fertilizer to meet crop nutrient requirements. A calendar worksheet is used to plan the timing of manure applications.

2.3 PROGRAM NAVIGATION

Mouse and Keyboard Moves

There are several ways to select and enter data. Like most Windows based programs, Cropware will let you select from a list by left clicking with the mouse or by using keyboard arrow keys to highlight the selection and then press the Enter key. Right clicking the mouse on a label or button will display “What’s this?” and the context sensitive help for that area of the program. If a heading has an underline, you can select the screen or menu by pressing the ALT key and the underlined letter at the same time. For instance, to display the “GoTo” drop down menu, press the ALT – G.

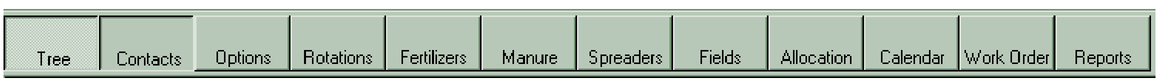
In most screens, pressing the “Tab” key will move the cursor from one entry field to the next. However, in entry areas that resemble a table with boarders (grids), you must use the arrow keys to move to the next entry cell. Using the left mouse button to click on the next entry area will move the cursor in both the screens and grid entry areas.

There are three ways to move around the program, drop down menus, tool bar buttons and the tree.

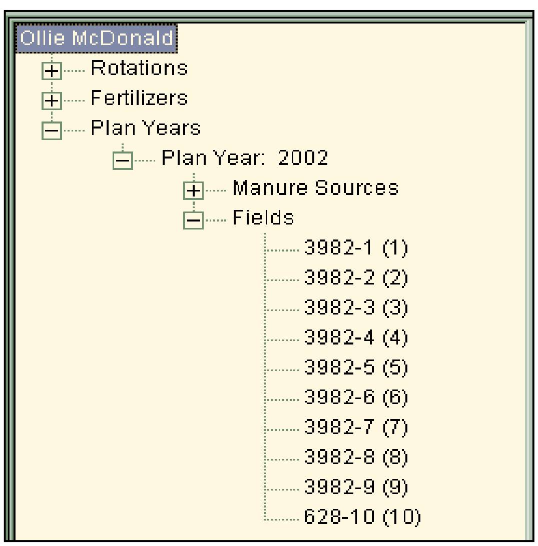
Drop down menu:

Tool bar buttons:

The buttons on the toolbar are probably the easiest way to navigate the program. They are shown below:



Tree:

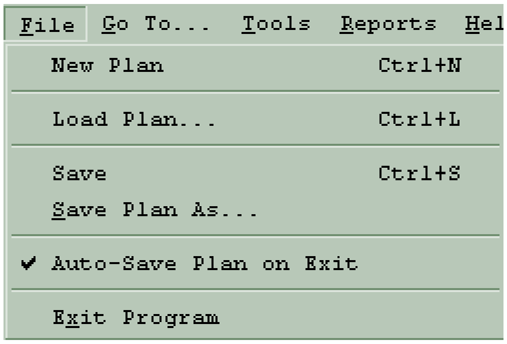


The Tree control summarizes the nutrient management plan at a glance, listing the rotations, fertilizers, and manure sources and fields for each plan year. It also provides another way to navigate the program.

Clicking on the "Rotations", "Fertilizer", "Manure Sources labels will take you to the appropriate inputs screen. Likewise, clicking on a field will take you to the Field screen with that field selected. Clicking on the + will expand the tree, showing additional, subordinate, topics. Clicking on the – will collapses the tree by hiding subordinate topics.

2.4 DROP-DOWN MENUS

File



The "File" menu choices are as follows:

New Plan
: Creates a new nutrient management plan.

Load Plan
: Loads a previously saved nutrient management plan.

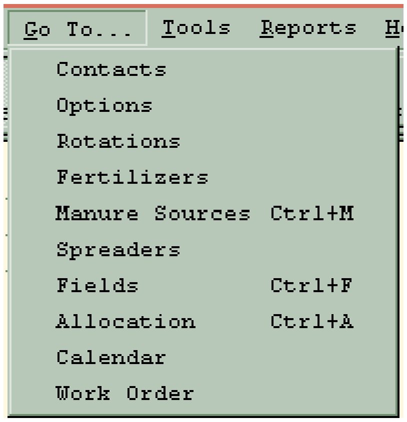
Save
: Saves the current nutrient management plan. If the current plan is one that has been loaded, it saves it with the same name. Otherwise it saves the current simulation as the default. All Cropware datafiles are saved with the extension ".mdb".

Save Plan As
: Allows you to save the current nutrient management plan with a new name. All Cropware datafiles are saved with the extension ".mdb".

Auto-Save Default Data on Exit
: If checked, the program will automatically save the current plan as the default when you exit the program. Note that the current plan will only be saved as the default. If you wish to save your file as an actual plan data file (with its own name), you must do this separately with the "Save" or "Save As" menu options.

Exit
: Exits the program.

Go To



The "Go To" menu choices are as follows:

<u>Contact Information</u>

This screen lets you enter farmer and planner name, address and contact information.

<u>Rotations</u>

In the Rotations Screen you can create a list of all rotations which will commonly be used in the plan. The purpose of defining the rotations is to allow quick entry of the past and future crops for each field.

<u>Fertilizers</u>

Enter nutrient content and price of fertilizers used in the nutrient management plan.

<u>Manure Sources</u>

Enter quantity and analysis information for each manure source on the farm.

<u>Spreaders</u>

Enter manure spreader capacity.

<u>Fields</u>

Field data is entered in seven screens: Field Data, Soil Test, Crop Data, Manure Use, Past Manure Use, Fertilizers and Phosphorus Index Factors. You can move from screen to screen by clicking on the folder "tabs" at the top of the screen.

Allocation

Fertilizer and manure application rates are established for each to balance crop nutrient requirements and the quantity of manure available on this screen.

Calendar

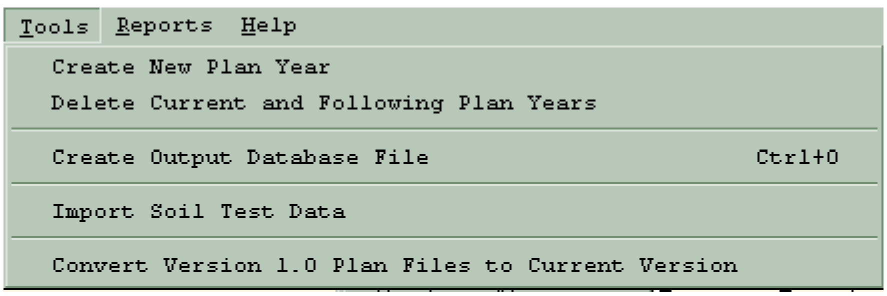
This screen acts as a worksheet to budget the timing of manure applications.

Work Order

This sheet is used to produce a "work order" or tractor sheet to hand to the person driving the tractor or truck spreading manure.

Tools

The "Tools" menu choices are as follows:



You can quickly create new plan years using the Tools drop down menu. To create one new plan year, choose “Create New Plan Year”. To create several new plan years, choose “Create Multiple New Plan Years”. The “Delete Current and Following Plan Years” will delete the currently selected and all subsequent plan year data. This action can not be “un-done”. Delete plan years cautiously.

You can select the current plan year by clicking on the year number in the tree. The newly created plan year or years will always follow the currently selected plan year. For instance, if the currently selected plan year is 2002 and you click on “Create New Plan Year”, a plan will be created for 2003. If plan year 2003 already exists, a warning message will be displayed: “This operation will permanently erase Plan Year 2003 and replace it with this new Plan Year. Do you wish to continue?”. There is no practical limit to how many plan years you can have but the addition of each plan year will increase the size of your data file and slow down the speed of the program computations.

All of the plan information is copied “as-is” from the selected plan year to the new plan year except:

- Current year crop and rotation is updated as defined by the field’s rotation;
- fertilizer rate = 0.
- “User Selected Manure Application” rate (new plan) = 0.

- Last year's manure rate (new plan) = "User Selected Manure Application" rate (current plan).
- Two year's ago manure rate (new plan) = last year's manure rate (current plan);
- The "Amount (of manure) at Start of Plan Year" = last year's "Manure Balance" (from the Allocation screen).

Warning:

The new plan year data file is based on the current year data. However, once the new plan year is created, changes in the current year plan are <u>not</u> carried through to the subsequent (existing) plan years. For example, if the current plan year 2002 had a manure application rate in Field 10 of 5,000 gallons/acre and you created a new plan year (2003), the "last year's manure rate in 2003 would be 5,000 gallons. But, if you later changed the application rate in the 2002 plan to 10,000 gallons, the corresponding rate in 2003 would remain at 5,000. Deleting 2003 and re-creating it would solve this problem and copy the correct value into the new year but would also copy over any data entered in 2003 since it was originally made.

<u>Delete Current and Following Plan Years</u>

This selection deletes the currently selected plan year and all future plan years.

<u>Create Output Database File</u>

Cropware saves entered data in an Access Database format. However, calculated values such as the P Index are not a part of the saved input file. To effectively use all of the Cropware input and output variables in a common file, you can use this function. The output file is independent of the Cropware plan file. This file includes plan inputs and outputs that can be used to share with other software that can access databases (e.g. GIS, spreadsheets, databases, etc.) without the risk of inadvertently altering the Cropware plan file. The created file name will be apprended with "(Output File).mdb". The Control – O key combination will also create the output file.

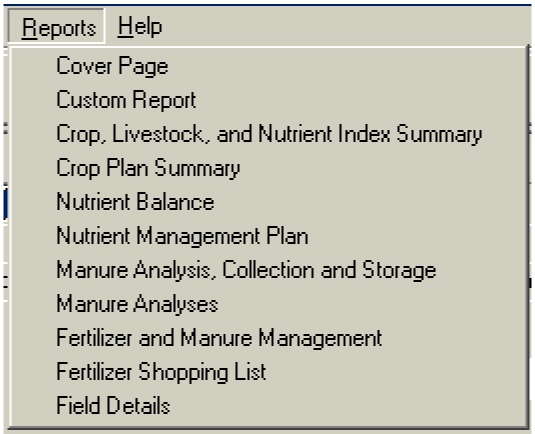
<u>Import Soil Test Data</u>

A utility to download multiple soil analyses from a soils lab into the current plan.

<u>Convert Version 1.0 Plan Files to Current Version</u>

This function converts Version 1.0 (.cpw) plan data files to Version 2.0 (.mdb) files.

Reports



The "Reports" menu choices are as follows:

Cover Page

The farm and planner contact information in a cover page format.

Custom Report:

Customize and save your own reports by selecting, sorting and limiting plan information.

Crop, Livestock and Nutrient Index Summary:

This report summarizes crop, livestock and nutrient index data for each plan year.

Crop Plan Summary:

This report shows the farm crop plan for a 14 year span, including 3 previous years, the current year and 10 future years.

Nutrient Balance:

The Nutrient Balance report shows N, P and K available and required by crop production for each plan year.

Nutrient Management Plan

The report summarizes nutrients required, applied as manure and fertilizer and surplus or deficit for each crop field.

Manure Analysis, Collection and Storage

This report lists the last nutrient analysis, quantity and nutrients produced and storage information for each manure source.

Manure Analyses:

This report lists all nutrient analyses for each manure source.

Fertilizer and Manure Management

The Fertilizer and Manure Management details the fertilizer and manure use for each field.

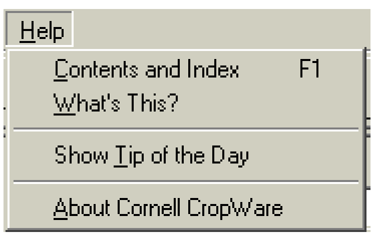
Fertilizer Shopping List:

A summary of all of the fertilizer used in the nutrient management plan which can be used to project the quantity and cost of each fertilizer blend needed.

Field Detail Report:

This report is a detailed description of a selected crop field including crop rotation, soil test data, field hydrological risk factors, nutrient requirements and planned manure and fertilizer applications.

Help



The "Help" Menu choices are:

Contents and Index:

Displays a "tree" menu on the left portion of the screen and help text on the right portion of the screen. Clicking on the + will expand the tree, showing additional, subordinate, topics. Clicking on the – will collapses the tree by hiding subordinate topics. Clicking on words or phrases shown in blue underlined text will jump you to additional information on that topic.

What’s This?:

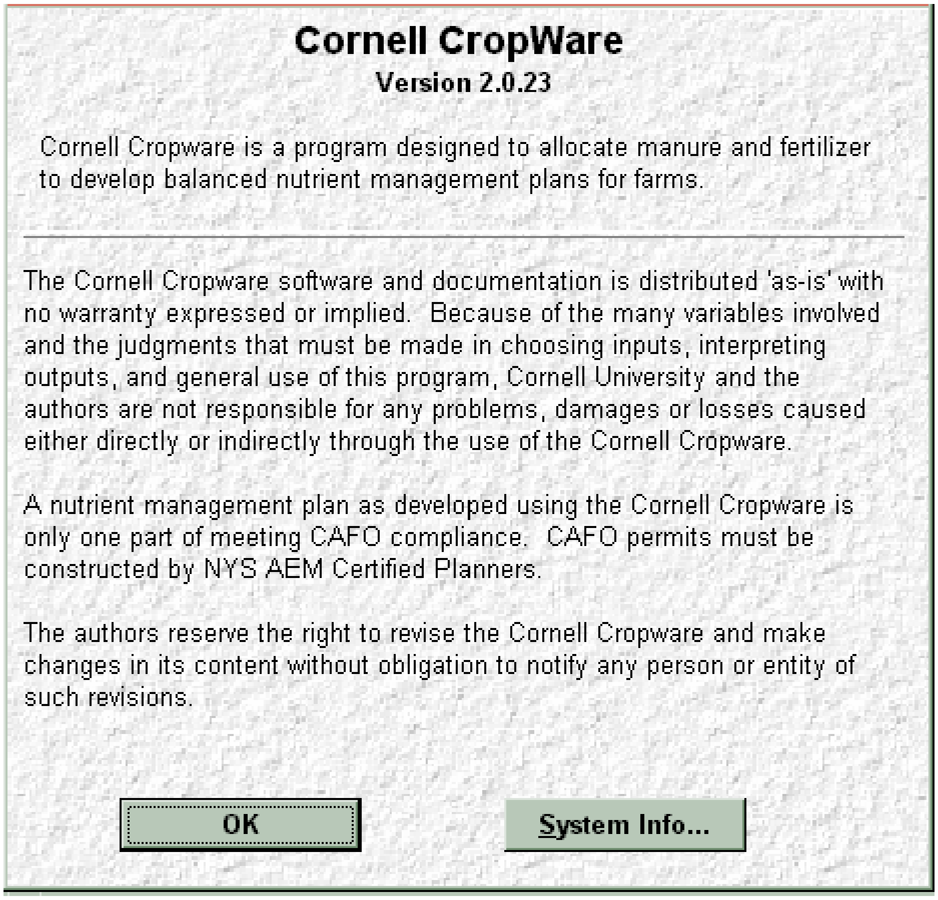
When you choose "What’s This" a ? appears. Move the ? to the text of the item that you have a question about and left mouse click or press Enter. A pop-up window will appear describing the selected item. You can print or copy the information in a pop-up window by right-clicking inside the pop-up window and then clicking Print Topic or Copy. To close the pop-up window, click inside it. You can also get Help on an item by right-clicking it, and then clicking What’s This?.

Show Tip of the Day

Display various bits of Cropware advice and information.

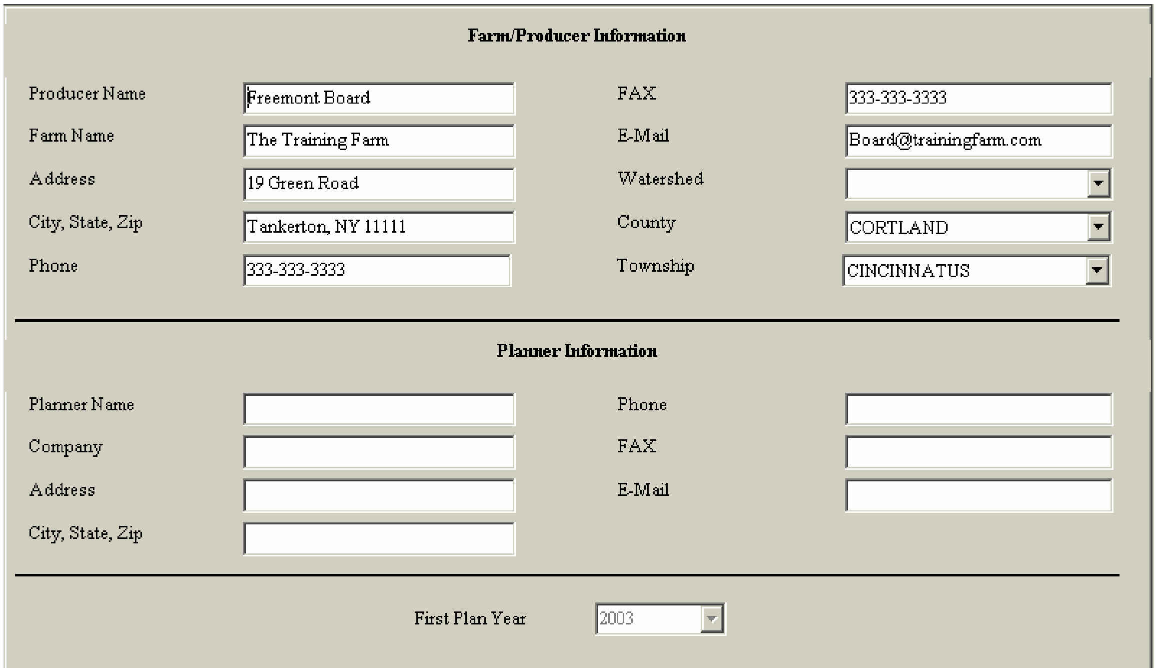
About Cornell Cropware

Displays standard "About…" screen information.



3. DATA ENTRY SCREENS

3.1 CONTACT SCREEN



Contact information for the producer and planner, farm location and the starting plan year are entered on this screen.

Screen Entries

Contact Information

Contact information, including name, address, phone, fax, and email for both the producer and planner, entered on this page, are printed on the reports cover page.

Watershed

The watershed that the majority of the farm's surface water flows to is selected from a drop down menu. At this time, the watershed is a descriptive entry not used in program calculations.

County

Enter the county that most of the crop fields are in. The County can also be entered for each field. The name entered here will be the default county for each field in this plan. When the county is entered or changed, a pop-up window will ask "Would you like to set the county for each of the fields to (selected county name) as well, yes, no?". If you select yes, the county entry for each of the existing fields will be set to the entered county name. Be careful: this choice will over ride previous county entries to the field screen. If you select "no" the contact county will remain as selected but the field county data will not change. The name entered here will be the default county for each new field in this plan. The 25 year storm rainfall and lot runoff constants are defined by the county entered here. These values are used to calculate manure storage sizing.

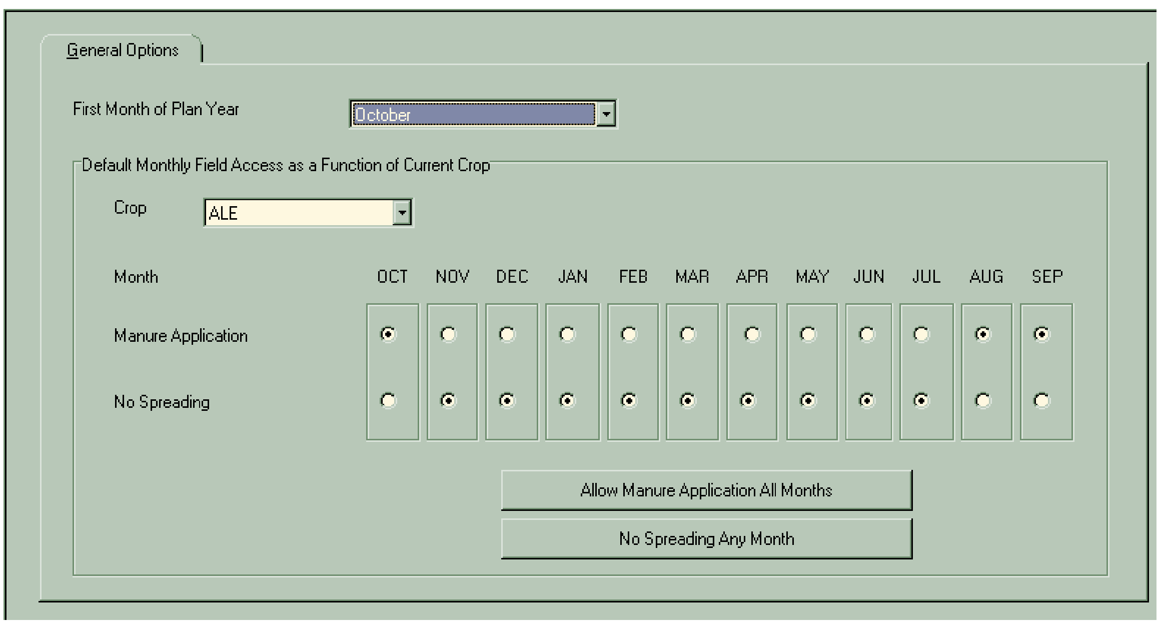
Township

After the county is selected, the townships in that county are displayed in the township dropdown box. Choose the township that the majority of the farm fields are located in. When you choose the township, a pop-up window will ask “Would you like to set the township for each of the fields to (selected township name) as well, yes, no?”. If you select yes, the township entry for each of the existing fields will be set to the entered township name. If you select “no” the contact township will remain as selected but the field township data will not change. The name entered here will be the default township for each newly created field in this plan.

First Plan Year

Choose the calendar year of the first cropping year being planned. For instance, if it is currently December 2001 and you are planning for nutrients to be applied on crops planted in 2003, choose "2003".

3.2 Options Screen



You can customize the Cropware default settings in the Options screen. The first month of the plan year and the default field access are set on this screen.

Screen Entries

First Month of Plan Year

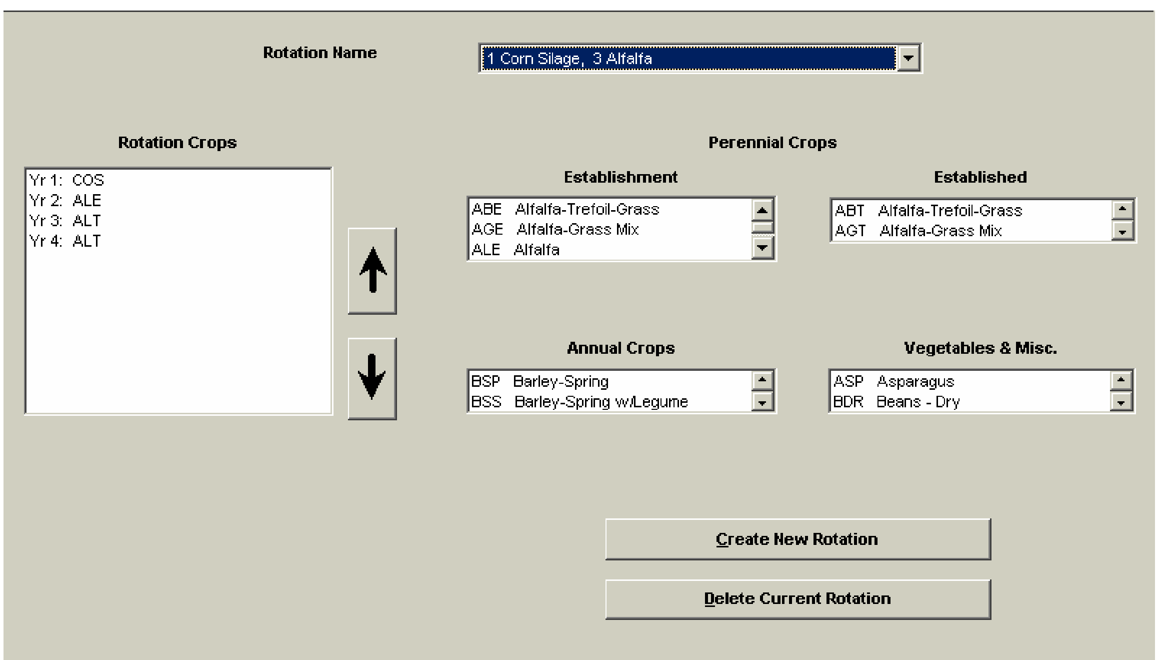
Select the first month of the plan year. The selected month will be the beginning month in the Manure Spreading Calendar Worksheet.

Default Monthly Field Access as a Function of Current Crop

An important consideration in the development of a nutrient management plan is determining if the planned allocation of manure and fertilizer is feasible given site specific constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor and machinery available to spread all the manure between harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides a calendar with a running manure inventory to plan the timing of manure applications for each month of the year. Times when the field is not available for manure application are shaded gray on the calendar.

The months that the field can be spread can be specified on a field by field basis. However, the field access commonly depends on the current crop on the field. If the field access is only limited by the growing crop, the access months can be automatically set for the field when the crop is selected. In this screen, you can set the months that manure can be applied for each crop. In the example shown above, the calendar would be shaded May to September for all corn silage (COS) fields. This setting could be changed for individual fields in the Fields Screen - Field Access button. To change the default field access from “Manure Application” to “No Spreading”, click the white circle in the “No Spreading” row. You can set each month to allow manure application, by clicking on the “Allow Manure Application All Months” button. The “No Spreading Any Month” button will set each month to “No Spreading”. The default monthly field access values set during Cropware installation are in Table 17.10.

3.3 Rotations Screen



In this screen, you can define the common rotations used on this farm. The predefined rotation can then be used in the Crop Data Tab of the Fields screen to quickly enter the past and planned future crops for each field.

How to create a rotation:

For example, if two years of soybeans followed by three years of Grass is a rotation used on this farm, you would:

1. Left click Create New Rotation button.
2. At the prompt type "2 soy/3 grass" or any other name for the rotation.
3. Click on SOY in the Annual Crops box twice. Click on GRE in the Perennial Crops Establishment box once and GRT in the Perennial Crops Established box twice. For all sod crops, an "E" as the third letter of the crop code signifies an establishment year (seeding year) of the sod crop and a "T" (topdress) denotes an established sod.
4. Use the arrow buttons to the right of the Rotation Crops Window to change the order of crops in the rotation.

You can add crops to the rotation but you cannot take crops out of the rotation. If you make a mistake and select a crop that you do not want, select the rotation in the Rotation Name dropdown box and click the Delete Current Rotation button. Recreate the rotation starting at step 1.

Screen Entries

Rotation Name

In this dropdown box, you can choose a predefined rotation such as "1 Corn Silage, 4 Alfalfa", or you can define your own rotation name. On this screen the rotation names are created so that the crop sequence for several years can quickly be assigned to a field in the Fields screen.

Up/Down Arrow Buttons

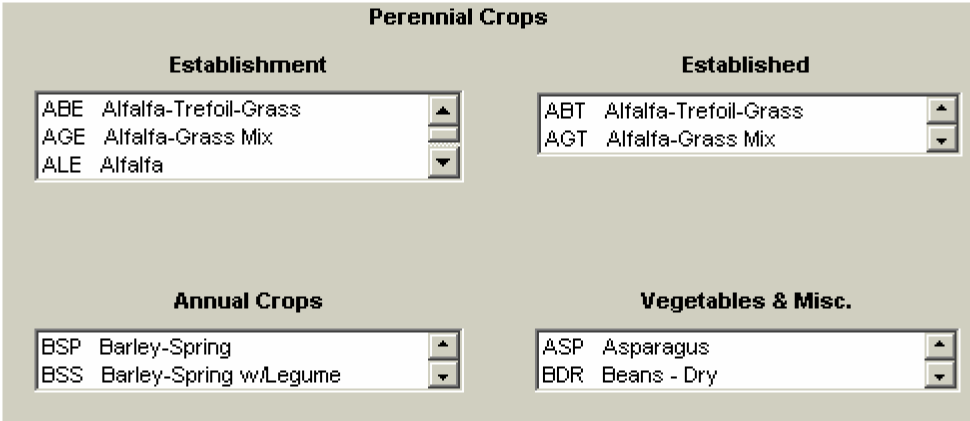
Move the selected crop up/down in the rotation sequence.

Create New Rotation

Creates a custom rotation. A popup box will allow you to enter a new rotation name. The rotation name entered will appear in this "Rotation Name" drop down box. You can now select the crops in the rotation by selecting the crop from any of the four boxes listing crop names.

Delete Current Rotation

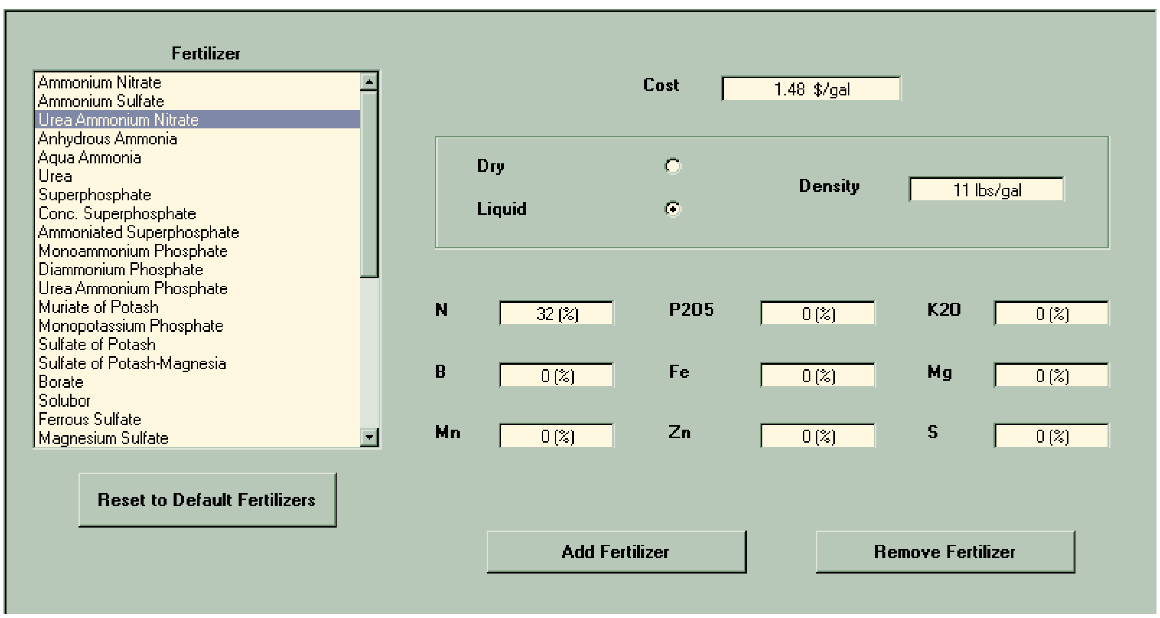
Delete the selected rotation name.



Perennial Crops Establishment and Established, Annual Crops, Vegetables and Miscellaneous

Select the crops in the rotation by clicking with the mouse pointer or highlighting the crop and pressing an arrow key. The selected crops will appear in the order selected in the "Rotation Crops" window.

3.4 FERTILIZERS SCREEN



On this screen, enter information about all of the fertilizers that will be used in the nutrient management plan. Many common fertilizers are already loaded when Cropware is installed (Fertilizer Information Tables). The cost and composition values for these fertilizers can be edited by selecting the fertilizer from the drop down list and editing any of the information on the screen. The information will be updated when you select another fertilizer or move to a different screen. To create your own custom blend or add a fertilizer not on the list, click the Add Fertilizer button and complete the form, entering the cost, liquid or dry composition, and nutrients as a percent (whole number not decimal).

Screen Entries

Add Fertilizer button

Create a new fertilizer name. A popup box will allow you to enter a new fertilizer name. The new fertilizer will be added at the bottom of the Fertilizer Drop Down list.

Remove Fertilizer button

Delete the selected fertilizer name.

Cost

The fertilizer cost per unit. For dry fertilizer this value is $ per ton. For liquid fertilizer, the cost is reported in $ per gallon.

Dry

The fertilizer is applied as a dry material.

Liquid

The fertilizer is applied as a liquid.

Density

If the fertilizer is a liquid, the density (pounds per gallon) is entered. Fertilizer nutrient application calculations in the Allocation screen are on per acres basis. The application rate in pounds is calculated by multiplying the entered rate in gallons by the density.

N

The Nitrogen content of the fertilizer on a percentage basis.

B

The Boron content of the fertilizer on a percentage basis.

Mn

The Manganese content of the fertilizer on a percentage basis.

P_2O_5

The phosphorus equivalent content of the fertilizer on a percentage basis.

Fe

The Iron content of the fertilizer on a percentage basis.

Zn

The Zinc content of the fertilizer on a percentage basis.

K_2O

The Potash equivalent content of the fertilizer on a percentage basis.

Mg

The Magnesium content of the fertilizer on a percentage basis.

S

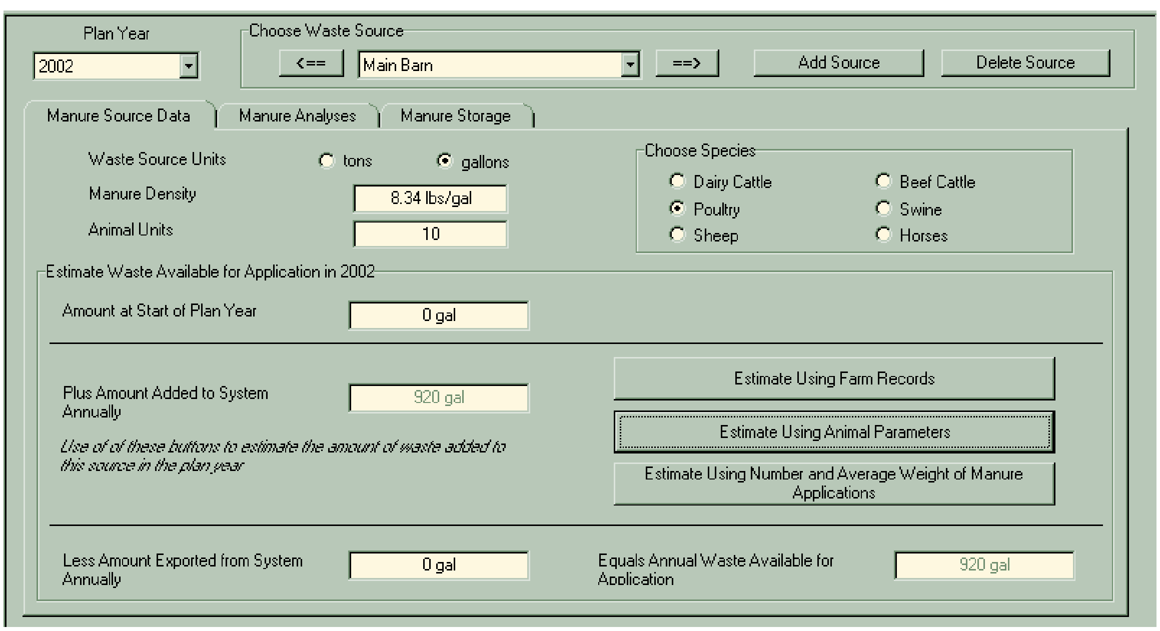
The Sulfur content of the fertilizer on a percentage basis.

Reset to Default Fertilizer

Resets the fertilizer list to Cropware default values. Any user added fertilizers will be permanently erased.

3.5 Manure Screens

Manure Source Data



To create a nutrient management plan, you will need to determine the composition and quantity of manure to be allocated to crop land. On this screen, enter information about waste storage systems, manure quantity and manure nutrient composition. A waste system must be entered before any field information is entered. The "system" is any manure or other waste handling system where the nutrients or waste are produced and must be accounted for. Examples of waste systems are "daily spread", "silage leachate", "bedded pack" and "pasture". An estimated capacity for waste storage structures can be calculated using the Calculate Capacity from Structure button on the Manure Storage Screen.

Essential to developing a nutrient management plan is an accurate estimate of the quantity of waste to be distributed to farm fields or exported off of the farm. There may be a significant difference between the total quantity of manure excretion and the manure/waste considered in the nutrient management plan. The quantity of waste which must be handled may be increased by additions of waste water, clean water to facilitate pumping, silage leachate, lot runoff and precipitation. The quantity of waste may be decreased by animals being on pasture, ammonia volatilization, manure exported off the farm and manure treatments such as solids separation and composting.

The manure/waste quantity must be entered or calculated for each manure source. In this context, a "manure source" is defined as a discrete manure handling system. For example, one dairy farm may have milking herd manure stored as a liquid in a manure pit, heifer bedded pack manure handled as a solid, and dry cows on pasture and silage leachate collected in a tank. In this example, the farm would have four organic nutrient sources, which the user has the option of naming i.e. "pit", "bedded pack", "pasture" and "leachate". The total annual manure quantity is the amount in the system at the start of the plan year (for storage systems) plus the amount added to the system annually less the amount exported from system annually. The sum calculated here is also displayed on the Allocation screen and the Calendar screen.

In Cropware, you have the option of choosing one of three ways to estimate total quantity of manure which will be allocated from each source:

1) Estimate Using Farm Records.
2) Estimate Using Animal Parameters.
3) Estimate Using Number and Average Weight of Manure Applications.

How to create a new waste system using the "Estimate Using Farm Records" method:

1) Left click on the "Add Source" button.
2) At the prompt add a new source name, such as "Daily spread".
3) Choose the units by clicking on the radio button the left of the desired units. The radio buttons will default to tons (black dot next to tons).
4) Select the animal species by clicking the radio button next the type of animal using the waste system.
5) Enter Animal Units.
6) Click on the button "Estimate Amount Added Using Farm Records." A pop-up box will appear. In the "Enter Tons (gallons) of Waste Added to System

Annually" entry box, enter the tons of manure taken from the barn for daily spread each year.

7) Click "Ok".
8) Enter the beginning inventory amount in the "Amount at Start of Plan Year" entry box. The value that you entered in step 6 will show in the "Plus Amount Added to System Annually".
9) Enter any waste which is exported from the system and will not be considered in the nutrient management plan in the entry box "Less Amount Exported from System Annually."
10) Adding a new waste system or moving to a different screen will save the entered waste system information.

Screen Entries

Plan Year

Enter the plan year that the manure system data will be used for. Manure analyses values will be copied to a future plan year when the Tool: Create New Plan Year is used. However, changes to the manure analysis or source data, after future plan years are created, will only affect the selected plan year.

Left arrow button

Move to the previous waste storage system.

Right arrow button

Move to the next waste storage system.

Add Source button

Create a waste system. A popup box will allow you to enter a new storage system name. The system name entered will appear in the Waste System drop down box.

Delete Source button

Delete the selected waste system.

Waste Source Units

Click on the tons or gallons circle to select the unit of measure for this manure source.

Manure Density

If the "Waste Source Units" selected is gallons, an entry item for "Manure Density" appears on the screen. The total quantity of manure is stored by the computer in pounds, as the nutrient recommendations and allocation are reported in pounds per acre. Liquid manure is assumed to have a standard density of 8.34

pounds per gallon when organic bedding such as sawdust and straw is used. However, this standard density is not appropriate when inorganic bedding such as sand is used. See Measuring Manure Density.

Animal Units

An "Animal Unit" is not necessarily one cow, horse or other type of animal. An animal unit is the equivalent of 1,000 pounds of body weight. For instance, 60 head of 1,400 pound dairy cattle would be equal to 84 animal units.

Choose Species

Select the livestock species contributing to this waste storage system. A default manure analysis is defined for each species. There is a great variation in manure nutrient composition. Always use a current nutrient analysis done on a sample from the specified source. The default values shown here are "place holders" for program computations. The livestock species also defines the rate of manure organic N decay. See table 17.6.

Amount at Start of Plan Year

Enter the amount of waste from this source that is in inventory at the beginning of the plan year. This value is the beginning month quantity in the inventory table on the Manure Spreading Calendar Worksheet. When a new plan year is created the "Amount at Start of Plan Year" is set as the manure available for application less the user selected manure allocated ("Manure Balance" from the Allocation screen). However, if you use the Manure Spreading Calendar Worksheet to plan the manure allocation through the year, the ending inventory amount in the last month may be a better estimate of the "Amount of Start of Plan Year" than the program set value. In that case, you can manually enter the correct beginning inventory quantity here.

Plus Amount Added to System Annually

Enter the estimated amount of manure added to this waste storage system annually. Use one of the three buttons: "Estimate Using Farm Records", "Estimate Using Animal Parameters" or "Estimate Using Number and Average Weight of Manure Applications." The manure available for application in the Allocation Screen is the "Amount Added to System Annually" plus "Amount at Start of Plan Year" less "Amount Exported from System Annually".

Less Amount Exported from System Annually

The amount of manure (or composted manure) from this storage that is exported off of the farm and does not have to be accounted for in the nutrient management plan. The manure available for application in the Allocation Screen is the "Amount Added to System Annually" plus "Amount at Start of Plan Year" less "Amount Exported from System Annually".

Equals Annual Waste Available for Application

The "Annual Waste Available for Application" is not a user entry but is calculated and displayed by the program. "Annual Waste Available for Application" = "Amount at Start of Plan Year" plus "Amount Added to System Annually" less " Amount Exported from System Annually". This value appears on the Allocation Screen.

Estimate Amount Added Using Farm Records

If you have a good estimate of the quantity of waste added to this source from farm records, you can directly enter the quantity in this entry box.

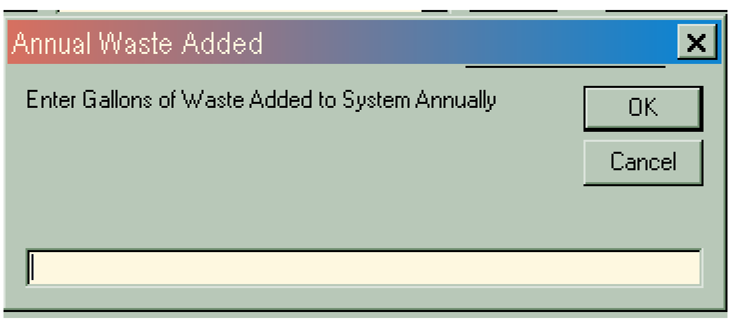
Estimate using animal parameters button

This selection will go to the Estimate from Animal Parameters screen. This screen is used to estimate total manure, waste water, bedding, precipitation and runoff added to this waste system annually.

Estimate using number and average weight of manure applications button

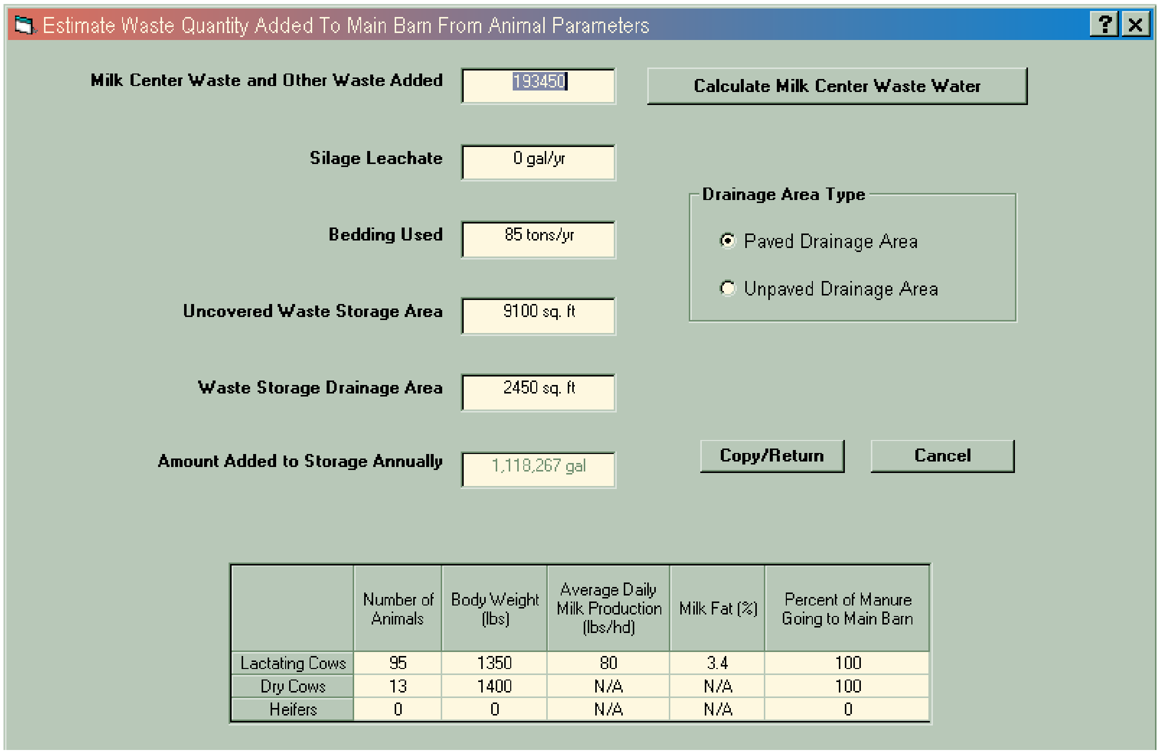
Select to go to the Estimate Using Number and Average Weight of Manure Applications screen. This screen estimates total waste hauled from this system annually given the average weight and frequency of hauled loads.

ESTIMATE AMOUNT USING FARM RECORDS



This popup window will appear when you choose the "Estimate Using Farm Records" button from the Manure Source Data Screen. Use farm records to calculate the total quantity of waste added to each source annually including additional water added and product exported. Enter the value here.

ESTIMATE WASTE QUANTITY FROM ANIMAL PARAMETERS



The total quantity of manure and waste added to the waste source can be estimated from the total manure excreted plus water, bedding and/or other waste added. This calculated value is the amount added in a ”normal” plan year. It does NOT include 25 year 24 storm precipitation and runoff. Milk Center Waste and Other Waste can be entered directly on this screen or estimated using entries made to a program worksheet (Calculate Milk Center Waste Water). The table, at the bottom of the screen, used to estimate the daily manure excretion depends on the livestock species selected on the Manure Screen. The daily manure for dairy cattle is calculated based on the animals body weight, average daily milk production and percent milk fat produced. The estimated daily manure excretion for all other species is based on the animal's weight as presented in Manure Characteristics MWPS-18 section 1, First Edition, 2001, Table 6. Additions from precipitation include precipitation directly into uncovered storage plus run off into storage from adjacent lots. Annual precipitation values depend on the township entered in the Contacts screen for the plan (Table 17.2). The methodology used to calculate annual runoff is outlined in the Agricultural Waste Management Field Handbook, Part 651(a), July 1996. The total "Amount Added to Storage Annually" is calculated as:

Liquid manure volume

Liquid manure volume = Daily manure excretion* 365.25
+ Milk Center Waste and Other Waste Added
+ Silage Leachate
+ Bedding Used
+ normal precipitation and runoff additions

Dry manure volume

Dry manure volume = Daily manure excretion * 365.25 + bedding

How to estimate (Waste Quantity) Using Animal Parameters:

1. In the Manure Source Data screen, click on the Estimate Using Animal Parameters button. The screen shown above will be displayed.
2. Enter data in each of the data entry boxes. The screen entries section below gives details about each entry item. To use a program worksheet to calculate the total waste and fresh water added to the system, click on the Calculate Milk Center Waste Water button.
3. The table at the bottom of the screen depends on the animal species selected. Enter each requested item including the "Percent of Manure Going to (*source name*)". In a total confinement system, this value will be 100%. If the animals are on pasture some of the time, enter the estimated amount of manure going into the source you are working with. *Note*: The grid entry movement requires you to press an arrow key to move to the next data item in the grid.
4. Look at the totaled waste quantity in the "Amount Added to System Annually" cell. Does it seem reasonable?
5. Click on Copy/Return to copy the "Amount Added to System Annually" to the corresponding data item in the Manure screen.

Screen Entries

Milk Center Waste and other Waste Added

Milk Center Waste and Other Waste Added is the quantity of milk center waste, flush and other liquid added to the waste system in the plan year. You can enter the total directly in this box or use the Calculate Milk Center Waste Water button to estimate the amount of waste water added.

Calculate Milk Center Waste Water Button

Jumps to a worksheet to help estimate additions to waste storage from milk center waste.

Silage Leachate

Enter the gallons of silage leachate added to this manure source annually. See Silage Leachate Volume.

Bedding Used

Enter the tons of bedding used each year. To calculate the tons of bedding used see Table 3.1 Bedding Material Density.

Uncovered Waste Storage Area

The uncovered waste storage area in square feet. For example, if an uncovered rectangular storage was 300 by 100 feet in dimension, including freeboard, the uncovered waste storage area would be (300*100) = 30,000 feet. This value is used to calculate the quantity of precipitation added to the manure. The calculation is: Water added from precipitation = Waste Storage Area*(P/12)*7.48 *where* P is the annual precipitation in inches and 7.48 is gallons per cubic foot.

Annual precipitation values are in Table 17.2. Precipitation values are determined by the township selected in the Contacts screen. If the annual precipitation is 35 inches per year, the structure in the example would receive an estimated (30,000* (35/12)*7.48) = 654,500 gallons of water from precipitation annually.

Waste Storage Drainage Area

Waste storage drainage area is the area, in square feet, of the lot contributing rain and snow melt run-off to the waste storage. This value is used to calculate the quantity of run-off water added to the manure. The calculation is:

If the waste storage drainage area is paved

Water added from runoff = Waste Storage Drainage Area*(P/12)*ROVp*7.48

If waste storage drainage area is unpaved

Water added from runoff = Waste Storage Drainage Area*(P/12)*ROVu*7.48

where ROVp and ROVu factors are used to estimate the quantity of run off from paved and unpaved lots and depend on the county chosen in the Contacts screen, see Table 17.11. P is the annual precipitation in inches and 7.48 is the gallons per cubic foot.

For example, assume the township annual precipitation is 43.2, the ROVu is 20 percent and the ROVp is 50 percent. If the value entered to this field is 1,000 square feet, and “unpaved” is selected on the radio buttons, the water added from run-off is (1,000 * (43.2/12) * 0.20 * 7.48) = 5,386 gallons. If the lot is paved, the water added from run-off is (1,000 * (43.2/12) * 0.50 * 7.48) = 13,464 gallons.

Amount Added to Waste System Annually

This is the sum of Annual Manure Excreted, milk center waste, flush and other liquid amount, silage leachate, bedding amount, normal precipitation and runoff additions, as measured in gallons or tons. Milk center waste, flush and other liquid amounta are the entered (or program calculated) milk center and other water volumes added in gallons. SilageLeachate is the entered silage leachate in gallons. Bedding amount is the entered tons of bedding added to the system. Normal precipitation is the calculated precipitation added to uncovered storage in gallons.Runoff is the calculated lot runoff water added to the system in gallons.

Drainage Area Type

Choose "paved" or "unpaved" to describe the runoff surface contributing runoff to the waste storage system. This entry sets the ROV (runoff value) used in the equations used to determine runoff. Runoff is the precipitation falling on the area around and flowing into the waste storage structure.

Copy/Return

Copies the calculated amount added to storage annually to the Manure Screen and returns to the Manure Screen.

Cancel

Returns to the Manure Screen without saving screen entries.

Animal Parameters Table

Enter animal data necessary for estimating manure excretion. The data entered depends on the species selected on the Manure Screen. For dairy cattle, entries include: the number of animals, body weight, daily milk production, milk fat percent and the percent of the manure going to the manure source. For horses, enter the number of animals, body weight and the percent of the manure going to the manure source. For all other species, enter the average number of animals per given class, and the percent of the manure going to the manure source.

Milk production is daily average milk production in pounds per head. Milk fat is the average milk fat percent, entered as a whole number ("3.5"). The "Percent of Manure Going To Storage" is the percent of the manure that goes to the manure source specified. This value is used when some of the manure generated by the animals described goes to a different manure system. For instance if animals are on pasture part of the day or part of the year, enter the estimated percent of manure going the specified manure source as a whole number. If all of the excreted manure is going to the specified manure source, enter "100".

To calculate the Annual Manure Excretion:

Annual Manure Excretion: Dairy cattle[1]

	Number of Animals	Body Weight (lbs)	Average Daily Milk Production (lbs/hd)	Milk Fat (%)	Percent of Manure Going to Main Barn
Lactating Cows	95	1350	80	3.4	100
Dry Cows	13	1400	N/A	N/A	100
Heifers	0	0	N/A	N/A	0

Lactating dairy cows

SBW_cows = BW_cows * 0.454
milk_kg = milk production * 0.454

$$\text{DMI\_kg} = ((0.0185 * \text{SBW}) + (0.305 * (0.4 + (0.15 * \text{Milk Fat})) * (\text{milk\_kg}))$$
$$\text{DMI\_lb} = \text{DMI\_kg} * 2.204$$
$$\text{Annual Manure Excretion} = ((-8178.30) + (1262.42 * \text{DMI\_lb})) * \text{Number Cows} * \text{PercentToStorage}$$

Dry dairy cows

$$\text{DMI\_lb} = 0.02 * \text{BW\_drycows}$$
$$\text{Annual Manure Excretion} = ((-438.23) + (1196.7 * \text{DMI\_lb})) * \text{NumberDryCows} * \text{PercentToStorage}$$

Dairy heifers

$$\text{DMI\_lb} = (0.0235 * \text{BW\_heifers}) + 1.5815$$
$$\text{Annual Manure Excretion} = ((-438.23) + (1196.7 * \text{DMI\_lb})) * \text{Number Heifers} * \text{PercentToStorage}$$

Where:

milk production is entered daily milk production in lbs.
BW_cows is entered lactating cows body weight in lbs.
BW_drycows is entered dry cows body weight in lbs.
BW_heifers is entered dry cows body weight in lbs.
Milk Fat is entered milk fat %.
PercentToStorage is the percent of the manure which goes to the manure source specified as opposed to pasture. See Estimating manure on pasture.

[1] Dairy excretion equations from T. P. Tylutki personal communication, February 2, 2000, based on data published in: Application of the Cornell Nutrient Management Planning System: Optimizing Herd Nutrition by T.P. Tylutki and D.G. Fox, 1997 Cornell Nutrition Conference for Feed Manufacturers, October 21-23, 1997.

Annual Manure Excretion: Beef Cattle

	Number of Animals	Percent of Manure Going to Main Barn
Growing (< 625 lbs)	25	50
Growing (625-875 lbs)	0	0
Growing (875-1125 lbs)	0	0
Growing (> 1125 lbs)	0	0
Cow - Calf	50	25

Animal Description	Manure per head, lbs/day[1]
Calf (average 450 lbs)	26
High forage (750 lbs)	62
High forage (1,100 lbs)	92
High energy (750 lbs)	54
High energy (1,100 lbs)	80
Cow (1,000 lbs)	63

[1] Manure Characteristics. MWPS-18 Section 1. 2001. Table 6.

Annual Manure Excretion = ∑ (Number of head * Manure per head * PercentToStorage * 365.25)

Annual Manure Excretion*: *Sheep

Animal Type	Number of Animals	Percent of Manure Going to Main Barn
Ewes - Early Pregnancy	95	100
Ewes - Late Pregnancy/Lactation	13	100
Weaned Lambs	0	0

Animal Description	Manure per head (lbs/day) [1]
Ewes early pregnancy	4.8
Ewes late pregnancy/lactation	6.3
Weaned lambs	3.9

[1] Doug Houge 8/23/00; Nutrient Requirements of Sheep, 6th edition NRC 1985.

Annual Manure Excretion = ∑ (Number of head * Manure per head * PercentToStorage* 365.25)

Annual Manure Excretion: Swine

Group Type	Number of Animals	Percent of Manure Going to Main Barn
Nursery Pig	195	100
Growing Pig	200	100
Finishing Pig (< 150 lbs)	0	0
Finishing Pig (> 150 lbs)	0	0
Gestating Sow	50	100
Sow and Litter	50	100
Boar	0	0

Animal Description	Manure per head(lbs)/day [1]
Nursery pig	2.3
Grow-Finish pig	9.5
Gestating sow	9.0
Lactating	22.5
Boar	11.5

[1] Manure Characteristics. MWPS-18 Section 1. 2001. Table 6.

Annual Manure Excretion = ∑ (Number of head * Manure per head * PercentToStorage* 365.25)

Annual Manure Excretion: Horses

	Number of Animals	Body Weight (lbs)	Percent of Manure Going to Main Barn
Mature Horses	95	1350	80
Young Stock, Ponies	13	1400	0

Mature Horses

BW_horses = entered horses body weight in lbs.
Annual Manure Excretion = ((BW_horses * .025 * .50) / 0.25) * NumberHorses* 365.25 * PercentToStorage

Ponies and young horses

BW_ponies = entered ponies body weight in lbs.
Annual Manure Excretion = ((BW_ponies * .025 * .50) / 0.25) * NumberPonies* 365.25 * PercentToStorage

These equations assumes that horses eat 2.5% of their body weight; 50% of their diet is digestible and the dry matter of the feces is 75%.

[1] Dr. Harold Hintz personal communication May 8, 2000.

Annual Manure Excretion: Poultry

Animal Type	Number of Animals	Percent of Manure Going to Main Barn
Layers	10000	100
Broilers	0	100

Animal Description	Manure per head(lbs)/day [1]
Layer	0.26
Broiler	0.18
Turkey	0.90
Duck	0.33

[1] Manure Characteristics. MWPS-18 Section 1. 2001. Table 6.

Annual Manure Excretion = ∑ (Number of head * Manure per head * PercentToStorage* 365.25)

Normal precipitation and runoff additions

Water added from precipitation = WasteStorageArea *(P /12) * 7.48

If the waste storage drainage area is paved:

Water added from runoff = WasteStorageDrainage * (P/12) * ROVp * 7.48

If waste storage drainage area is unpaved:
Water added from runoff = WasteStorageDrainage * (P/12) * ROVu * 7.48

Where:
WasteStorageArea is the entered uncovered waste storage area in square feet.
P is the average monthly precipitation, Table 17.2.
WasteStorageDrainage is the entered waste storage drainage area in square feet.
ROVp is the percent runoff from a paved lot, Table 17.11.
ROVu is the percent runoff from an unpaved lot, Table 17.11.
7.48 is the average density of water (gallons per cubic foot).

Adjusting waste quantity for the addition of organic and inorganic bedding

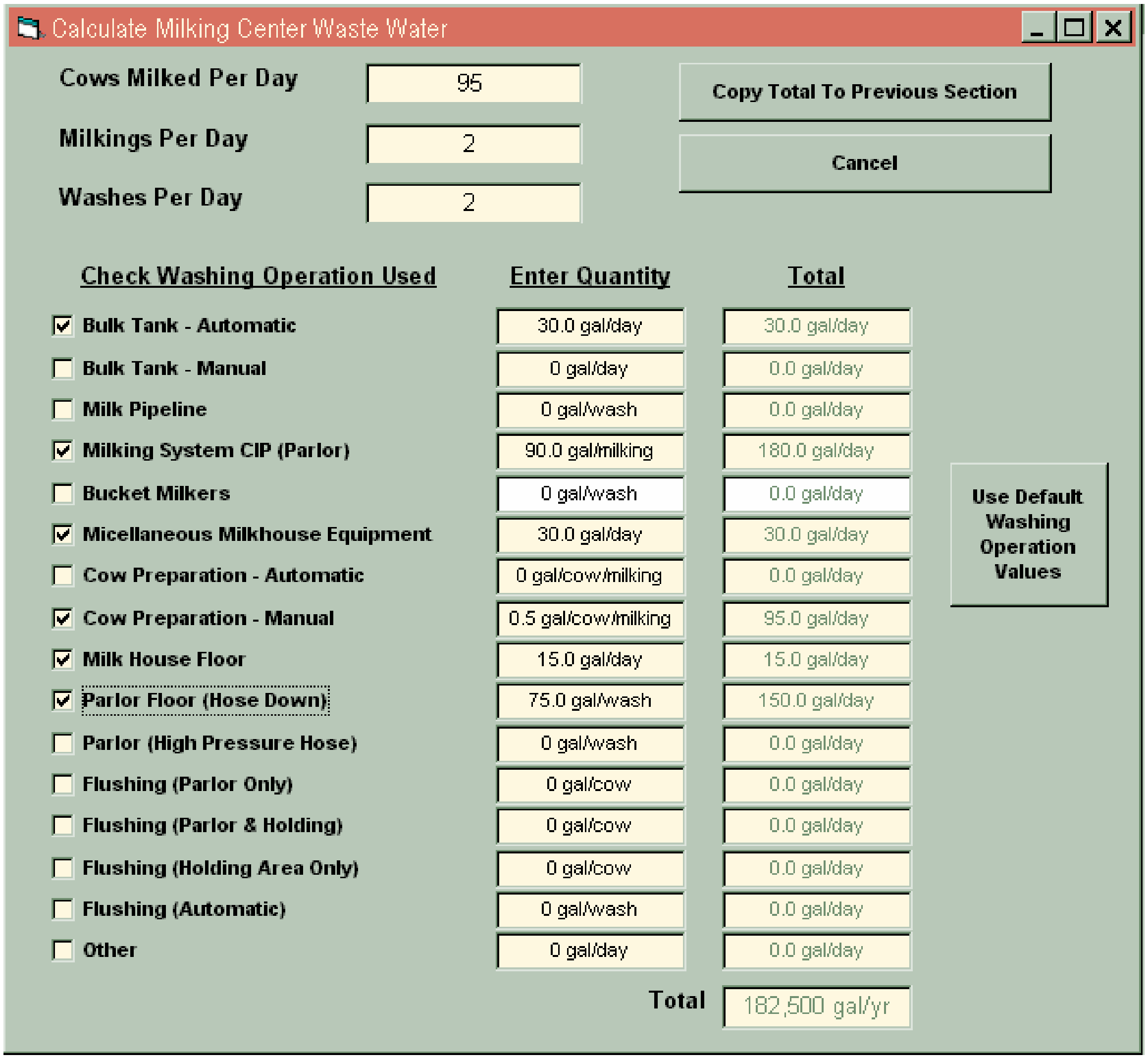
The total quantity of manure is stored in pounds as the nutrient recommendations and allocation are reported in pounds per acre. Liquid manure is assumed to have a standard density of 8.34 pounds per gallon (62.4 lbs/ cu feet) when organic bedding such as sawdust and straw is used. However, this standard density is not appropriate when inorganic bedding such as sand is used. See Measuring Manure Density.

The following table from MWPS-18, Livestock Waste Facilities Handbook (1993) shows the average density for various bedding materials. This table can be used to calculate the tons of bedding used. For instance, if one load of loose sawdust is delivered in a truck with box dimensions of 16 ft by 8 ft by 8 feet (=1024 ft^3), each load weighs 6.1 tons (1,024 * 12 lbs (from table)/2000).

Table 3.1 Bedding material density

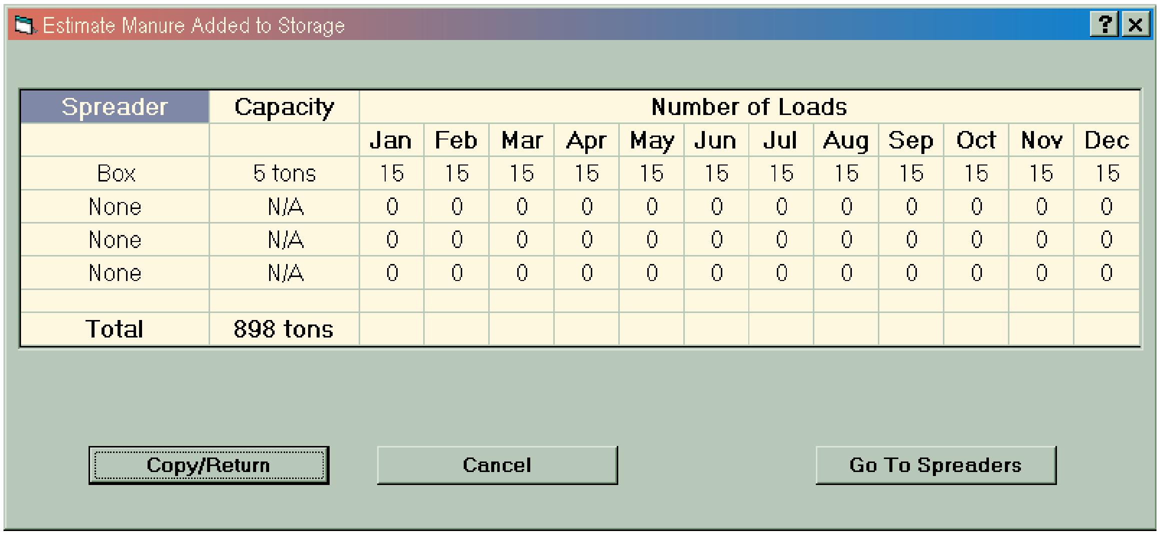
Form	**Material**	**Density lbs/ft^3**
Loose	Alfalfa	4-4.4
	Nonlegume hay	3.3-4.4
	Straw	2-3
	Shavings	9
	Sawdust	12
Baled	Alfalfa	6-10
	Nonlegume hay	6-8
	Straw	4-5
	Shavings	20
Chopped	Alfalfa	5.5-7
	Nonlegume hay	5-6.7
	Straw	5.7-8

CALCULATE MILK CENTER WASTE WATER



This screen is used as a worksheet to help estimate waste water additions to the waste system. The Use Default Washing Operation Values button will set the values to the "average" values given in Guideline for Milking Center Wastewater, NRAES-115 (Wright, P.E and R.E. Graves, 1990). Enter your own values in the "Enter Quantity" column. To add the value to the total, check the box to the left of the Washing Operation. Selecting the Copy Total to Previous Section button will copy the total value back to the "Milk Center Waste" entry in the Estimate Waste from Animal Parameters screen.

ESTIMATE WASTE QUANTITY BY COUNTING HAULED LOADS



For the selected manure source, enter the number of loads of manure hauled with a given spreader per month for up to four spreaders. You must define at least one spreader before you enter values in this screen. The Go to Spreaders button at the bottom of the screen will jump to the screen where the spreaders used on the farm can be created and defined. In addition to summing the total annual quantity of waste for the source, the amount entered for each month on this screen is carried over to the Manure Spreading Calendar Screen.

How to Estimate Manure Hauled from Waste System

1. After at least one spreader and its capacity have been entered, click the “Estimate Using Number and Average Weight of Manure Applications” button on the Manure screen.
2. The screen shown above will pop-up. In the first spreader row, click on the “None” cell. Click on the down arrow. All of the manure spreaders created for this nutrient management plan will be shown in a drop down menu.
3. Click on the first manure spreader used to haul from this waste system.
4. In each month, enter the number of loads hauled from the system. This value can be from historical records or an estimate of the number of loads that will be hauled in the plan year.
5. Note the “Total” value at the bottom of the screen. Does this look like a reasonable estimate for this waste source?
6. Repeat this process for up to four spreaders which haul from this source.
7. When all of the spreaders have been entered, click on the Copy/Return button to copy the total quantity hauled back to the manure screen, “Amount Added to System Annually” entry box. This action will also update the monthly manure application schedule on the Manure Spreading Calendar

Screen Entries

Spreader

Click on the “None” in any row under the “Spreader” column heading. Clicking on the down arrow will display all of the manure spreaders created for this nutrient management plan. Select a spreader. The capacity defined for that spreader will be displayed in the “Capacity” column.

Number of Loads

Enter the estimated number of loads removed from the manure source for each month for a given spreader.

Total

For each spreader, the number of loads are aggregated from January to December and multiplied by the capacity to result in the total manure spread. The number of loads can be a decimal, i.e. “1.5” is an accepted entry. The number of loads in each month multiplied by the selected spreader capacity entered in this screen, are carried over to the “Manure Added” row of the Manure Spreading Calendar Worksheet.

Copy/Return

Copies the total quantity of manure added to the selected manure system back to the “Amount Added to Source Annually” field of the Manure Screen and the monthly total manure added to the Manure Spreading Calendar Worksheet.

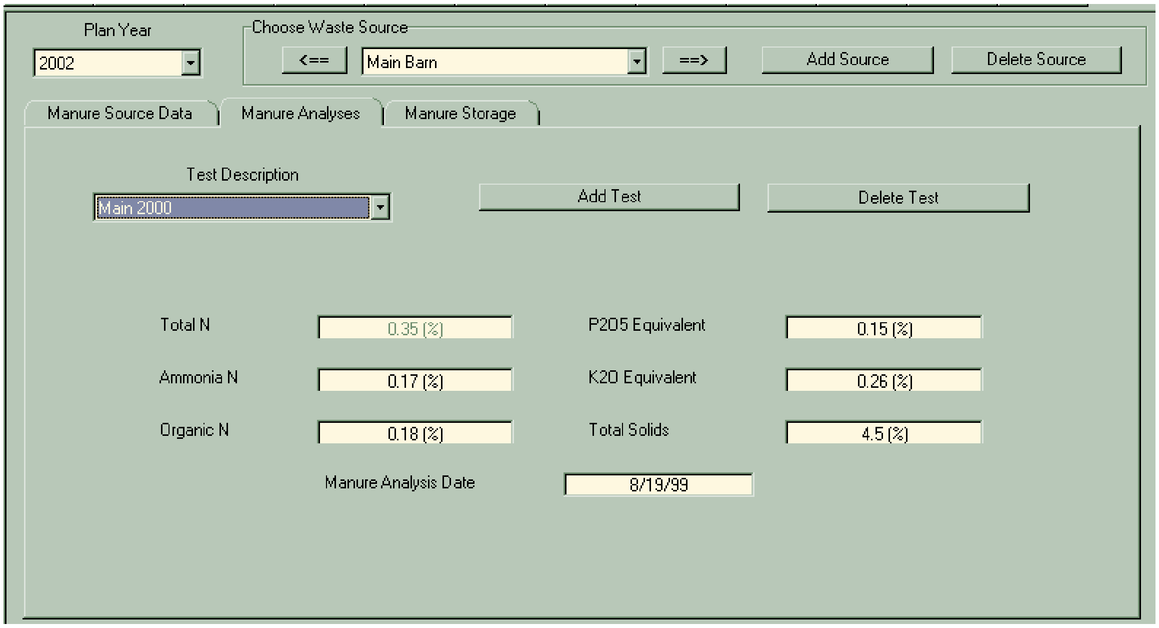
Cancel

Returns to the Manure Screen without saving screen entries.

Go To Spreaders

Jumps to the Manure Spreaders entry screen.

MANURE ANALYSES



Enter the waste nutrient analysis on this screen. Manure nutrient content is extremely variable. Periodic lab analysis of representative waste samples is critical to developing an accurate nutrient management plan. The default manure analysis values shown for each species are "book" values which may be very different from the manure analysis on your farm! These values act as a place-holder until you enter the manure analyses for your farm from current laboratory tests. See "Do you monitor the nutrient content of manure?".

The nutrient composition of manure from a given system may change over time. Stored manure is diluted with precipitation and loses nitrogen to volatilization. The nutrient content in a daily spread system may change due to ration or manure handling changes. Multiple manure analyses can be entered for each manure source in the "Manure Analyses" screen. Total N, Ammonia N, Organic N, P_2O_5 equivalent, K_2O equivalent and Total Solids are entered as percents.

How to enter a new manure analysis:

1) Choose the Manure Analysis tab.
2) Select the "Add Test" button.
3) At the prompt add a new manure analysis name, such as "Fall 03".
4) Add each of the nutrient values from your manure analysis report. Enter Total N, Ammonia N, Organic N, P_2O_5 equivalent, K_2O equivalent and Total Solids as percents.

Screen Entries

Add test button

Create a manure test analysis for this source. A popup box will allow you to enter a new manure test name. The test name entered will appear in the “Test Description” drop down box.

Delete test button

Deletes the displayed test description. If the test is currently being used in the plan, Cropware will not allow the test to be deleted.

Total N

Enter Nitrogen N percent from manure analysis report.

Ammonia N

Enter Ammonia Nitrogen percent from manure analysis report.

Organic N

Enter Organic Nitrogen percent from manure analysis report.

P_2O_5

Enter Phosphate Equivalent percent from manure analysis report.

K_2O

Enter Potash Equivalent percent from manure analysis report.

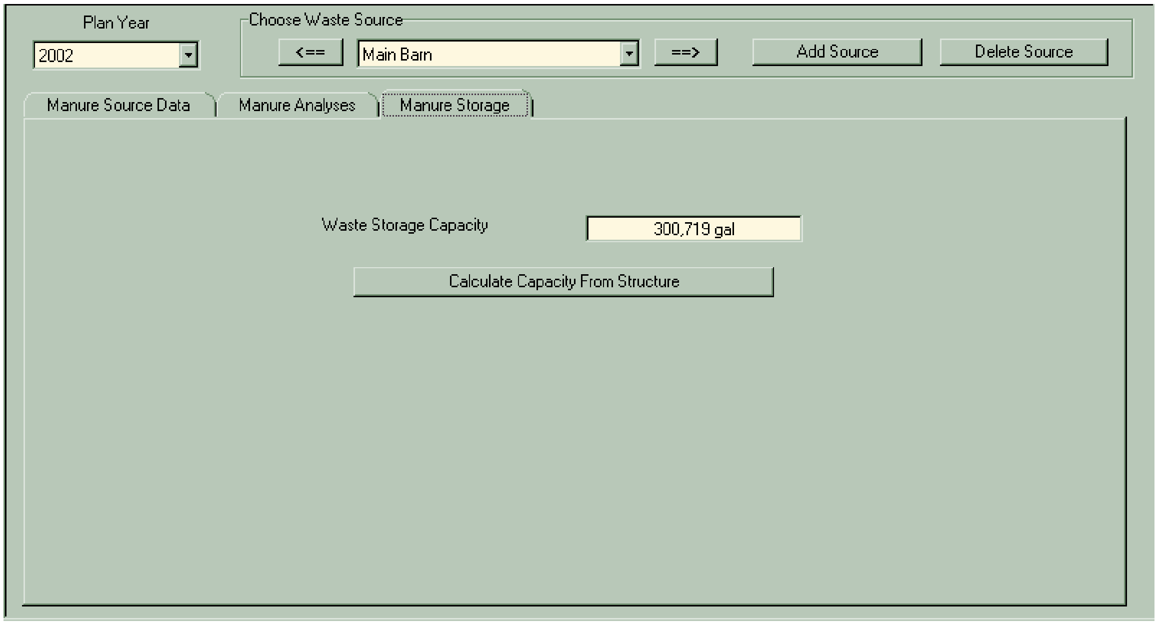
Total solids

Enter Total Solids or percent dry matter from manure analysis report.

Manure analysis date

Enter the manure analysis date from the manure analysis report. If the date is entered in a standard date format (mm/dd/yy or mm-dd-yy), the analysis with the most recent date will be displayed in the Manure Analysis, Collection and Storage Report.

MANURE STORAGE



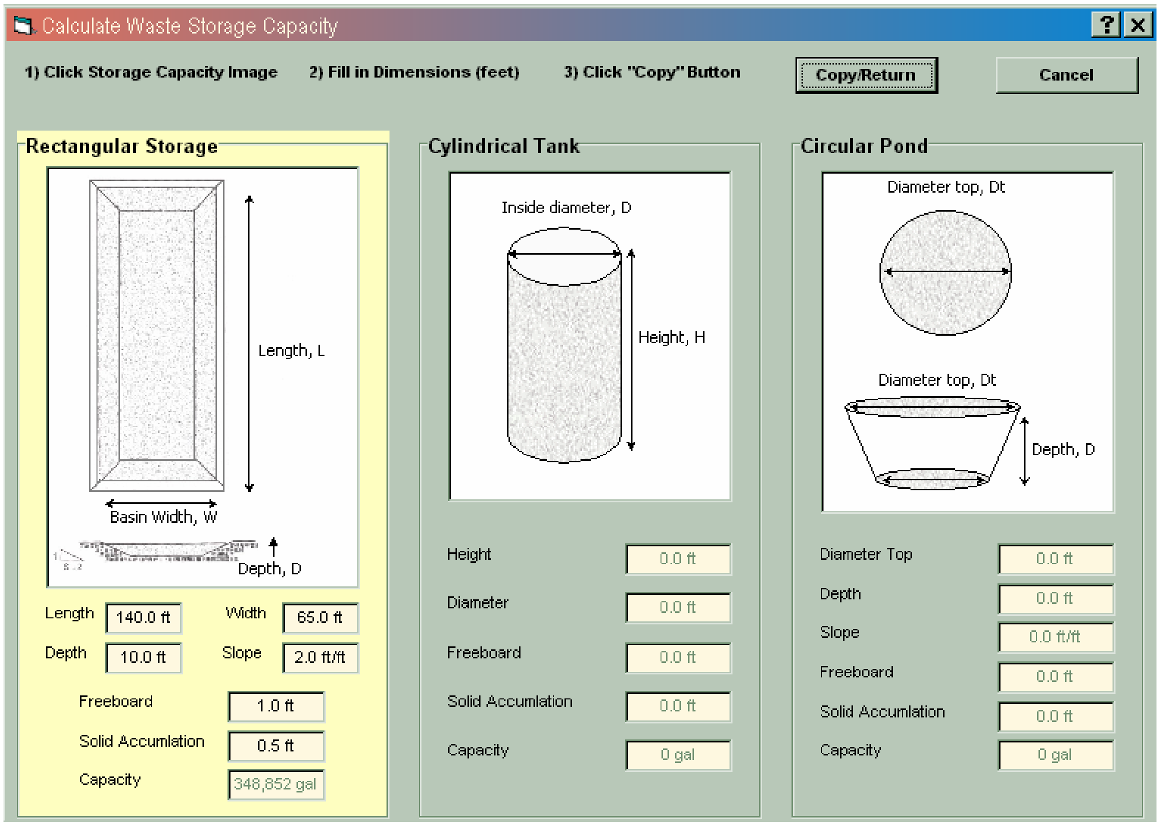
Waste Storage Capacity

For each waste source, the system capacity can be entered or calculated. This is not a required input but is necessary if you want to compare waste storage capacity to storage requirements and project months of storage duration.

Calculate Capacity from Structure button

Displays the Calculate Waste Storage Capacity Screen.

CALCULATE WASTE STORAGE CAPACITY



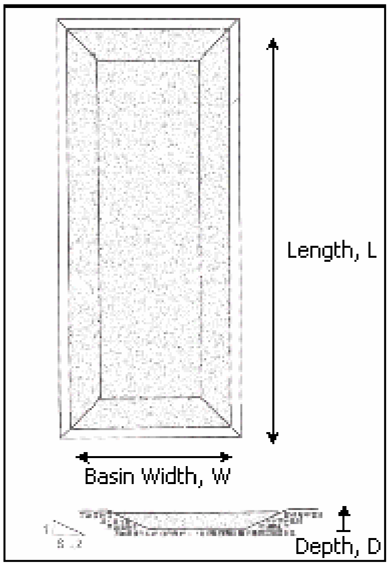
For each waste source, if there is storage, the storage capacity can be entered or calculated. This is not a required input but entering this information is necessary if you want to compare waste storage capacity to storage requirements and project months of storage duration. This function is for planning and not for design purposes.

The calculated capacity includes a deduction in capacity to account for freeboard but does not deduct for solids accumulation or precipitation from unusual storm evens. However, solids accumulation and 25 year 24 hour storm precipitation and runoff are calculated and used to estimate the total waste volume required for 12 months of storage. These values are reported in the Manure Analysis, Collection and Storage report. Units are selected on the Manure Screen – gallons or tons. Calculations are from Liquid Manure Application Systems Design Manual NRAES 89, page 46-47.

How to calculate the waste storage capacity:

1) Click the storage capacity image which is resembles the structure shape.
2) Fill in the dimensions in feet.
3) Click the Copy/Return button and the calculated capacity will be copied to the Manure Screen.

Screen Entries: Rectangular Storage



Length

The length of the storage structure, including the freeboard area, in feet.

Width

The length of the storage structure, including the freeboard area, in feet.

Depth

The depth of the storage structure, including freeboard and solid accumulation, in feet.

Slope

The slope of the storage (rise/run) in ft/ft.

Freeboard

The extra height (in feet) designed into a storage structure to minimize chances of the contents overflowing and causing contamination. The calculated capacity includes a deduction in capacity to account for freeboard.

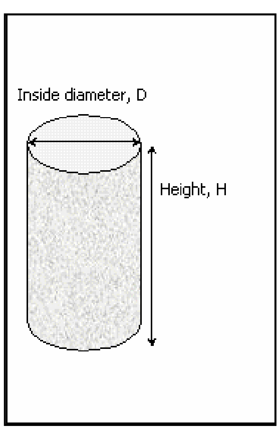
Solid Accumulation

The settled accumulation of solid material at the bottom of the storage structure. The calculated capacity includes a deduction in capacity to account for freeboard but does not deduct for solids accumulation. However, solids accumulation is used to estimate the total waste volume required for 12 months of storage (Manure Analysis, Collection and Storage report).

Capacity

The total calculated capacity of the storage structure in gallons.

Screen Entries: Cylindrical Tank



Height

The extra height (in feet) designed into a storage structure to minimize chances of the contents overflowing and causing contamination.

Diameter

The diameter of the storage structure in feet.

Freeboard

Extra height added as a safety factor in feet. The calculated capacity includes a deduction in capacity to account for freeboard.

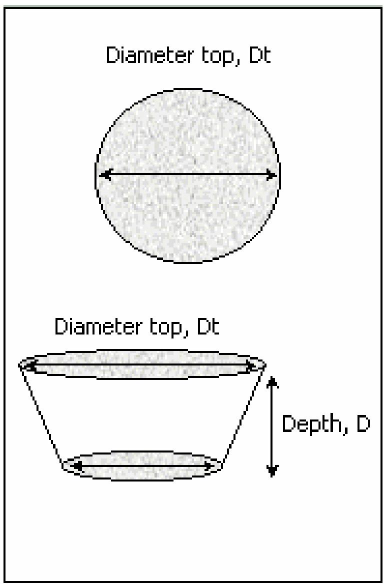
Solid Accumulation

The settled accumulation of solid material at the bottom of the storage structure. The calculated capacity includes a deduction in capacity to account for freeboard but does not deduct for solids accumulation. However, solids accumulation is used to estimate the total waste volume required for 12 months of storage (Manure Analysis, Collection and Storage report).

Capacity

The total calculated capacity of the storage structure in gallons.

Screen Entries: Circular Pit



Diameter Top

The diameter of the top of the storage structure, including freeboard, in feet.

Depth

The depth of the storage structure, including freeboard and solid accumulation, in feet.

Slope

The slope of the storage (rise/run) in ft/ft.

Freeboard

The extra height (in feet) designed into a storage structure to minimize chances of the contents overflowing and causing contamination. The calculated capacity includes a deduction in capacity to account for freeboard.

Solid Accumulation

The settled accumulation of solid material at the bottom of the storage structure. The calculated capacity includes a deduction in capacity to account for freeboard but does not deduct for solids accumulation. However, solids accumulation is used to estimate the total waste volume required for 12 months of storage (Manure Analysis, Collection and Storage report).

Capacity

The total calculated capacity of the storage structure in gallons.

Calculations

Volume of Rectangle

The volume of the rectangular storage is:

$V = (Ll * Wl * D) - ((S * D^2) * (Wl + Ll)) + (4/3 * S^2 * D^3)$
$Ll = (L - (2 * FB * S))$
$Wl = (W - (2 * FB * S))$

Where:

L is the entered length of the rectangle in feet.
D is the entered depth of the storage in feet.
S is the entered side slope (rise/run).
V is volume in cu ft.
FS is entered freeboard in feet.
D is the depth of liquid at maximum surface (total depth minus freeboard), feet.
S is entered top to bottom average slope.
L1 is the liquid length at the surface in feet.
W1 is the liquid width at surface in feet.

The volume of the solids (cubic feet) accumulation at the bottom of a rectangular storage is:

$V\_solids = (L\_solids * W\_solids * D\_solids) - ((S * D\_solids^2) * (W\_solids + L\_solids)) + (4/3 * S^2 * D\_solids^3)$
$Dt = D - D\_solids$
$L\_solids = L - (Dt * S * 2)$
$W\_solids = W - (Dt * S * 2)$

Where:

D_solids is solids accumulation in feet.
Dt is the depth of pit at top of solids accumulation in feet.
L_solids is the length at top of solids accumulation in feet.
W_solids is the width at top of solids accumulation in feet.
V_solids is volume of solids accumulation in cubic feet.

Manure Source Capacity and Total Solids Accumulated are converted to gallons for liquid storage systems by multiplying the calculated volume (cubic feet) to gallons (7.48 gal/cu ft).

Manure SourceCapacity = V * 7.48
Solids Accumulation = V_solids * 7.48

If a solid system is used, Manure Source Capacity and Total Solids Accumulated are converted by multiplying the calculated volume (cubic feet) to tons (0.031 tons/cu ft).

ManureSourceCapacity = V * 0.031
SolidsAccum_gal = V_solids * 0.031

Volume of cylinder tank

The volume capacity of a cylindrical tank is:

$V = (\pi * D^2 * H)/4$
$H = H – FB – SA$

The solids accumulation in a cylindrical tank is:

$V\_solids = (\pi * D^2 * SA)/4$

Where:

H is entered height in feet.
D is entered diameter in feet.
FB is entered freeboard in feet.
SA is entered solids accumulation in feet.
V is volume in cubic feet.

Manure and solids accumulation volume is converted from cubic feet to gallons:

ManureSourceCapacity = V * 7.48
SolidsAccum_gal = V_solids * 7.48

If a solid system is used, Manure Source Capacity and Total Solids Accumulated are converted by multiplying the calculated volume (cubic feet) to tons (0.031 tons/cu ft):

ManureSourceCapacity = V * 0.031
SolidsAccum_gal = V_solids * 0.031

Volume of circular waste storage pit:

The volume of a circular waste storage pond is

V = (1/3) * (A1 + A2 + SQRT(A1 * A2)) * D
D= Total Depth – FB
Dt = Dt – (2 * (FB * S))
Db = Dt – (2 * (D * S))
$A1 = \pi * (Dt/2)^2$
$A2 = \pi * (Db/2)^2$

Where:

D is entered depth less entered freeboard in feet.
Dt is the top diameter less the volume taken by freeboard (feet).

Db is the bottom diameter less the volume taken by freeboard (feet).
S is the entered average slope
FB is the entered freeboard in feet.
V is the volume in cubic feet.

The solids accumulation in a circular storage pond is:

Dt_solids = Db + (2 * SA * S)
A1_solids= π * (Dt_solids/2)^2
V_solids = (1/3) * (A1_solids + A2 + SQRT(A1_solids * A2)) * SA

Where:

A1 is the area of the top in ft^2.
A2 is the area of the bottom in ft^2.
SA is the entered solids accumulation in feet.
Dt_solids is the diameter at the top of solids accumulation.
A1_solids is the area of top bounded by solids accumulation.
V_solids is the ‘volume of solids accumulation at bottom of pond, cubic feet.

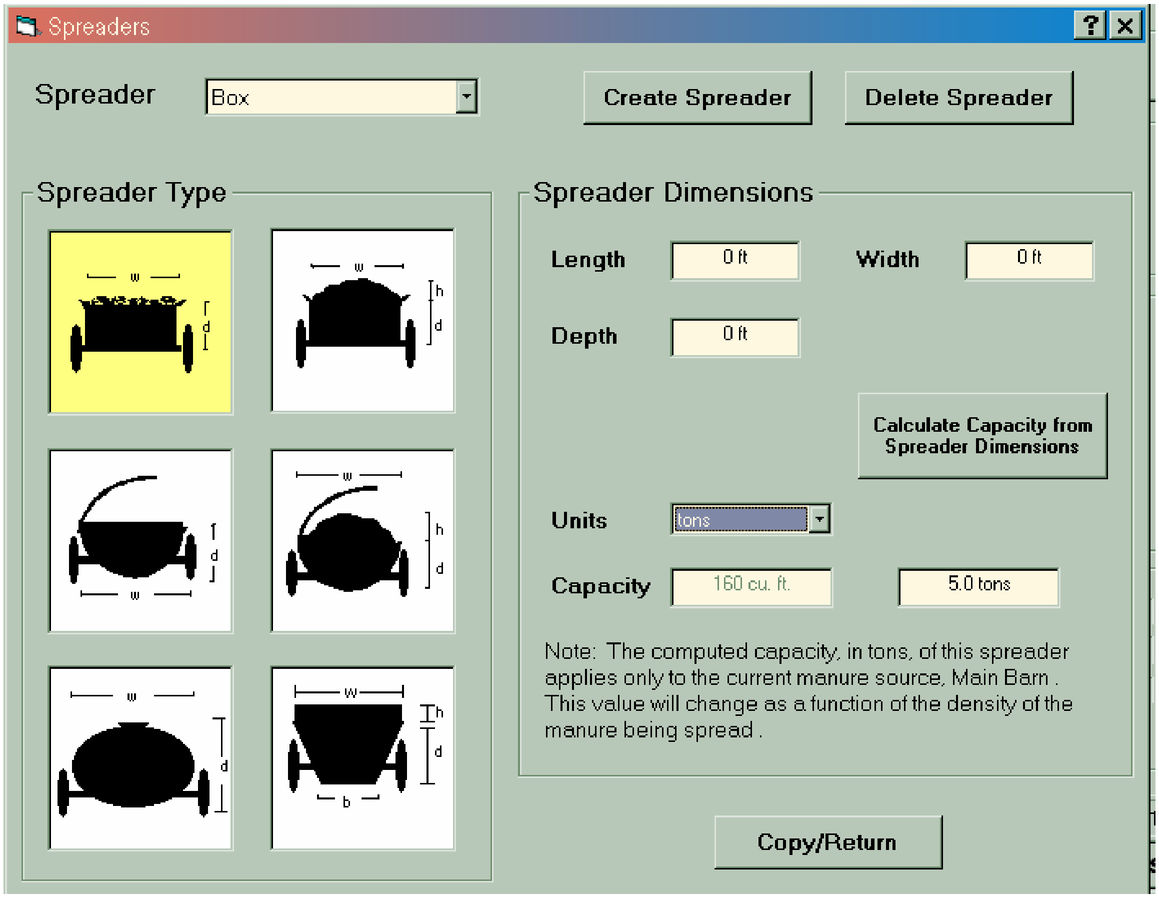
Manure and solids accumulation volume is converted from cubic feet to gallons:

ManureSourceCapacity = V * 7.48
SolidsAccum_gal = V_solids * 7.48

If a solid system is used, Manure Source Capacity and Total Solids Accumulated are converted by multiplying the calculated volume (cubic feet) to tons (0.031 tons/cu ft):

ManureSourceCapacity = V * 0.031
SolidsAccum_gal = V_solids * 0.031

3.6 SPREADERS SCREEN



Manure spreader capacity is entered on this screen. The capacity can be entered directly or calculated by the program from the size and shape of the spreader. The computed capacity applies only to the current manure source, as the value computed will change as a function of the density of the manure being spread and the units selected. If the default liquid manure density of 8.34 lbs per gallon is used, the gallons per load = cubic feet x 7.48. Solid manure (manure units selected = “tons”) tons per load = cubic ft x 62.5 ÷ 2000. Entering a measured capacity will be more accurate than calculating the capacity from spreader dimensions. See “Do you calibrate fertilizer and manure application equipment?”.

The spreader capacity is used to calculate the amount of manure added to the manure source annually when the Estimate Using Number and Average Weight of Manure Applications method is selected. Using this method, the total annual manure quantity is the sum of the spreader capacity times the number of loads for each spreader. The capacity of each spreader used must be entered before you can estimate the annual manure quantity from the number of loads spread.

How to create a new spreader:

1. Click on the Create Spreader button.
2. In the popup box enter a unique name for your spreader.
3. Select the units, tons or gallons.
4. You can estimate the spreader capacity by entering the spreader dimensions (or) entering the capacity directly in the "Capacity" entry box.
5. Click on Copy/Return to save the spreader capacity and return to the last program screen.

Screen Entries

<u>Create Spreader</u>

Create a new spreader. A popup box will allow you to enter a new spreader name.

<u>Delete Spreader</u>

Deletes the currently selected spreader.

<u>Length</u>

Spreader length in feet. The spreader capacity can be entered or calculated. This entry is only necessary if the spreader capacity is calculated by the program.

<u>Width</u>

Spreader width in feet. This entry is only necessary if the spreader capacity is calculated by the program.

<u>Depth</u>

Depth of spreader in feet. This entry is only necessary if the spreader capacity is calculated by the program.

<u>Height</u>

Height of heaped manure above spreader sides in feet. This entry is only necessary if the spreader capacity is calculated by the program.

<u>Units</u>

Choose "gallons" or "tons".

<u>Capacity</u>

You can directly enter the capacity of the spreader, in gallons or tons, in this text box or you can click on the Calculate Capacity from Spreader Dimensions button to have the program estimate the spreader capacity from the entered spreader dimensions. If you can get a good estimate of the spreader capacity from farm measurement, this method is generally more accurate than an estimate based on dimensions. See “Do you calibrate fertilizer and manure application equipment?”.

<u>Calculate Capacity from Spreader Dimensions</u>

Choose this button if you want the program to calculate an estimated manure spreader capacity.

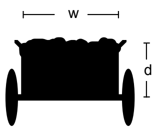
<u>Estimate manure spreader capacity</u>

Measure all dimensions in feet and tenths of feet.

Spreader volume

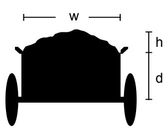
<u>Box spreader (level load)</u>

cubic feet = length (l) x width (w) x depth (d)



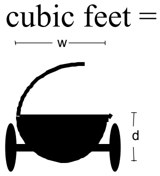
<u>Box spreader (piled load):</u>

cubic feet = length(l) x width(w) x [depth(d)+stacking height(h) x 0.8]



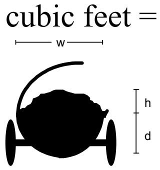
<u>Flail barrel spreader (level load):</u>

cubic feet = length(l) x depth(d) x depth(d) x 1.6



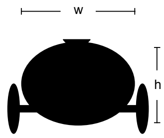
<u>Flail barrel spreader (piled load)</u>

cubic feet = length (l) x depth(d) x 1.6 x [depth(d)+stacking height(h)]



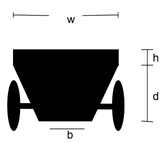
<u>Tank spreader</u>

cubic ft = length(l) x width(w) x depth(d) x 0.8



<u>V-Body spreader (level load)</u>

cubic feet = [width(w) x height(h) x length(l)] +
[0.5 x [width(w)- base(b)] x depth(d) x length(l)] + [base(b) x depth(d) x length(l)]



<u>Spreader Capacity</u>

If the manure units is “tons”:

Tons per load = cubic ft x 62.5 ÷ 2000

If the manure units is “gallons”:

Gallons per load = cubic ft * 7.48

The computed capacity, applies only to the current manure source as the value computed will change as a function of the density of the manure being spread and the units selected. If the default liquid manure density of 8.34 lbs per gallon is used, the gallons per load = cubic feet x 7.48. Solid manure (manure units selected = “tons”) tons per load = cubic ft x 62.5 ÷ 2000.

3.7 FIELDS SCREENS

The Fields data entry is divided into seven screens. Each screen, Field Data, Soil Test, Crop Data, Manure Use, Past Manure Use, Fertilizers and Phosphorus Index Factors can be selected by clicking on the folder tab at the top of the screen.

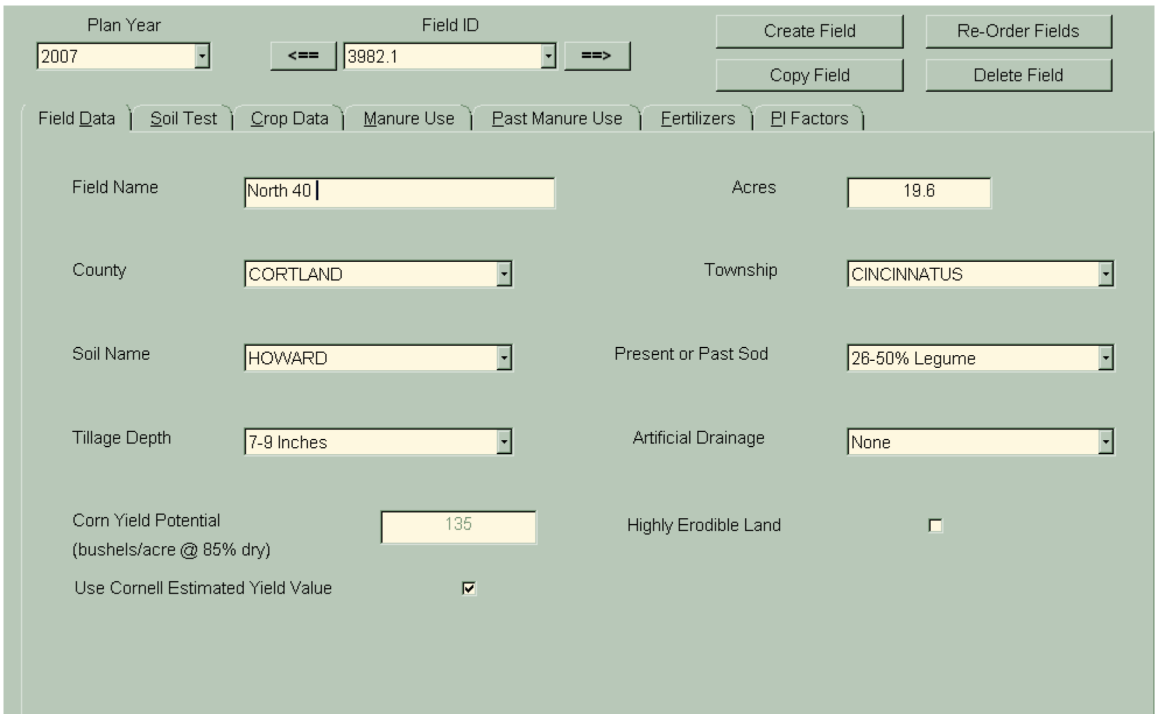
How to enter field data:

1) The most efficient way to enter field data is to enter groups of similar fields.
2) Click on **Create Field**.
3) Enter the field information for the field in each of the Field Screen tabs – Field Data, Crop Data, Manure Use, Fertilizers and Phosphorus Index Factors.
4) Click on **Copy Field**, to copy the “template” field to all similar fields. You must give each field a unique Field ID.

5) Go back to each of the new fields by clicking on the field ID in the tree or using the arrow keys on either side of the Field ID entry. Change the data that is different than the "template" field.

Note: When entering large amounts of data, it is wise to save your work to disk often (Control-S or File – Save).

FIELDS SCREEN – FIELD DATA TAB



Screen Entries:

Plan Year

The plan year that you are entering data for is shown here. You can enter field data for future or past plan years by changing the plan year shown here but the data are changed only in the year the entry is made and these changes are not carried forward.

Field ID

Enter any unique alpha-numeric name that identifies the crop field. Preferably, enter the Farm Service Agency tract and field number (FSA ID). The FSA ID is required for CAFO compliant comprehensive nutrient management plans. The FSA ID is also the common field identification for county, state and national farm databases. A valid FSA ID will be necessary to create farm maps from data supplied by New York State Soil and Water Conservation Districts. Enter FSA ID in the following format: 3928.25A (tract-period-field-strip). The tract is a number between 4 and 7 digits in length. The field is a two digit number and the strip is a letter, A to Z, identifying a portion of a field.

Left arrow

Move to the previous field.

Right arrow

Move to the next field.

Create Field

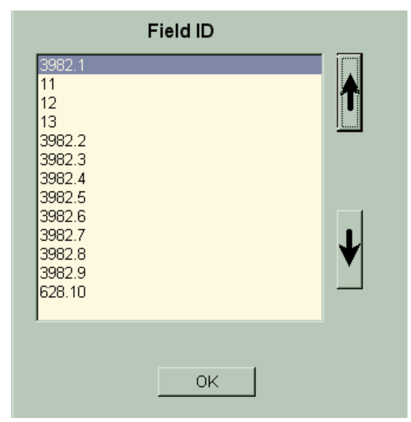
Create a new crop field. A popup box will allow you to enter a new field ID.

Copy Field

Copies the current field information. A popup box will allow you to enter a new field ID.

Re-order Fields

Select this button to re-order the ranking of the fields in your Field ID list. The following window will pop-up. Highlight the field that you want to move and use the up and down arrow keys until the selected field is in the desired position.



Delete Field

Deletes the current field.

Field Name

Enter a descriptive name for the crop field.

Acres

Crop field production area in acres.

County

Enter the county the field is in. Selecting the county will cause the Township dropdown box to display only the townships for the county entered.

Township

The average and seasonal rainfall is defined by what township the field is in. These values are used in the Nitrate Leaching Index calculation.

Soil Name

Enter the field's most dominant soil type. Detailed soil maps and descriptions of the soils are available for most counties in New York State from the Natural Resources Conservation Service, Soil and Water Conservation District, or Cornell Cooperative Extension. You can jump to the desired soil name by typing in the first few characters of the name. For a complete list of available soil names, see Table 17.1.

Present or Past Sod

If sod has been grown on this field during the past three years, select the percent legume in the stand currently or when it was plowed down. The "Present or Past Sod" is used to calculate the nitrogen available to the plant from sod. The N contribution from sod is discounted depending on the number of years since the sod crop was plowed down. Sod crops and their crop codes are listed in Table 6.1. The annual nitrogen contribution from plowed down sod crops is shown in table 3.2.

Table 3.2 N from Sods or Cover Crops

Choice:	legume %	N (lb/a)	------------------Available N--------------- Year 1 (lb/a)	Year 2 (lb/a)	Year 3 (lb/a)
100% Grass	0	150	83	18	8
1-25% Legume	1-25	200	110	24	10
26-50% Legume	25-50	250	138	30	13
+50% Legume	50+	300	165	36	15
None	-	-	-	-	
% contribution per year			55%	12%	5%

Tillage Depth

Select the tillage depth, including "no-till" which describes the tillage depth in the plan year. Tillage depth effects nitrogen and lime recommendations. The total nitrogen nutrient contribution from manure is decreased by 15 percent if "no-till" is selected. The choices are:

- No Till
- 1-7 Inches
- 7-9 Inches
- 9+ Inches

Artificial Drainage

Select the artificial drainage description for the field. The artificial drainage selection is used in the calculation of the Nitrogen Leaching Index, Crop Yield Potential and nitrogen recommendations (efficiency of nitrogen) use calculations.

Highly Erodible Land (HEL)

Check this box if the field qualifies as highly erodible land. Fields are considered to be highly erodible if one third or 50 acres of the field (whichever is less) are soils with a natural erosion potential at least 8 times their T level. HEL fields must have an NRCS approved conservation system. This value is for farm planning information and is not used in any Cropware calculations.

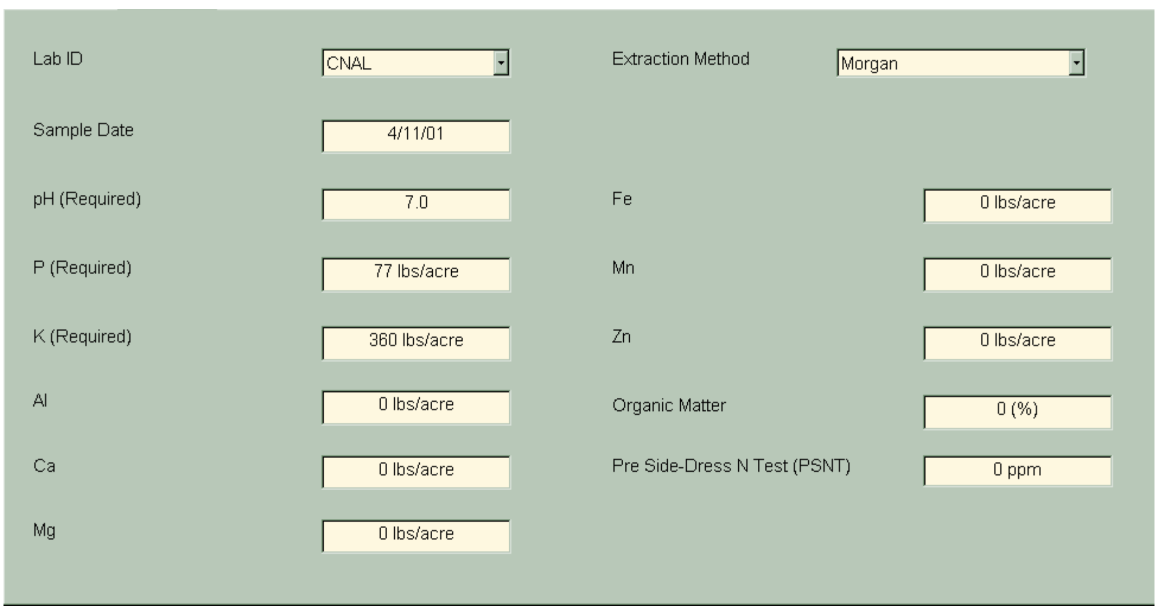
Corn Yield Potential

The Corn Yield Potential (YPC) is a value used to make nitrogen recommendations sensitive to crop yields. The default value is based on Cornell field trial research data for a given soil type and artificial drainage. You have the option of changing this value to reflect actual corn yields on this field or using program generated values. You should have three years of yield data to support a change from the program calculated YPC. To calculate the YPC for corn silage, multiply the corn silage yield in tons/acre (35% dry matter) by 5.9 bu/ton to get the YPC in bu/acre. The YPC is used in the nitrogen recommendations for corn grain, corn silage, sorghum forage, sorghum grain, sudangrass, sorghum-sudan hybrid and millet.

Use Cornell Estimated Yield Value

Check this box to have Cropware estimate a corn yield potential based on soil series and field artificial drainage.

FIELDS SCREEN – SOIL TEST TAB



Screen Entries

Lab ID

Choose the lab that preformed the soil analysis. The choices are:

CNAL – Cornell Nutrient Analysis Laboratory
Brookside Laboratories, Inc.
Spectrum Analytic, Inc.
A&L Eastern Laboratories, Inc.
A&L Canada Laboratories, Inc.
University of Vermont

Extraction Method

Choose the nutrient extraction method used by the soil test lab for this soil sample. The lab and extraction method determine nutrient soil test units (table 3.3).

Table 3.3 Entered units depend on the lab and extraction method.

Lab	Extraction Method	Enter P, Ca, Mg, K in	Enter Al in
CNAL	Morgan	lbs/acre	lbs/acre
Brookside	Mehlich III	ppm	ppm
Spectrum	Mehlich III	lbs/acre	ppm
	Morgan (Spectrum)	lbs/acre	ppm
A&L (East)	Modified Morgan	ppm	ppm
	Mehlich III	lbs/acre	ppm
A&L (Canada)	Mehlich III	ppm	ppm
Univ. Vermont	Modified Morgan	ppm	ppm

Note: 1 ppm = 2 lbs/acre

Phosphorus (P) and Potash (K2O5) recommendations are calculated by Cropware based on Cornell Nutrient Analysis Laboratory data using a well buffered and weakly acidic solution of sodium acetate (Morgan extraction). Mehlich III and Modified Morgan data are converted to Cornell Morgan equivalent values and used in the nutrient requirement calculations. **However, these conversions add additional uncertainty into the nutrient recommendations.**

Sample Date

Enter the date the soil sample was taken.

pH

Soil hydrogen ion activity used for estimating the lime requirement of soils.

P (Required)

Enter the phosphorus soil test value. The entry units depend on the Soil Test Lab and the extraction method. See Table 3.3. This is a required data entry.

K

Enter the potassium soil test value. The entry units depend on the Soil Test Lab and the extraction method. See Table 3.3. This is a required data entry.

Exchange Acidity

If exchange acidity is available from the soil test analysis, enter it in ME/100 grams. The exchange acidity is used in the lime recommendation when the soil pH is less than 6.1. This is a required entry if the soil pH is less than 6.1.

Al

Enter the aluminum soil test value. The entry units depend on the Soil Test Lab and the extraction method. See Table 3.3. This value is used to convert Mehlich III P test values to Morgan equivalent values for use in Cropware phosphorus requirement and P Index calculations. Therefore this is a required data entry when Mehlich III is the extraction method.

Ca

Enter the calcium soil test value. The entry units depend on the Soil Test Lab and the extraction method. See Table 3.3. This value is used to convert Mehlich III P test values to Morgan equivalent values for use in Cropware phosphorus requirement calculations. Therefore this is a required data entry when Mehlich III is the extraction method.

Mg

Enter the magnesium soil test value. Cropware does not calculate magnesium recommendations. The magnesium analysis value entered here is kept in the annual nutrient management plan to provide a historical reference. This is not a required data entry.

Fe

Enter the iron soil test value. Cropware does not calculate iron recommendations. The analysis value entered here is kept in the annual nutrient management plan to provide a historical reference. This is not a required data entry.

Mn

Enter the manganese soil test value. Cropware does not calculate manganese recommendations. The analysis value entered here is kept in the annual nutrient management plan to provide a historical reference. This is not a required data entry.

Zn

Enter the zinc soil test value. Cropware does not calculate zinc recommendations. The magnesium analysis value entered here is kept in the annual nutrient management plan to provide a historical reference. This is not a required data entry.

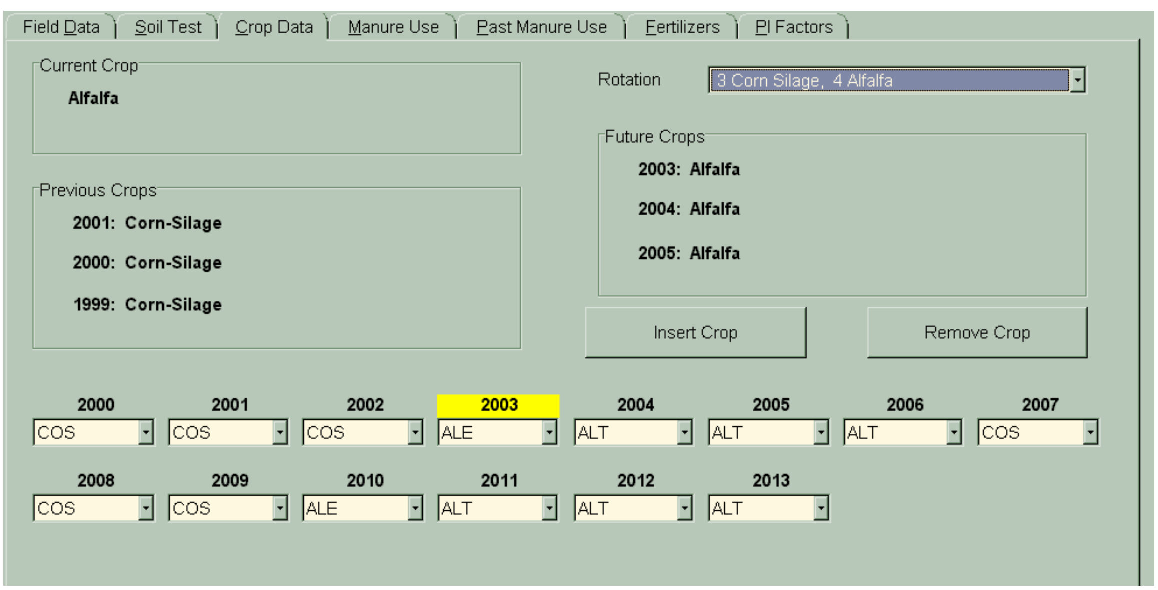
Organic Matter

Enter the % organic matter. The organic matter analysis value entered here is kept in the annual nutrient management plan to provide a historical reference. This is not a required data entry.

Pre Side-dress N (PSNT)

Enter the preside-dress nitrogen test (PSNT) in ppm. The PSNT provides a way to determine if there will be sufficient mineralizable organic nitrogen in the soil for maximum economic corn yields. PSNT determines the nitrate content of the top 12 inches of soil when the corn is 6 to 12 inches tall. The soil nitrate content at that time is an indication of the total amount of organic nitrogen that will become available to the plants for the remainder of the growing season. This value is not used in any Cropware calculations.

FIELDS SCREEN – CROP DATA TAB



The crop history and planned rotation is entered on this screen. The rotations that you made in the Rotations screen are used to quickly setup the planned rotation. The current (plan year) crop, three previous crop years and three future years crops are shown at the bottom of this screen. The rotation information is used when new plan years are created and in the Crop Plan Summary and Nutrient Balance reports. However, only the crop data from the past three crop years are used in the N nutrient requirement equation. If a sod crop has been plowed down or killed during the past three years, the organic nitrogen will become available to the plants through mineralization. The amount of nitrogen available is a function of the amount of legume in the stand and the years since plow down. The lime recommendation depends on the highest desired pH for the current crop and 5 future years.

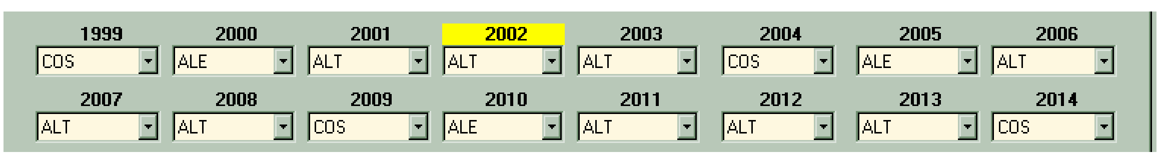
How to set the field's crop rotation:

1. Click on the down arrow in the "Rotation" box and select the desired rotation to fill the year boxes with the rotations crop codes.
2. To roll the rotation sequence forward or backward through the years, click on the year label. The crop code for the year you clicked will become the crop for the yellow highlighted plan year. The rotation order will roll with the selected plan year crop to maintain the correct sequence. See Screen Entries example below.
3. You can edit the rotation for each field by clicking on the down arrow key next the crop code in each year or by using Insert Crop or Remove Crop buttons.

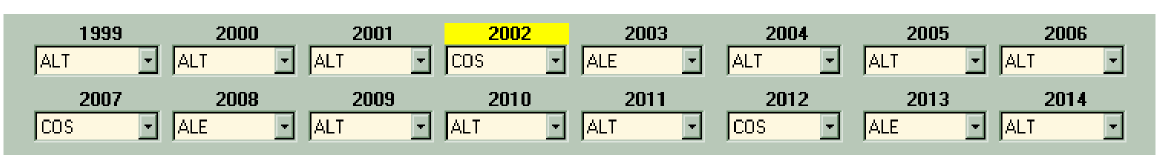
Screen Entries

<u>1999, 2000, etc.</u>

In this series of drop down boxes is the rotation sequence for the field. You can setup a rotation by choosing a stored or user defined rotation from the **Rotation** drop down box. You can change the crop in any year of the rotation by clicking on the drop down arrow and choosing a new crop code. This changes the crop in the rotation <u>for this field only</u> and does not change the stored, user-defined rotations. If the crop rotation sequence is correct but it is not falling on the year correctly, click on the year in the point of the rotation sequence that is representative of the current plan year. For example: you have a 1 Corn Silage/4 Alfalfa rotation and the years and crop codes initially appear as follows:



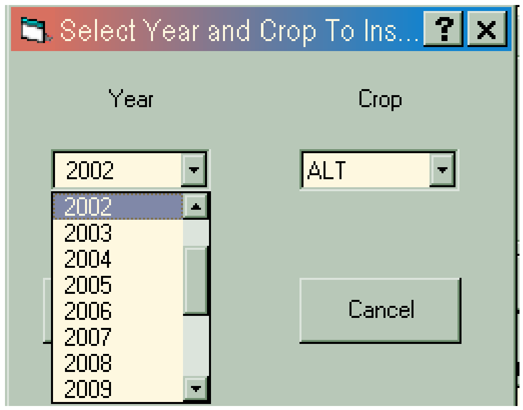
In reality, the plan year, 2002, is a corn silage year. To change the plan year to corn silage and update the other years while maintaining the 1 Corn Silage/4 Alfalfa rotation, click on either 1999 or 2004 and the crop codes will roll forward or backward to show the same crop rotation in "year" positions as follows:



<u>Insert Crop</u>

If the sequence of crops within a pre-defined rotation from the Rotation drop down box cannot be maintained precisely (e.g. a 5th year of ALT is necessary in a

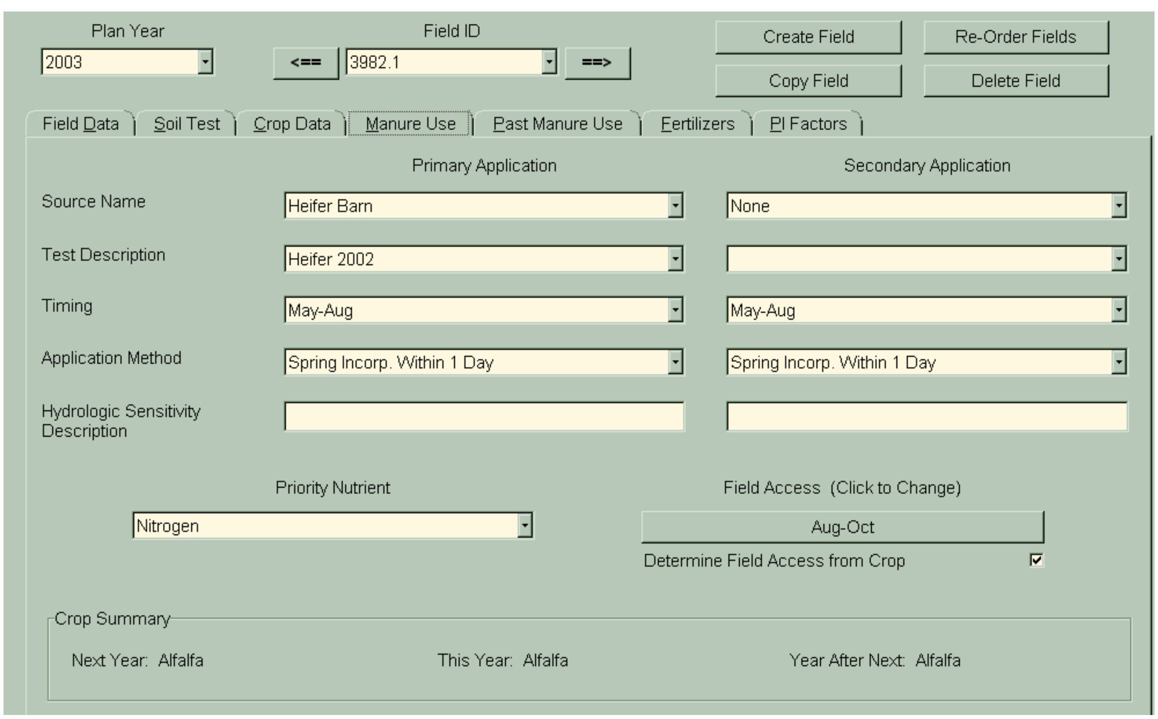
1 Corn Silage/4 Alfalfa rotation in order to maintain the desired balance of forages across the farm), you can choose to insert a crop into the rotation. Within the Insert Crop popup box, you can select the year and crop code for the inserted crop. Clicking OK inserts the chosen crop into the pre-defined rotation without altering the crop sequence of the pre-defined rotation for future years. For example, to insert ALT to crop year 2002 while maintaining the 1-4 rotation, click the Insert Crop button, select 2002 and ALT from the popup box:



Remove Crop

Removes the highlighted crop from the rotation based on the year selected within the Remove Crop popup box.

FIELDS SCREEN – MANURE USE



In this screen, enter planned manure application information. You can input one or two applications for each field. If there is just one application, enter it under the heading “Primary Application”. A second application can be entered under “Secondary Application”. The primary and secondary applications may have the same source but different nutrient analysis (test), application timing, and/or method.

The source and test description selected for this field can also be selected on the Allocation screen. The “Field Access” sets up the months that manure can be applied on the Manure Spreading Calendar. The “Priority Nutrient” is the nutrient (N, P or K) that the planner considers the highest priority nutrient. Priority Nutrient does not affect nutrient recommendations. The “Timing” and “Application Method” entries are used in the Phosphorus Index and N recommendation (Ammonia Conservation) equations.

Screen Entries

Source Name

Select the source(s) that will supply the manure nutrients on this field for the plan year. You can enter one or two applications. The primary and secondary applications may have the same source but different nutrient analysis (test), application timing, and/or method. The manure source can also be selected or changed on the Allocation screen.

Test Description

Select the manure analysis that best describes the nutrient content of the manure being applied to this field for the plan year. The test description can also be selected or changed on the Allocation screen.

Timing

Select the time of year that manure will be applied from the drop down list. This value is used in the Phosphorus Index calculation. The choices are “May-Aug”, “Sep-Oct”, “Nov-Jan” and “Feb-Apr”. The month (or range of months) for application are not often known until the manure application timing is planned for a field in the Calendar screen. The timing range displayed here can be updated to reflect planned applications entered on the calendar screen by clicking on the Calendar Screen “Update PI” button.

If manure applications are planned across multiple ranges given in the Timing drop down box, then conservatively choose the range of months that represents the highest risk according to the Phosphorus Index; i.e. “May-Aug” is less risky than “Sep-Oct”, which is less risky than “Nov-Jan”, which is less risky than “Feb-Apr”.

Application Method

Enter the manure application method from the drop down list. The choices are:

"Spring Incorporate Within 1 day"
"Spring Incorporate Within 2 days"
"Spring Within 3 days"
"Spring Within 4 days"
"Spring Incorporate Within 5 days"
"Top Dress/Incorp. After 5 days"
"Injected as Sidedress on Row Crops"
"Fall Injection"
"Fall Incorporated, 1-2 Days"
"Fall Incorporated, 3-5 Days"
"Surface Application on Frozen or Saturated Ground"

The application method selection is used in the Phosphorus Index calculation and determines the ammonia conservation values. The following table shows the ammonia N lost on a percentage basis for each application method and the Phosphorus Index weighting factor for manure application method:

Table 3.4 NH_4-N conservation and P Index factor associated with manure incorporation methods.

Method	NH_4N conservation (%)	PI factor
Spring Incorporate Within 1 day	65	0.4
Spring Incorporate Within 2 days	53	0.4
Spring Incorporate Within 3 days	40	0.6
Spring Incorporate Within 4 days	29	0.6
Spring Incorporate Within 5 days	17	0.6
Top Dress/Incorp. After 5 days	0	0.8
Injected as Sidedress on Row Crops	100	0.2
Fall Injection	0	0.2
Fall Incorporated, 1-2 Days	0	0.4
Fall Incorporated, 3-5 Days	0	0.6
Surface Application on Frozen or Saturated Ground	0	1.0

Hydrologic Sensitivity Description

Enter a comment or description of the field's hydrologic sensitivity for each application. This comment is for planner and farmer reference. The entered description appears on the Allocation screen, Work Order form and can be selected on a Custom Report.

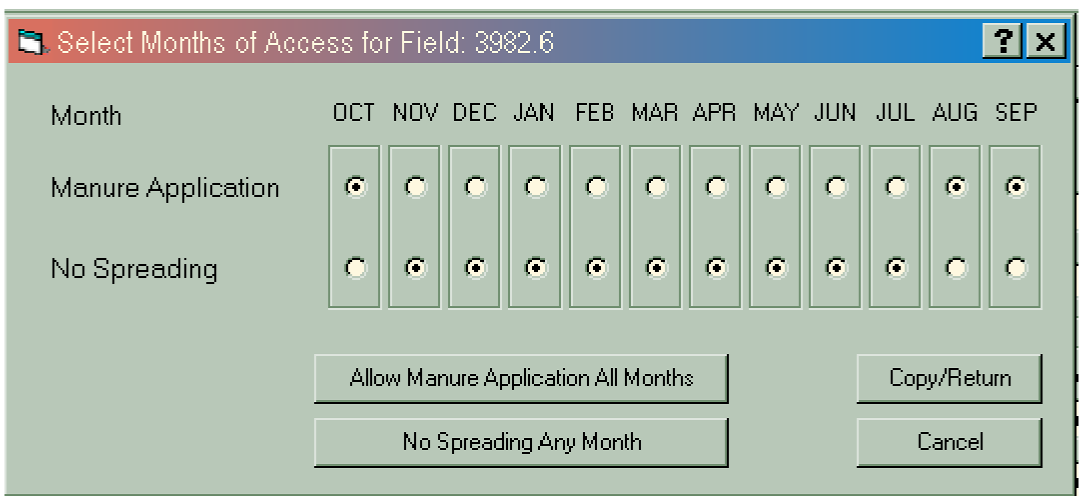
Priority Nutrient

Enter the highest priority nutrient, N, P or K, for this field. This entry is for planner and farmer reference. It is not a factor in any program calculations.

Field Access

Default Monthly Field Access as a Function of Current Crop

An important consideration in the development of a nutrient management plan is determining if the planned allocation of manure and fertilizer is feasible given site specific constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor and machinery available to spread all the manure between harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides a calendar with a running manure inventory to plan the timing of manure applications for each month of the year. Times when the field is not available for manure application are shaded gray on the calendar.

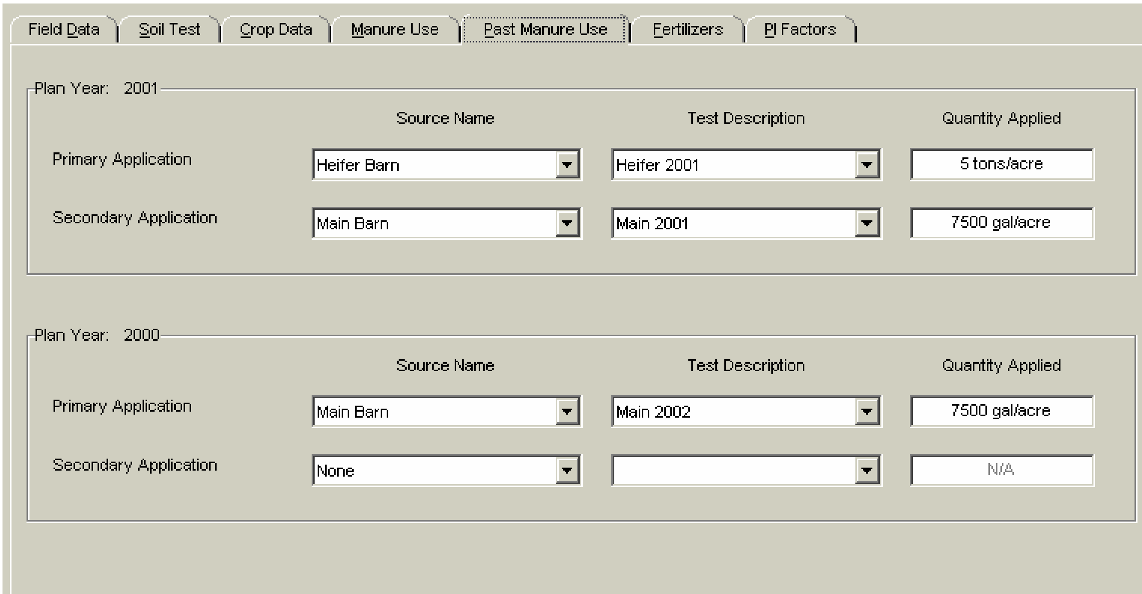


Enter the time period that this field is available for manure applications here. You can set the manure application access periods by clearing the check box "Determine Field Access from Crop" by clicking on the checkmark, and click on the button showing the currently selected access periods. To change the field access from "Manure Application" to "No Spreading", click the white circle in the "No Spreading" row. You can set each month to allow manure application, by clicking on the "Manure Application Access – All Months" button. The "No Spreading – All Months" button will set each month to "No Spreading". The selections made here are used in the Manure Spreading Monthly Calendar Worksheet to plan manure applications over the year.

Crop Summary

The crop rotation for next year, this year and last year is displayed at the bottom of the screen to help plan manure application rates, methods and timings.

FIELDS SCREEN – PAST MANURE USE



Previous Manure Use data is used to calculate the residual nitrogen available for plan year plant use manure applications made in the past two years. The organic N in manure decomposes into inorganic N available for plan use at different rates. A decay series is used to estimate the fraction of manure organic N which will be available to the plant each year. The current year decay rate in this program depends on the animal species and dry matter content (Table 17.6). For all species, Cropware uses a decay rate of 12% and 5% for manure applied last year and two years ago, respectively. For example, if the Organic N content of the manure was 6 lbs per ton, and 10 tons/acre of manure was applied last year and two years ago, the calculated nitrogen available to plants in the plan year from residual manure would be ((10*6*0.12) + (10*6*0.05)) =10.2 lbs/acre. Two manure applications can be entered for each field.

Enter last years manure application primary and secondary manure source, test description and rate applied in the upper box "Plan Year: (current plan year – 1)". Enter information for applications made two years ago on the box at the bottom of the screen, "Plan Year: (currently plan year -2)". Enter single applications on the "Primary Application" row.

Screen Entries

Source Name

Enter the manure source(s) supplying manure for the primary and secondary applications last year and two years ago. The historical manure analysis, test description, and quantity applied from the source are used to calculate residual nitrogen from past manure applications for determining plan year nitrogen contribution.

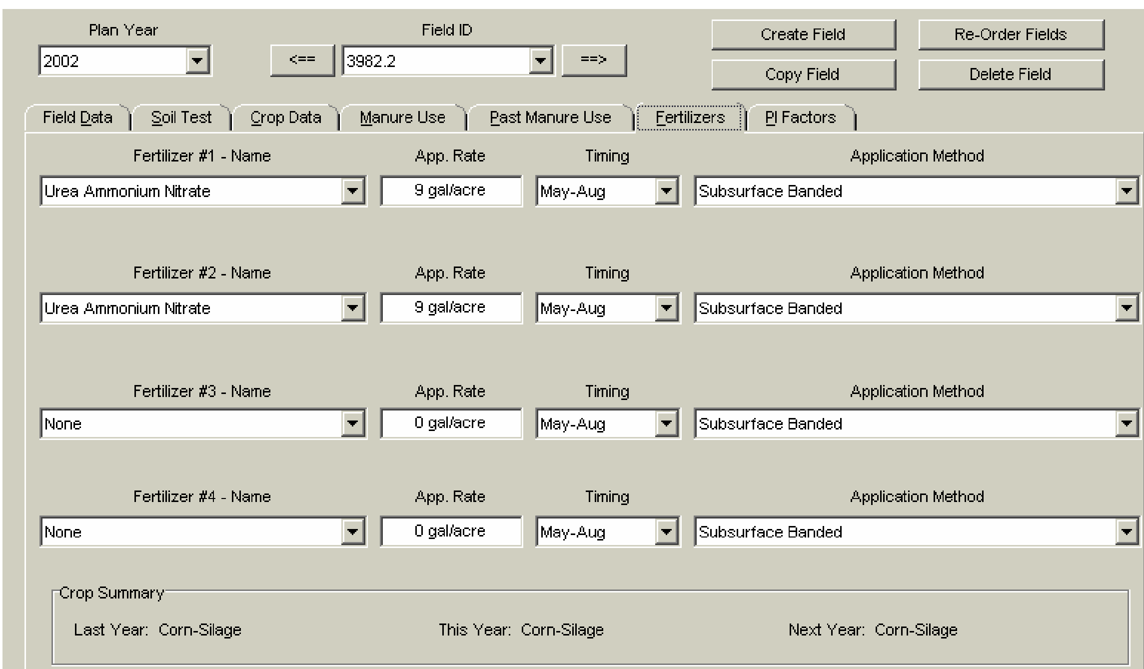
Test Description

Enter the manure test descriptions which identify the manure nutrient composition for of primary and secondary applications last year and two years ago. The historical manure analysis, test description, and quantity applied from the source are used to calculate residual nitrogen from past manure applications for determining plan year nitrogen contribution.

Quantity Applied

Enter the manure application rate in units (tons or gallons) per acre. This value is used to calculate residual nitrogen from past manure applications for determining plan year nitrogen requirements. The contribution made to the current plan nitrogen pool for manure organic nitrogen applied last year is estimated at 12%. The contribution rate for manure organic nitrogen applied two years ago is estimated at 5%.

FIELDS SCREEN – FERTILIZERS



On this screen, you can enter up to four fertilizers to be applied to each field in the plan year. The fertilizers available for selection must be in the plan fertilizer list. A long list of fertilizers comes loaded on the Cropware installation. You can add fertilizers to this list on the Fertilizers screen. The fertilizers and their application rate in pounds per acre or gallons per acre can be entered on this screen or in the Allocation screen. Fertilizer application rates are used to calculate N, P and K balances. Fertilizer application rate, timing and method are used in the Phosphorus Index calculations.

Screen Entries

Fertilizer Name

Select a fertilizer to be applied to this field. Fertilizers listed in this drop down box are originally entered in the **Fertilizer** Screen. Up to four fertilizers blends, timings and application methods can be entered for each crop field.

Planned Application Rate

Enter a planned fertilizer application rate in pounds per acre or gallons per acre. The planned fertilizer application rate can be changed on the **Allocation** screen.

Timing

The time of year that the planned fertilizer application will take place. The choices are “May-August”, “Sep-Oct”, “Nov-Jan”, and “Feb-Apr”. This variable is used in the Phosphorus Runoff Index calculation.

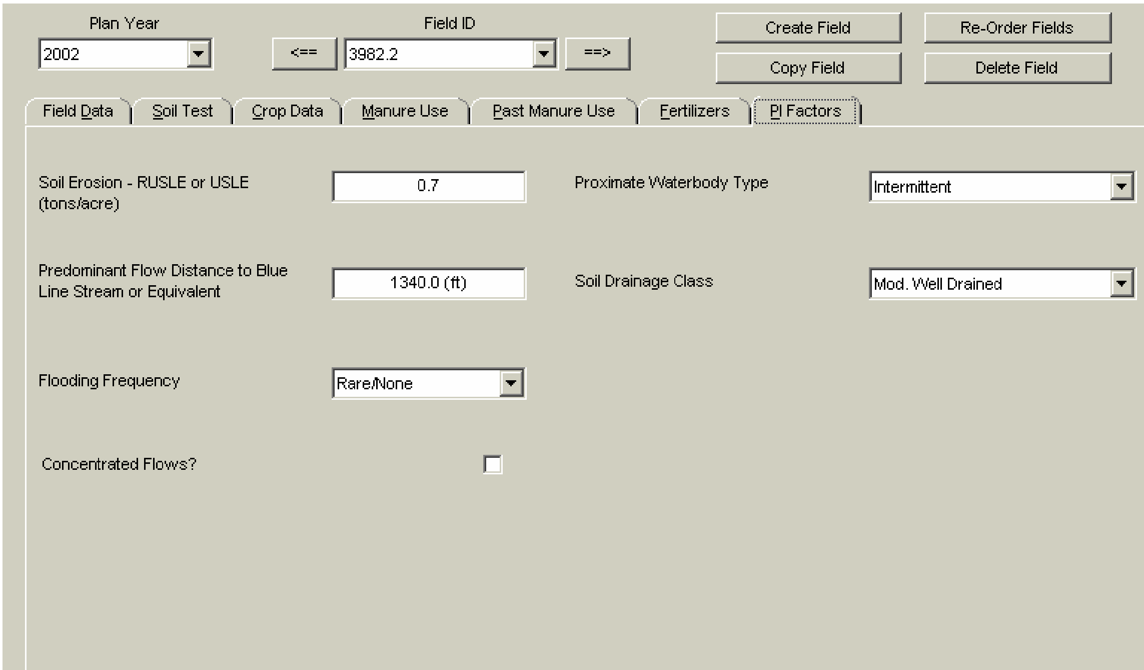
Application Method

Select the fertilizer application method. The choices are:

“Subsurface Banded”
“Broadcast and Incorporate in 1-2 Days”
“Broadcast and Incorporate in 3-5 Days”
“Surface Applied or Broadcast and Incorporated after 5 days”
“Surface applied on Frozen or Saturated Ground”

This variable is used in the Phosphorus Index calculation.

FIELDS SCREEN – PHOSPHORUS INDEX FACTORS



This screen collects information used with other entered data to rank the fields according to their risk of phosphorus losses. Two of the input items, "Flooding Frequency" and "Soil Drainage Class" are set by the "Soil Name' selected on the Field Data tab. This default value can be changed on this screen, but if the soil name is changed, the "Flooding Frequency" and "Soil Drainage Class" will be reset to correspond to the new soil name.

Screen Entries

Soil Erosion - RUSLE

Soil erosion is estimated using the Revised Universal Soil Loss Equation (RUSLE). This is an estimate of average soil loss in tons/acre/year, given by the equation, A = R K L S C P, where: A = average annual soil loss, K = soil erodibility factor, L = slope length factor, S = slope steepness factor, C = cover-management factor, and P = supporting practices factor. Software to calculate RUSLE can be downloaded from www.sedlab.olemiss.edu/rusle. This value is used in the Phosphorus Index calculation.

Predominant Flow Distance to Blue Line Stream or Equivalent

The flow distance is the edge of "field" drainage path that excess water takes as it leaves a field and finds its way downhill to a watercourse (blue line stream). This can be estimated by field observation or determined from topographic maps where the flow path is perpendicular to the contour lines. This value is used in the Phosphorus Index calculation.

Flooding Frequency

The default flooding frequency is determined from the soil type. When the soil type is changed, the flooding frequency value is reset. The field's flooding frequency can be changed here. The choices are "Rare/None", "Occasional" or "Frequent". This value is used in the Phosphorus Index calculation. See Table 17.1.

Concentrated Flows?

Check this box if the field has concentrated flows. Concentrated flows are wash or gully areas of water flow through a field. The determination of whether or not concentrated flow paths are present in the field is best done through field observation. The current resolution of contour lines on topographic maps may not be sufficient to indicate whether a concentrated flow path is present. If all wash or gully areas are appropriately addressed with soil and water conservation best management practices, do not check the "Concentrated Flow" check box. This value is used in the Phosphorus Index calculation.

Proximate Water body Type

The characteristics of the nearest water body type. The choices are "none", "intermittent" and "perennial". Intermittent streams are depicted on topographic maps as a dashed blue line. Perennial streams are depicted on topographic maps as a solid blue line. This value is used in the Phosphorus Index calculation.

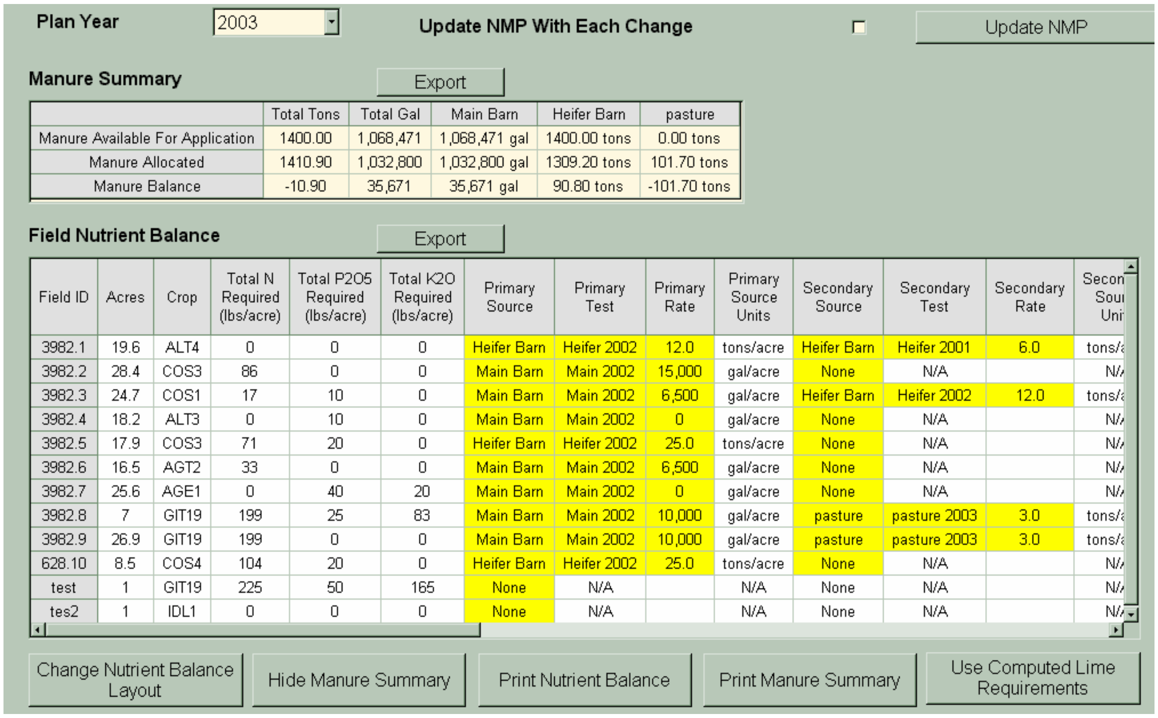
Soil Drainage Class

Select the natural soil drainage class. The choices are:

- "Excessively Drained"
- "Well Drained"
- "Moderately Well Drained"
- "Somewhat Poorly Drained"
- "Poorly Drained"
- "Very Poorly Drained"

This value is a function of soil series. The default soil drainage class is determined from the soil type. When the soil type is changed, the soil drainage class value is reset. The field's drainage class can be changed here but should not be modified if drainage practices have been installed. This value is used in the Phosphorus Index calculation. See Table 17.1.

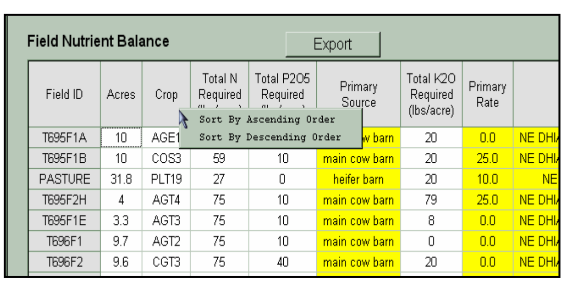
3.8 ALLOCATION SCREEN



The Allocation Screen is the step in the nutrient management plan where the crop nutrient requirements are balanced by allocating manure and fertilizer to the fields at rates which do not impair water quality. On this screen, you assign the manure and fertilizer sources and rates for each field. The N, P and K nutrient requirements, manure available and risk indices guide appropriate sources and rate selection..

The table on the top of the screen titled "Manure Summary" shows the quantity of manure available for application, the current quantity allocated to the fields and the difference between the two for each manure source and for the whole farm. In the table below, balance nutrient individual field nutrients requirements with manure and fertilizer nutrients. All entry cells are shaded yellow.

You can rearrange the column order by clicking the left mouse button in the header row and dragging and dropping the column to a new location.



You can order the rows of data within a column by right clicking on the column header and choosing "Sort by Ascending Order" or "Sort by Descending Order." In this way you can group fields with the same crops together or see the fields with the highest to lowest phosphorus index, etc.

Buttons

Update NMP

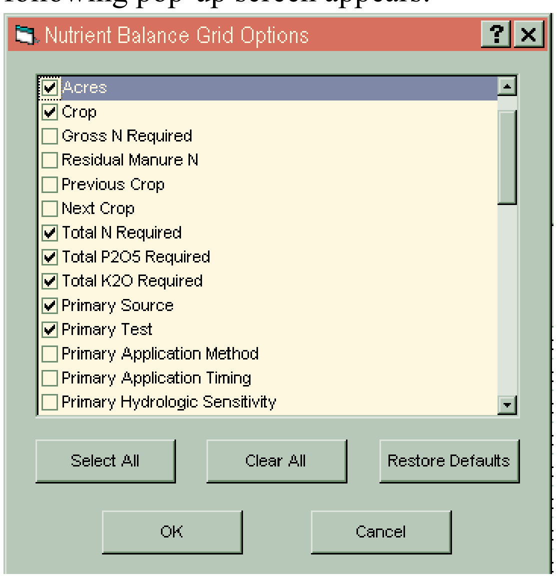
The Manure Summary values are updated to reflect entries made in the field nutrient balance table when the "Update NMP" button is selected. To have the Manure Summary updated after each entry, check the "Update NMP with Each Change" box. However, selecting this option will slow down the Allocation screen operation.

Export

There are two "Export" buttons: one that exports the Manure Summary table and one that exports the field nutrient balance table. Each of these buttons is just above to its respective table. When Export is selected, the table data is exported to a comma delimited (.csv) file. Comma delimited is a common file protocol which can be used in a variety of spreadsheet, database, GIS and other programs.

Change Nutrient Balance Layout

The Change Nutrient Balance Layout button will allow you to choose the data that is displayed on the Allocation screen. When you choose this button, the following pop-up screen appears:



Check the boxes next to the data that you want to appear on the Field Nutrient Balance table. Cropware installs a default set of columns: Acres, Crop, Total N Required, Total P_2O_5 Required, Total K_2O Required, Primary (manure) Source, Primary Test, Primary Rate, Primary Source Units, Secondary (manure) Source, Secondary Rate, Secondary Source Units, Fertilizer 1, N Balance, P_2O_5 Balance, K_2O Balance, Phosphorus Index, Leaching Index. You can restore these default selections by clicking the "Restore Defaults" Button. "Select All" checks all of the column data items. "Clear All" clears the checks from all of the check boxes. "OK" saves the selections made, and displays the Allocation screen with the selected columns. "Cancel" returns to the Allocation screen without updating the displayed data.

Hide Manure Summary

The Hide Manure Summary button will toggle the display to hide the Manure Summary table and expand the Field Nutrient Balance table. This button works as a toggle switch: clicking the button again (now labeled "Show Manure Summary") will shrink the height of the field information and display the "Manure Summary" table again.

Print Nutrient Balance

Clicking on this button will print the field nutrient balance table.

Print Manure Summary

This button prints the manure summary table with the currently selected column layout.

Use Computed Lime Requirements

Field lime recommendations can be user entered or calculated by Cropware. Click on this button to set the User Selected Lime rate equal to the Cropware calculated lime rate. The User Selected Lime Required is entered in the yellow shaded column, "User Selected Lime Required (tons/acre). The program calculated Lime Requirement is displayed in the column to the left. You can edit the User Selected Lime rate for individual fields after using this button to transfer the program calculated values to the User Selected column. However, if you choose this button after you have made entries to the User Selected column, those entries will be over-written by the program calculated values. See Nutrient Guidelines: Lime for more detail about how lime recommendations are calculated.

How to Allocate Manure and Fertilizer

See Tutorial.

Screen Entries:

Plan Year

Displays the currently selected plan year. To allocate manure and fertilizer to fields for a different plan year, click on the down arrow and select the desired plan year.

Manure Summary:

Manure Available for Application

This is the total manure available for application for the whole farm and each waste source. The "Manure Available for Application" = "Amount Added to System Annually" (as entered the Manure Screen) + "Amount at Start of Plan

Year" (as entered the Manure Screen) - "Amount Exported from System Annually" (as entered the Manure Screen).

Manure Allocated

The sum of the values entered in the "Primary Rate" and "Secondary Rate" columns (multiplied by field acreage) for the whole farm and for each waste source.

Manure Balance

The difference between the "Manure Available for Application" and the "Manure Allocated" for the whole farm for each waste source. A positive balance (more manure available than allocated) is shown as a positive number and a deficit balance (more manure allocated than available) is shown as a negative number.

Field Nutrient Balance:

The order of the columns can be rearranged by clicking on a column with the left mouse button and dragging it to where you want it inserted and then releasing the mouse button. The items in each of the grid columns can be sorted by right clicking in the column title box. You may sort by ascending or descending order. The column order and the sort will revert to their original order when the Allocation Screen is closed.

Field ID

The unique field identification.

Priority Nutrient

The highest priority nutrient, N, P or K selected for that field.

Field Name

The field name.

Acres

The field size in acres.

Crop

Crop grown in the selected plan year.

Gross N Required

The crop nitrogen requirement before N contribution from previous years manure applications is deducted from the total N required.

Residual Manure N

The nitrogen available from the previous two years of manure applications. The rate of mineralization is assumed to be 12% for manure applied in the last crop year and 5% for manure applied two years ago.

Previous Crop

The crop grown on this field in the year preceding the plan year.

Next Crop

The crop planned to be grown on this field in the year following the selected plan year.

Total N Required (lbs/acre)

The total N in lbs per acre required to meet the crop nutrient requirement. See N nutrient guideline parameters and equations.

P_2O_5 Required (lbs/acre)

The total P_2O_5 in lbs per acre required to meet the crop nutrient requirement. See P_2O_5 nutrient guideline parameters and equations.

K_2O Required (lbs/acre)

The total K2O in lbs per acre required to meet the crop nutrient requirement. See K_2O nutrient guideline parameters and equations.

Primary Source

Select the primary manure source for this field in the current plan year. If you selected a manure source for this field on the Fields: Manure Use Screen, that source will appear. If no source has been selected, "none" appears. When you left click in the cell, a down arrow will appear. Click on the down arrow to display a drop down box from which you can select a different manure source.

Primary Test

Select the manure analysis which characterizes the primary manure application for this field. A primary source must be selected before entries can be made to this field. The primary test can also be selected on the Fields: Manure Use Screen. The default primary test is the program created default test for the species selected. For example if "Dairy Cattle" is the species selected for the designated Primary Source, "Default Dairy Cattle" will appear in this cell. When you left click in this cell, a down arrow will appear. Click on the down arrow to display a drop down box from which you can select a different manure test.

Primary Application Method

The primary manure application method selected on the Fields: Manure Use screen is displayed here. The manure application method can only be changed on the Field: Manure Use screen. This value is used in the Phosphorus Index calculation. The application method selected also determines the ammonia conservation values used in the manure N content calculation.

Primary Application Timing

The timing of the primary manure application selected on the Fields: Manure Use screen is displayed. The timing of the manure application can only be changed on the Field: Manure Use screen. This value is a variable in the Phosphorus Index calculation.

Primary Hydrologic Sensitivity

The description of hydrologic sensitivity entered on the Fields: Manure Use screen. This description can only be changed on the Field: Manure Use screen.

Primary Rate

Enter the manure application rate for the primary manure source. Use this column to best balance crop nutrient requirements with the manure available.

Primary Source Units

The units (tons/acre or gallons/acre) for the selected manure source as entered on the Manure screen.

Secondary Source

Use this entry field to enter a second manure application source. A primary source must be entered before a secondary source can be identified. The primary and secondary source may be the same source with a different application analysis, method or timing. For instance, if a field received a fall and spring application from the same source (Main Barn), the allocation screen entries may look like this:

Field ID	Primary Source	Primary Test	Primary Application Method	Primary Application Timing	Primary Rate	Primary Source Units	Secondary Source	Secondary Test	Secondary Application Method	Secondary Application Timing	Secondary Rate
3982.1	Main Barn	Main 2001	Fall Injection	Sep-Oct	7,500	gal/acre	Main Barn	Main 2002	Spring Incorp. Within 1 Day	Feb-Apr	15,000

If you selected a manure source for this field on the Fields: Manure Use Screen, that source will appear. If no source has been selected, “none” appears. When you left click in the cell, a down arrow will appear. Click on the down arrow to display a drop down box from which you can select a different manure source.

Secondary Test

Select the manure analysis which characterizes the secondary manure application for this field. A secondary source must be selected before entries can be made to this field. The secondary test can also be selected on the Fields: Manure Use Screen. The default secondary test is the program created default test for the species selected. For example if "Dairy Cattle" is the species selected for the designated Secondary Source, "Default Dairy Cattle" will appear in this cell. When you left click in this cell, a down arrow will appear. Click on the down arrow to display a drop down box from which you can select a different manure test.

Secondary Application Method

The secondary manure application method selected on the Fields: Manure Use screen is displayed here. The manure application method can only be changed on the Field: Manure Use screen. This value is used in the Phosphorus Index calculation. The application method selected also determines the ammonia conservation values used in the manure N content calculation.

Secondary Application Timing

The timing of the secondary manure application selected on the Fields: Manure Use screen is displayed here. The timing of the manure application can only be changed on the Field: Manure Use screen. This value is a variable in the Phosphorus Index calculation.

Secondary Hydrologic Sensitivity

The description of hydrologic sensitivity associated with the secondary manure application as entered on the Fields: Manure Use screen. This description can only be changed on the Field: Manure Use screen.

Secondary Rate

Enter the manure application rate for the secondary manure application. Use this column along with the primary rate to balance crop nutrient requirements with the manure available.

Secondary Source Units

The units (tons/acre or gallons/acre) for the selected manure source as entered on the Manure screen.

Field Access

Field Access is the months that the field is available for manure applications. The field access shown here are the months selected on the Fields: Manure Use screen. Field access can be changed on the Field: Manure Use screen for each individual field or can be set to default to field access months set for the current crop (Options Screen).

Fertilizer (#1 to 4) Name

Enter up to four different fertilizers to be used in the nutrient management plan. When you left click in this cell, the list of fertilizers that you created in the Fertilizer Screen is displayed in a drop down box.

Fertilizer Formulation (# 1 to 4)

The N-P-K formulation of the fertilizer selected is displayed. To update the nutrient composition of a fertilizer, go to the Fertilizer Screen.

Fertilizer Rate(# 1 to 4)

Enter the selected fertilizer application rate in lbs or gallons per acre in this column. This value can be adjusted to meet nutrient requirements for each field.

N Balance

This column displays the difference between "Total N Required" and the sum of nitrogen supplied by the manure (primary and secondary applications) and fertilizer applications for each field. If the manure and fertilizer nutrients contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrients contributions are less than the nutrients required, the difference will be displayed in this column as a negative number.

Because not all the N in manure is available to plants immediately and some portion of the available N is lost to the air, the N available from manure is discounted using the following equations:

ManureSupply_N = (NH4N_supply + OrganicN_supply)

OrganicN_supply is the entered manure organic N adjusted for current year mineralization. The degree of mineralization (decay_current) depends on several factors including the species and matter content of the manure (see Table 17.6).

OrganicN_supply = ManureAnalysis_OrganicN * decay_current

Ammonium N supply is the entered manure NH4N value adjusted for ammonia volatilization. The percent of the NH4N remaining in the manure depends on the manure application method and incorporation timing (see Table 17.5).

$NH_4N\_supply = ManureAnalysis\_NH_4N * NH_4N\_remain$

Note: The total N available from manure is discounted by 15% if no-till production is used.

P_2O_5 Balance

This column displays the difference between "Total P_2O_5 Required" and the sum of P_2O_5 supplied by the manure (primary and secondary applications) and fertilizer applications for each field. If the manure and fertilizer nutrients contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrients contributions are less than the nutrients required, the difference will be displayed in this column as a negative number.

K_2O Balance

This column displays the difference between "Total K_2O Required" and the sum of nutrients supplied by the manure (primary and secondary applications) and fertilizer applications for each field. If the manure and fertilizer nutrients contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrients contributions are less than the nutrients required, the difference will be displayed in this column as a negative number.

Phosphorus Index (DP/PP)

The NY Phosphorus Run-off Index is a risk assessment tool that ranks the field's potential for particulate and dissolved phosphorus runoff. The NY-PI assigns two scores to each field based upon its characteristics and the producer's intended management practices. Dissolved P Index (DP), addresses the risk of loss of water-soluble P from a field (flow across the field or through the soil profile) while Particulate P Index (PP) estimates the risk of loss of P attached to soil particles and manure.

Leaching Index

The Nitrate Leaching Index is a risk assessment tool that ranks the field's potential for nutrient loss from ground water leaching. The leaching index is a function of annual and season precipitation, the soil's hydrologic group and field artificial drainage.

Soil Type

The field's most dominant soil type as entered on the Fields: Field Data screen.

Soil Test Units

The units for Soil P and Soil K, "lbs/acre" or "ppm" are displayed here. The units are dependent on the Soil Test Lab and Extraction Method selected on the Fields: Soil Test screen. See table 3.3.

Soil P

The soil test phosphorus analysis.

Soil K

The soil test potassium analysis

Soil pH

The soil analysis pH as entered on the Fields: Soil Test screen.

Lime requirement

The program calculated lime requirement (100% ENV) for the field assuming no lime has been applied since the last soil test is displayed in this column.

User Selected Lime Rate

For a variety of reasons, the planner or producer may want to use lime recommendations which are different than those calculated by Cropware. You can either enter your lime recommendation values in this column or click on the “Use Computed Lime Requirements” button to copy the program calculated lime requirements into this column. You can edit the User Selected Lime rate for individual fields after using the “Use Computed Lime Requirement” button to transfer the program calculated values to the User Selected column. Note: the values in this column are the lime recommendation rates shown in the program reports. See Lime Requirements for more detail about how lime recommendations are calculated.

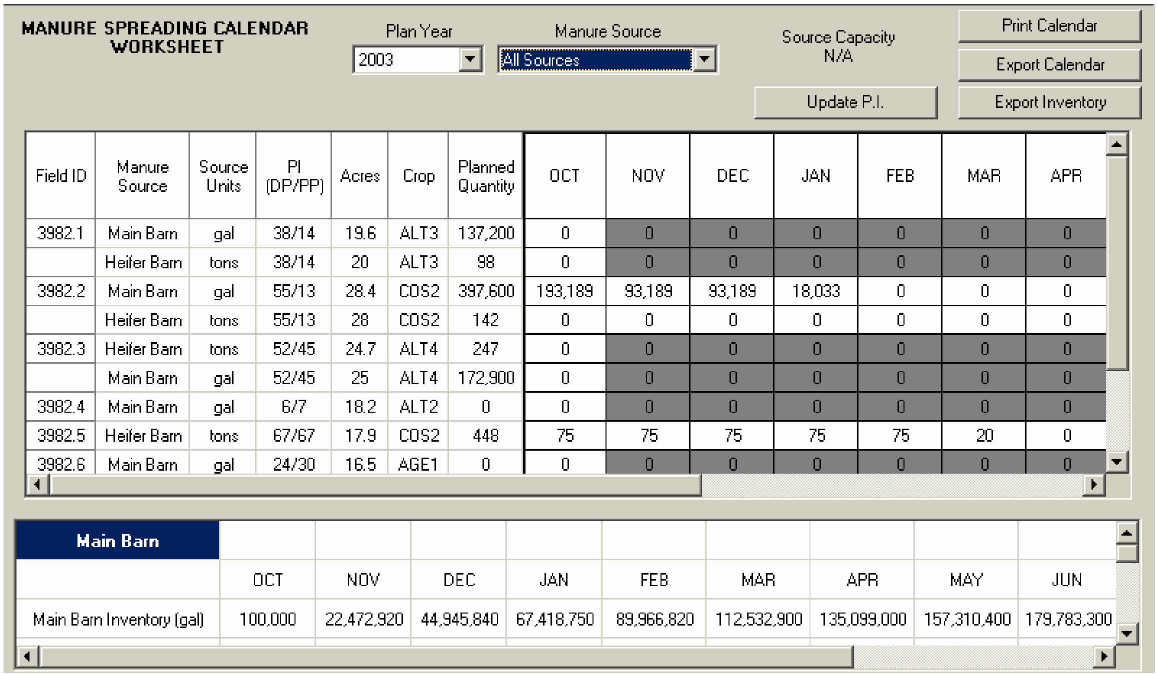
Soil Test Date

The last soil test date entered in the Fields: Soil Test screen. Soil analysis should be done on each field at least every three years.

Comments

You can enter nutrient management plan comments in this column. The comment can be displayed and printed on the Custom Reports.

3.9 MANURE SPREADING CALENDAR SCREEN



Field ID	Manure Source	Source Units	PI (DP/PP)	Acres	Crop	Planned Quantity	OCT	NOV	DEC	JAN	FEB	MAR	APR
3982.1	Main Barn	gal	38/14	19.6	ALT3	137,200	0	0	0	0	0	0	0
	Heifer Barn	tons	38/14	20	ALT3	98	0	0	0	0	0	0	0
3982.2	Main Barn	gal	55/13	28.4	COS2	397,600	193,189	93,189	93,189	18,033	0	0	0
	Heifer Barn	tons	55/13	28	COS2	142	0	0	0	0	0	0	0
3982.3	Heifer Barn	tons	52/45	24.7	ALT4	247	0	0	0	0	0	0	0
	Main Barn	gal	52/45	25	ALT4	172,900	0	0	0	0	0	0	0
3982.4	Main Barn	gal	6/7	18.2	ALT2	0	0	0	0	0	0	0	0
3982.5	Heifer Barn	tons	67/67	17.9	COS2	448	75	75	75	75	75	20	0
3982.6	Main Barn	gal	24/30	16.5	AGE1	0	0	0	0	0	0	0	0

Main Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Main Barn Inventory (gal)	100,000	22,472,920	44,945,840	67,418,750	89,966,820	112,532,900	135,099,000	157,310,400	179,783,300

This screen acts as a worksheet to budget the timing of manure applications. An important consideration in the development of a nutrient management plan is determining if the planned allocation of manure and fertilizer is feasible given temporal constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor and machinery available to spread all the manure between corn harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides the calendar above with a running manure inventory to plan the timing of manure applications for each month of the year.

The calendar worksheet can show the temporal plan for selected sources or the calendar for all sources. You can make this selection in the Manure Source drop down box. The default selection is “All Sources.” The manure source is identified on the Nutrient Allocation Screen. When you select the plan year and the manure source at the top of the screen, all of the fields with manure from that source in the plan year are listed in the table. For each field, the planned primary and secondary manure applications (Allocation screen, "Primary Rate" and “Secondary Rate” columns) are shown in the "Planned Quantity" column of the calendar. Under each month, you can enter the quantity of manure which will be applied in that month. Times when the field is not available for manure application are shaded gray on the calendar. The months that the field can be spread can be specified on a field by field basis. This setting can be changed for individual fields in the Fields Screen: Manure Use tab – "Field Access" button. Entries can be made in the shaded cells but the program will give you a warning message. You have the option of updating the manure application timings to reflect the values entered on this grid by clicking on the “Update P.I.” button.

The monthly manure quantity values are totaled for the planning year and shown in the column "Summed Quantity". The "Quantity Difference" is "Planned Quantity" less "Summed Quantity". This value tells how much of the total planned manure application for the year has been met by the monthly amounts entered in the calendar worksheet. The fields and monthly manure application amounts entered on this screen are used to create the Manure Application Work Order.

Heifer Barn									
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Heifer Barn Inventory (tons)	0	0	0	0	0	0	0	0	0
Manure Added (tons)	75	75	75	75	75	75	50	50	50
Manure Used (tons)	75	75	75	75	75	75	50	50	50
Ending Inventory (tons)	0	0	0	0	0	0	0	0	0

At the bottom of the screen, is a monthly inventory for all plan manure sources. The selected plan will appear the in the window but you can move the vertical scroll bar to see the inventory status of other sources. You can select which month is the first in the plan year on the Options screen.

The beginning inventory value is entered on the Manure screen in the box labeled "Amount in Source at the Start of Plan Year". The second row of the inventory table, "Manure Added" is the defaults to the quantity entered to "Amount Added to Source Annually" on the Manure screen divided by 12. You can edit the manure added monthly by directly entering values into this row.

The third row of the Manure Inventory table, "Manure Used" is the summed values for each field from the calendar above. The "Ending Inventory" is the beginning inventory plus manure added less manure used. The ending inventory is carried forward as the beginning inventory in the next month, i.e. the ending inventory for October is the beginning inventory for November.

The Manure Spreading Calendar can be printed by clicking on the Print Calendar button. You can export the calendar and inventory grids to a rich text format file which can then be used in a spreadsheet or word processing program. More room is available for the calendar screen if the Tree is turned off.

How To Use The Manure Spreading Calendar To Plan Monthly Manure Applications

Refer to the Cropware tutorials for specific guidelines on how to plan using the manure spreading calendar.

Buttons

Update P.I.

The time of year that manure is application is a variable in the calculation of the P Runoff Index (PI). When you plan the manure application schedule for the year using the calendar screen, the planned timing originally entered on Field Screen: Manure Use Tab, may need to be changed. When you click on this button, the Manure application timing variable is reset throughout Cropware to reflect your entries in the Calendar grid. Entries that range across multiple P Index timing periods will result in the manure application timing being set to the highest risk period within the range. For instance, if you entered manure values in each of the months of September, October, and November, the manure application timing would be set to "Nov – Jan".

Print Calendar

Prints the calendar grid (top table).

Export Calendar

This button copies the calendar information from the table at the top of the page to a comma delimited (.cvs) file. Comma delimited files are common file format that can easily be imported into spreadsheet, database and most GIS programs.

Export Inventory

This button copies the inventory information from the table at the bottom of the page to a comma delimited (.cvs) file. Comma delimited files are common file format that can easily imported into spreadsheet, database and most GIS programs.

Screen Entries

Plan Year

Displays the currently selected plan year. To display the manure spreading calendar worksheet for a different plan year, click on the down arrow and select the desired plan year.

Manure Source

This dropdown box will display "All Sources" and a list of each of the manure sources for this plan. You can choose to display the fields and inventory summary associated with a selected manure source or choose "All Sources" to see all of the manure sources. Depending on the selection made in this drop down box, the manure inventory grid at the bottom of the screen, will display the inventory for a selected source or all sources. If "All Sources" is selected, use the vertical scroll bars to display each source in the inventory summary grid.

<u>Field ID</u>

The field identifying name or number.

<u>PI (DP/PP)</u>

The Phosphorus Index scores for Dissolved Phosphorus (DP) and Particulate Phosphorus (PP).

<u>Acres</u>

The field size in acres.

<u>Crop</u>

The crop planned in the specified plan year.

<u>Planned Quantity</u>

For each field, the planned primary and secondary manure application amount for the entire field is shown in the "Planned Quantity" column of the calendar. The Planned Quantity is the manure application rate specified on the Allocation screen multiplied by the field size in acres. Since each field can have two manure application events, you will see 2 rows on the manure application grid for fields with 2 applications.

<u>Months</u>

Under each month, you can enter the quantity of manure that will be applied in that month. Times when the field is not available for manure application are shaded gray on the calendar. The months available for spreading can be specified on a field by field basis. This setting can be changed for individual fields with the Field Access button on the Manure Use Tab of the Fields screen. Entries can be made in the shaded cells but the program will display a warning message.

<u>Summed Quantity</u>

For each field and application, the monthly manure quantity values are totaled for the planning year and shown in the column "Summed Quantity".

<u>Quantity Difference</u>

For each field and application, the "Quantity Difference" is "Planned Quantity" less "Summed Quantity". This value tells how much of the total planned manure application for the year has been met by the monthly amounts entered in the calendar worksheet.

Manure Source Inventory Grid

The plan year beginning inventory value is entered on the Manure screen in the box labeled "Amount in Source at the Start of Plan Year".

Manure Added

You can change the amount of manure added to each source on a monthly basis on this row. The default value is the total annual amount of manure divided by the 12 months of the plan year. The total annual amount is determined, previously, on the Manure screen. As you change the manure added values here, Cropware assumes that the total amount of manure added to this source for the year will remain the same as the value you determined on the Manure Screen. The last (to the right) cell in the “Manure Added” row acts as a balancing row. The manure added in the last month of the plan year will be the difference between the total manure added for the source (from the Manure Screen) and the sum of the manure added values entered on this row.

Alternatively, the monthly “Manure Added” quantities can also be defined if the user determines the total annual quantity of manure with the “Estimate Using Number and Average Weight of Manure Applications” method on the Manure screen. The number of monthly loads will be translated into tons or gallons of manure produced per month and carried forward to the “Manure Added” row within the Calendar screen.

If you need to account for manure exports throughout the plan year, you can enter a negative number to the manure added row.

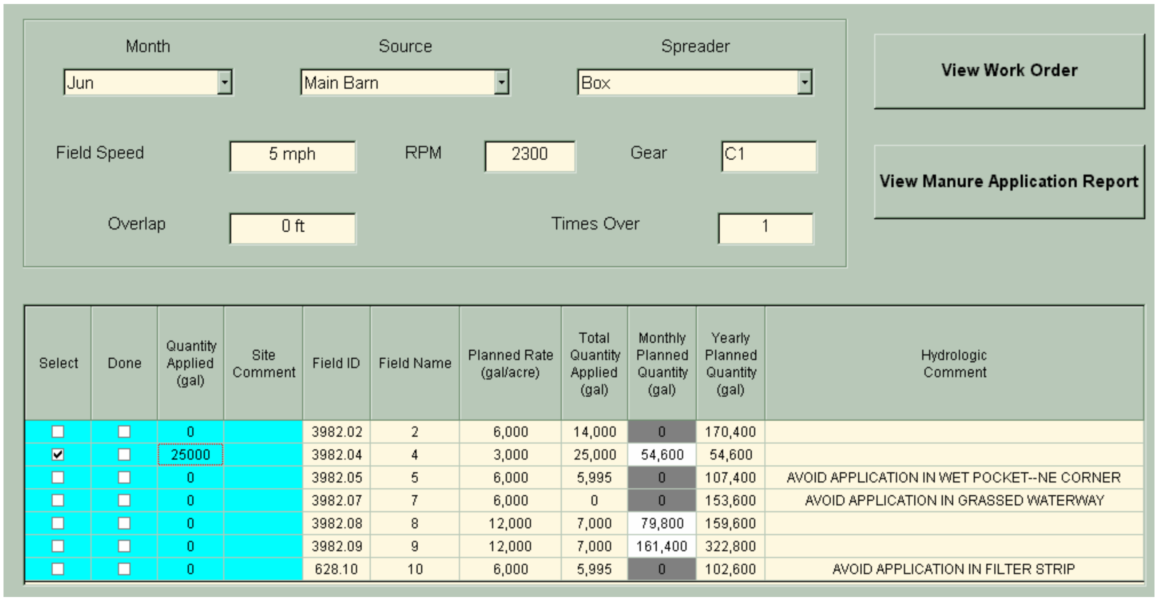
Manure Used

The "Manure Used" is the summed values for each field for a given month from the calendar above.

Ending Inventory

The "Ending Inventory" is the beginning inventory plus manure added less manure used. The ending inventory for a month is carried forward as the beginning inventory of the next month (i.e. the ending inventory for October is the beginning inventory for November).

3.10 Manure Spreading Work Order Screen



This screen is used to produce a "work order" or tractor sheet to hand to the person driving the tractor or truck spreading manure. When the month and manure source are selected, each of the fields which have been identified on the Calendar Worksheet as having manure applied in that month, from that manure source, are listed in the table in the lower portion of this screen. Since the work order is specific for each manure spreader, the spreader which will be used is selected from the "Spreader" drop down box. Application suggestions such as Field speed, RPM, Gear, Overlap, and/or Times Over can be entered at the top of the screen. Additional instructions for each field can be made in the "Site Comment" column.

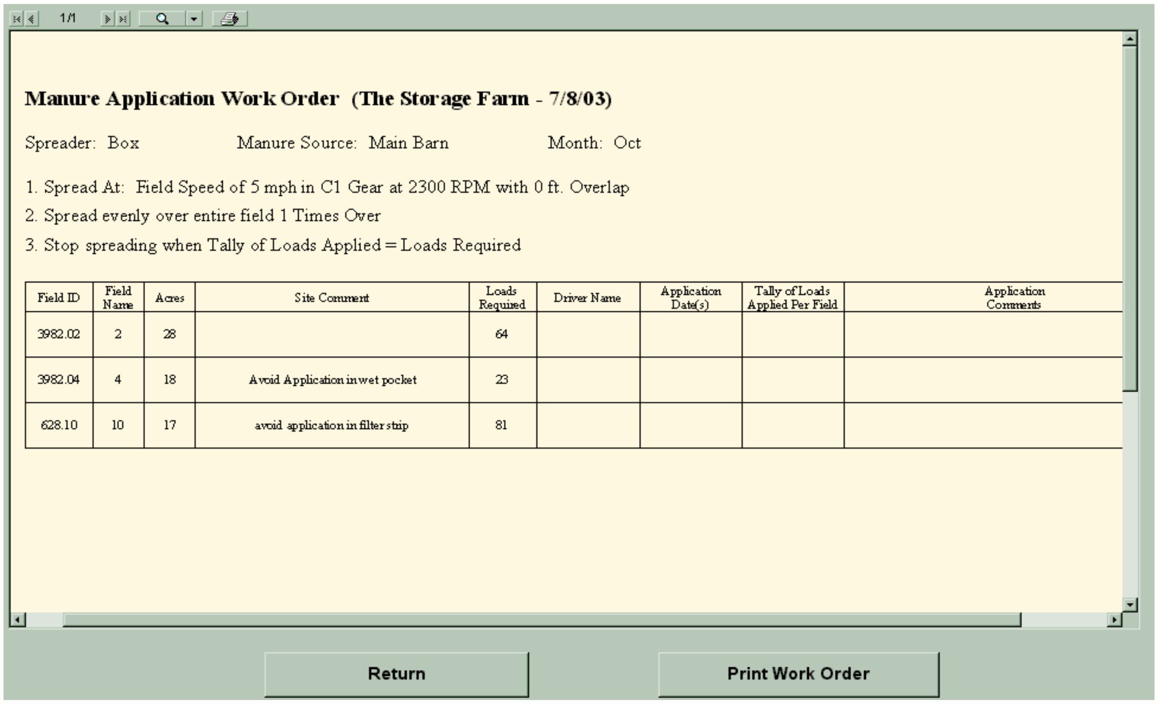
How To Create A Work Order

Refer to the Cropware tutorials for specific guidelines.

Buttons

View Work Order

Selecting this button displays the manure application work order / tractor sheet (below). You can make the image larger by clicking the left mouse button on the sheet or selecting the magnifying glass icon at the top of the screen. You can print the work order sheet by clicking on the “Print Work Order” button at the bottom of the screen or selecting the printer icon at the top of the screen. The Work Order has blank areas for the user to record the Driver Name, Application Date(s), Tally of Loads Applied Per Field, and Application Comments. The “Return” button will return you to the Manure Spreading Work Order input screen.



Manure Application Work Order (The Storage Farm - 7/8/03)

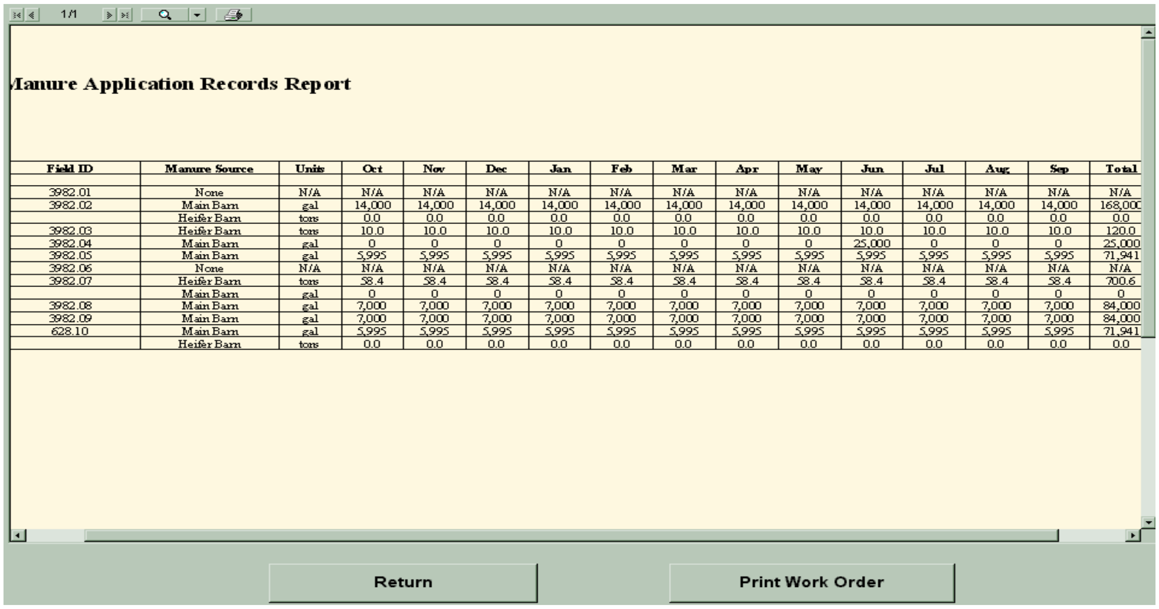
Spreader: Box Manure Source: Main Barn Month: Oct

1. Spread At: Field Speed of 5 mph in C1 Gear at 2300 RPM with 0 ft. Overlap
2. Spread evenly over entire field 1 Times Over
3. Stop spreading when Tally of Loads Applied = Loads Required

Field ID	Field Name	Acres	Site Comment	Loads Required	Driver Name	Application Date(s)	Tally of Loads Applied Per Field	Application Comments
3982.02	2	28		64				
3982.04	4	18	Avoid Application in wet pocket	23				
628.10	10	17	avoid application in filter strip	81				

<u>View Manure Application Report</u>

The Manure Application Report gives an overview of the quantity of manure actually applied in each month as recorded in the Work Order "Quantity Applied" column. The Field ID for each field is the first column. Each field has one or two rows for the primary and secondary manure sources. If no manure is applied for the field, the manure source column entry is "none". The source units, the quantity applied for each of the twelve months and the total manure quantity applied are shown. You can print the Manure Application Report by clicking on the "Print Work Order" button at the bottom of the screen or selecting the printer icon at the top of the screen. The "Return" button will return you to the Manure Spreading Work Order input screen.



Manure Application Records Report

Field ID	Manure Source	Units	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
3982.01	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3982.02	Main Barn	gal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	168,000
	Heifer Barn	tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3982.03	Heifer Barn	tons	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	120.0
3982.04	Main Barn	gal	0	0	0	0	0	0	0	0	25,000	0	0	0	25,000
3982.05	Main Barn	gal	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	71,941
3982.06	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3982.07	Heifer Barn	tons	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	700.6
	Main Barn	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
3982.08	Main Barn	gal	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	84,000
3982.09	Main Barn	gal	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	84,000
628.10	Main Barn	gal	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	5,995	71,941
	Heifer Barn	tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Screen Entries

<u>Month</u>

Enter the month the work plan will be created for. When the month and manure source are selected, each of the fields which have been identified on the Calendar worksheet as having manure applied in that month, from that manure source, are listed in the table in the lower portion of this screen.

<u>Source</u>

Enter the manure source that the work plan will be created for. When the month and manure source are selected, each of the fields which have been identified on the Calendar worksheet as having manure applied in that month, from that manure source, are listed in the table in the lower portion of this screen.

<u>Spreader</u>

Since the work order is specific for each manure spreader, the spreader which will be used is selected from the "Spreader" drop down box.

<u>Field Speed</u>

Enter the suggested spreading field speed. The field speed entered will be printed on the work order.

<u>RPM</u>

Enter the suggested spreading tractor RPM speed The RPM entered will be printed on the work order.

<u>Gear</u>

Entered the suggested spreading gear. The gear entered will be printed on the work order.

Overlap

Entered the suggested width of the spreading overlap. The overlap entered will be printed on the work order.

Times Over

Entered the number of times the spreader should go over the field. The times over entered will be printed on the work order.

Select and Done

On this screen, entry cells are shaded teal. In most cases, new work orders will be printed out more often than once a month. Check the "Select" box for each of the fields you want to appear on this work order. When the total planned amount has been applied to the field, and you do not want the field to come up on this screen again, check the field's "done" box.

Quantity Applied and Total Quantity Applied

Enter the quantity actually applied in the "Quantity Applied" column. Each time a quantity applied entry is made, the value is added to the amount in the "Total Quantity Applied" column. In this way, you can keep a running total of manure applied to the field from each manure source. The "Total Quantity Applied" field can be adjusted down by entering a negative value in the "Quantity Applied" column.

Site Comments

Application comments and instructions for each field entered under "Site Comment" will be printed on the Work Order.

Planned Quantity, Hydrologic Comments and PI

The total manure application quantity in the nutrient management plan for the month and the year are given under the headers "Monthly Planned Quantity" and "Yearly Planned Quantity". The hydrologic comments and phosphorus index are displayed for each field to help plan manure application rates, timing and driver instructions.

View Work Order

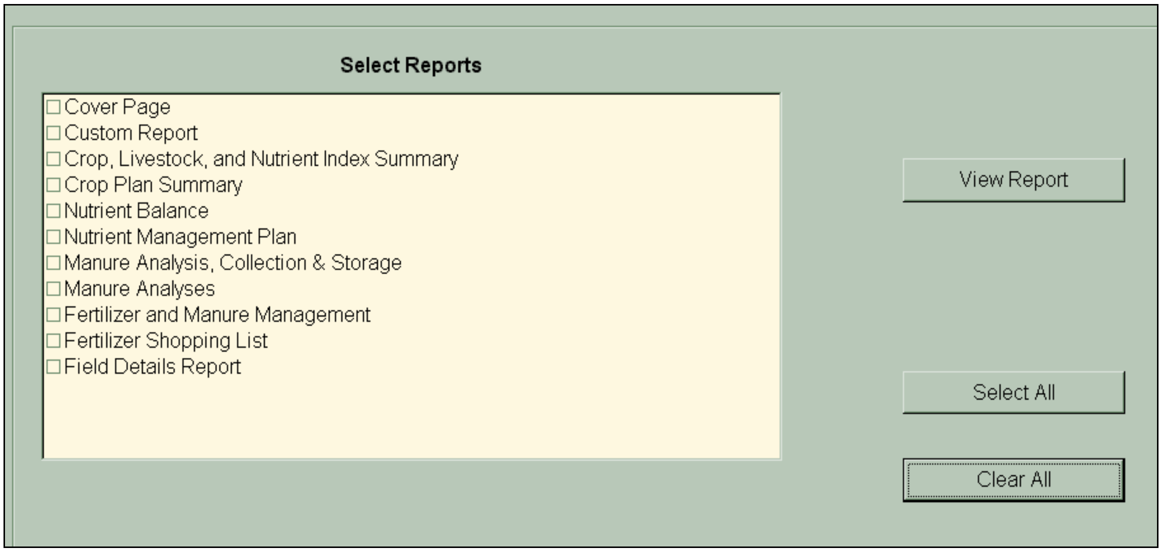
Displays the Manure Application Work Order. Because the work order is created for a particular spreader, the printed Work Order communicates the actual number of loads necessary for the field during a given time period. Manure applicators may then record the number of loads actually applied with hash marks within the "Tally of Loads Applied per Field" column of the printed Work Order. The tally of loads can then be multiplied by the amount of manure per load to determine the value to enter into the "Quantity Applied" column of the Work Order screen.

View Manure Application Report

Displays the Manure Application Records Report. Based on the record keeping within the "Quantity Applied" column of the Work Order screen, the total amount of manure applied to a field for a given month will be recorded in the "Manure Application Report".

4. CROPWARE REPORTS

4.1 REPORTS MENU



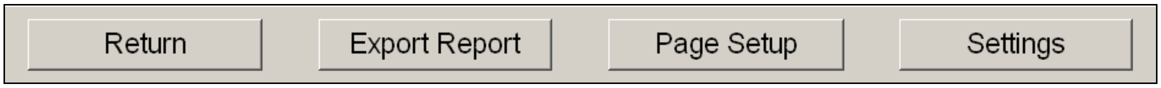
How to view and print reports

1. From this screen, click on the boxes next to the reports you would like to view or print.
2. Click “View Report” button.
3. Click on the magnifying glass icon, just above the report body, to increase the size of the report on the screen. For the same effect, you can double click the left mouse button to zoom in or the right mouse button to zoom out.
4. Click on the printer icon to print the report.
5. To return to the report menu click on the “Return” button.

How to move around in the reports

1. Most of the reports will have a more readable display if the tree is turned off.
2. You can also select reports by using the Reports Drop down menu at the top of the screen.
3. You can use the vertical and horizon scroll bars to show more of the screen.
4. Holding down the left mouse button and moving the mouse will turn the mouse pointer into a hand. Use the hand to grab and move the report display around on the screen.
5. Use the greater than and less than buttons at the top of the screen to move forward and backward. Clicking on the will move forward one page. Clicking on the will move to the last page of the last report. The will move backward one page and the will move to the first page of the first report selected.

Report Buttons



Return

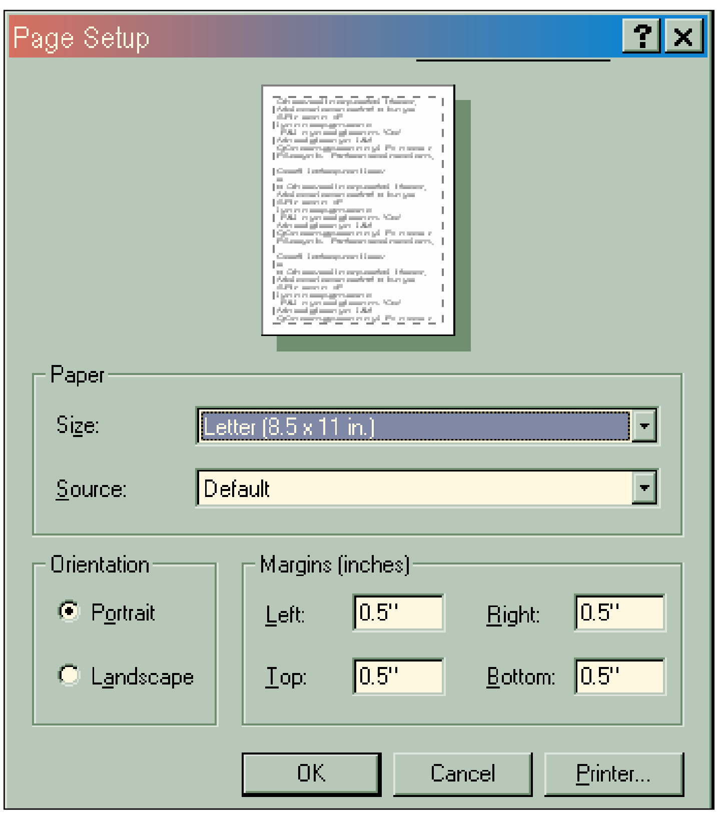
The Return button will take you back to the previous Select Reports menu.

Export Report

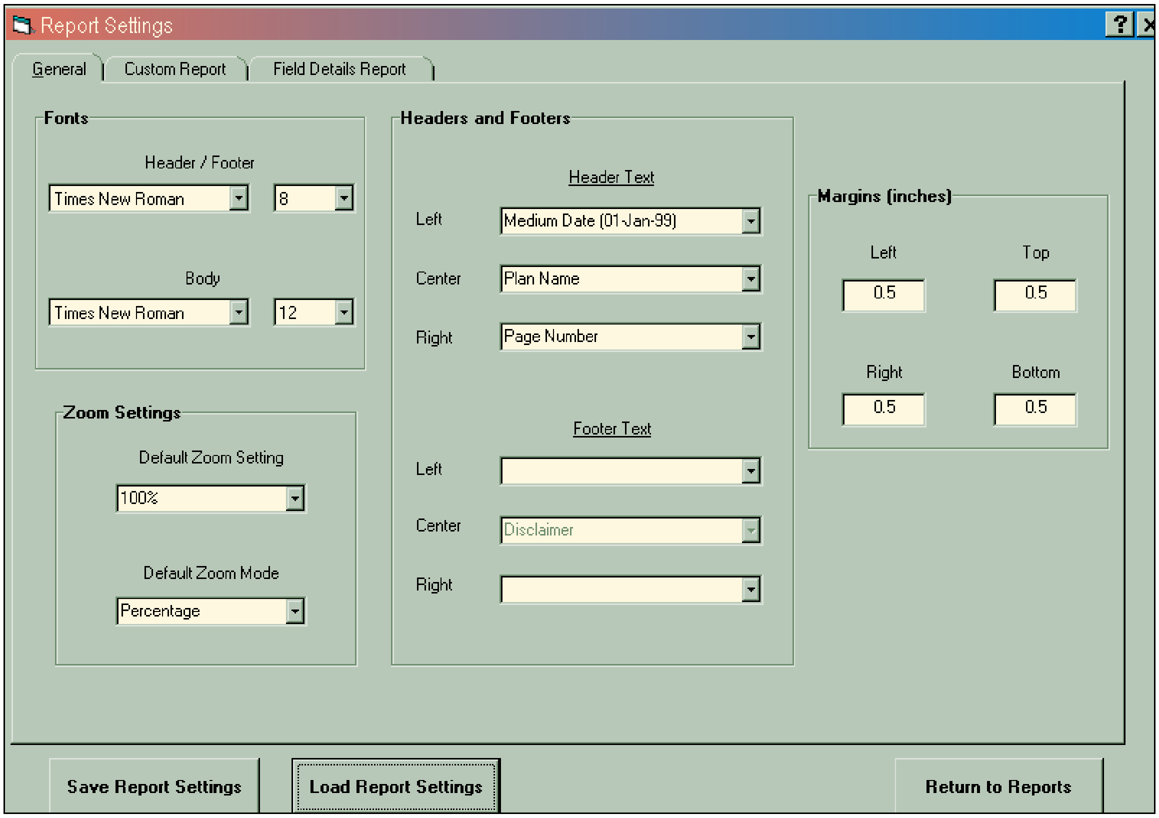
The Export Report button will export the selected report(s) to a file. The exported file will be in a rich text format (rtf) which can be imported into other Windows programs such as Word.

Page Setup

In Page Setup you can select the printer to be used and enter the instructions for the printer, including the paper size, orientation (portrait or landscape) and the margins.



Settings: General



In the General tab of the Report Settings you can customize how each report will be displayed and printed.

<u>Fonts</u>

The Font style and size can be selected for the body of the reports and for the headers and footers.

<u>Zoom Settings</u>

The appearance of the page is set using the "Zoom" settings. You have the option of seeing the some set percentage of a page, thumbnails, whole page, two-pages, page-width, and zooms from 10-400%.

<u>Headers and Footer Text</u>

You can select three headers (left, center, right) and two footers (left, right) to be displayed on the reports. Choices include: Page Number, Plan Name, Producer Name, Plan Year, Date (4 formats) and Time (3 formats). You can also type header or footer text directly into the entry box.

<u>Margins</u>

You can set the space in inches from the top and bottom, left and right paper edges.

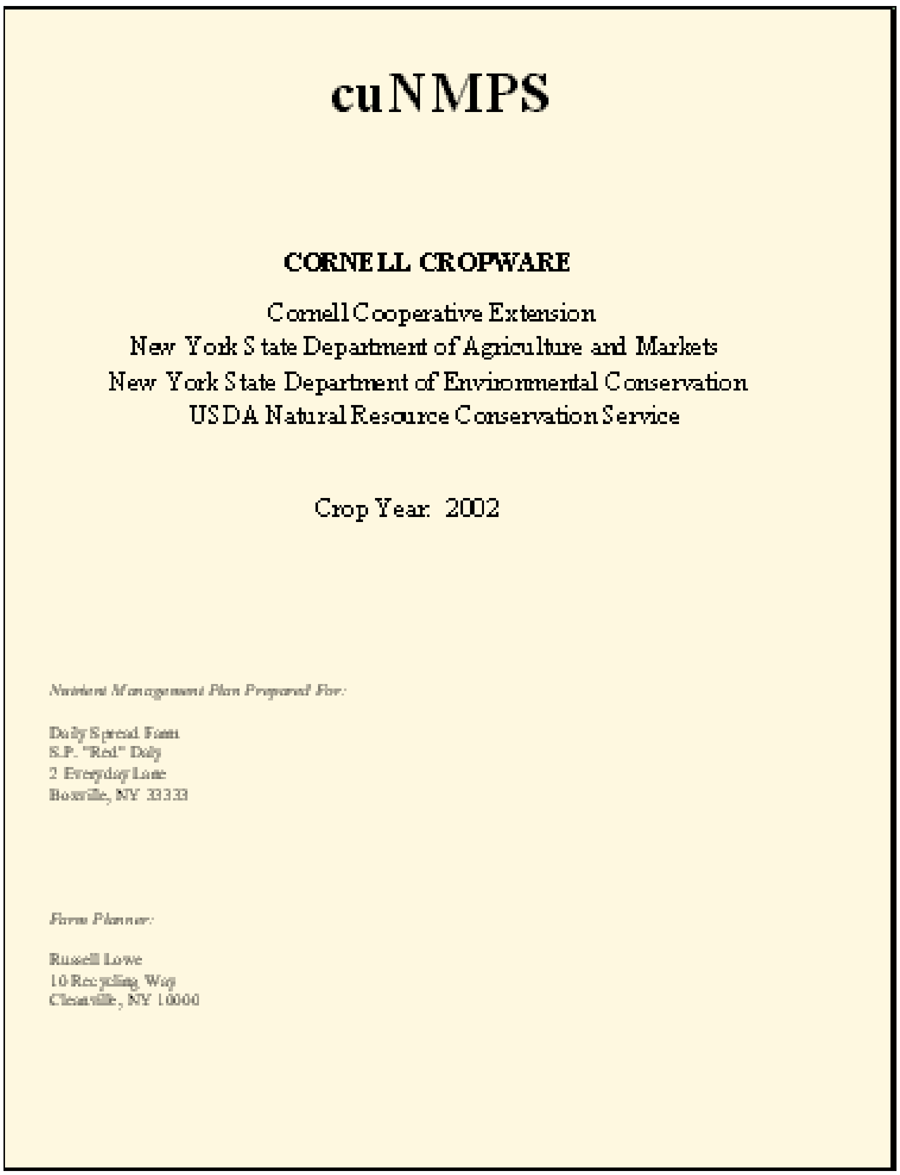
Settings: Custom Report

See Custom Report help.

Settings: Field Detail Report

See Field Detail Report Help.

4.2 COVER PAGE


cuNMPS

CORNELL CROPWARE

Cornell Cooperative Extension
New York State Department of Agriculture and Markets
New York State Department of Environmental Conservation
USDA Natural Resource Conservation Service

Crop Year: 2002

Nutrient Management Plan Prepared For:

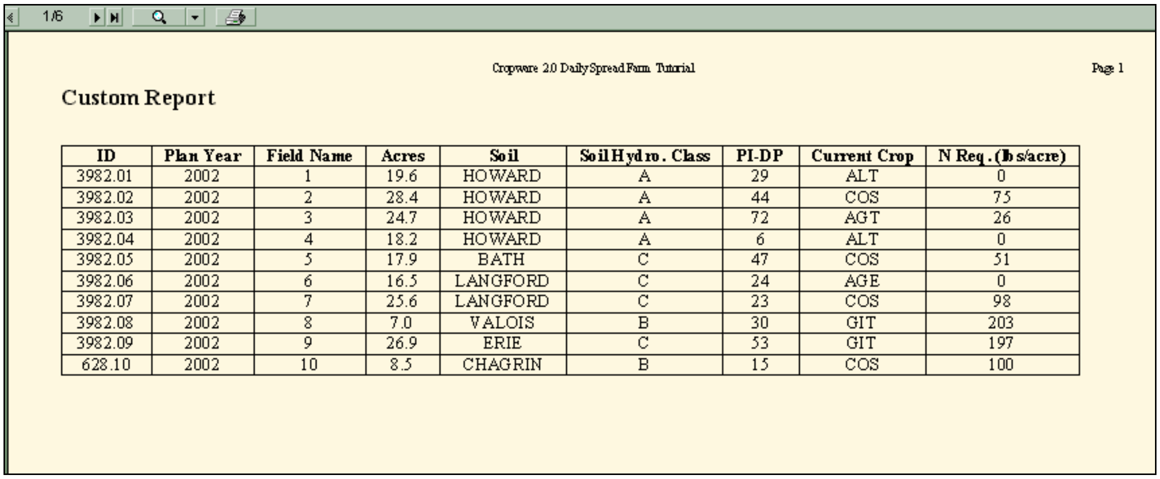
Daily Spread Farm
S.P. "Red" Daily
2 Everyday Lane
Bossville, NY 33333

Farm Planner:

Russell Lowe
10 Recycling Way
Clearville, NY 10000

The Cover Page can be printed to provide a cover page for the comprehensive nutrient management plan. Information on the cover page includes title and author information for Cornell Cropware, producer and planner contact information and the plan crop year.

4.3 Custom Report



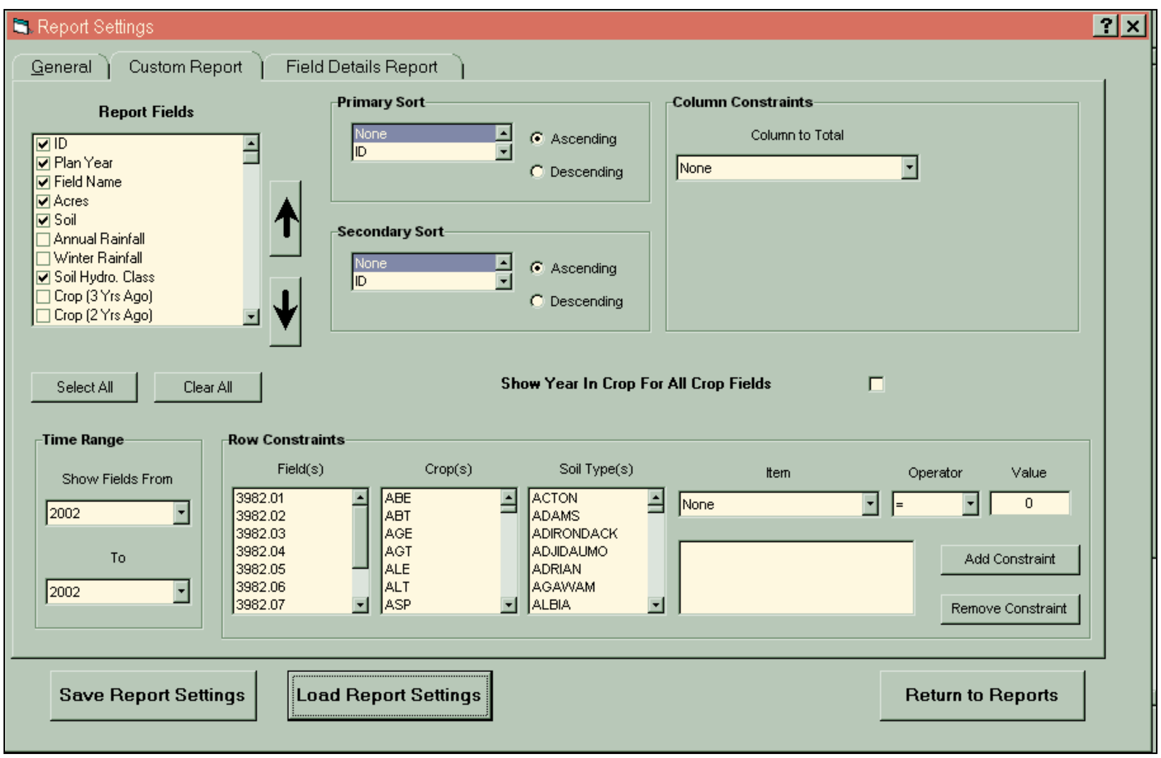
Cropware 2.0 DailySpread Farm Tutorial Page 1

Custom Report

ID	Plan Year	Field Name	Acres	Soil	Soil Hydro. Class	PI-DP	Current Crop	N Req. (lbs/acre)
3982.01	2002	1	19.6	HOWARD	A	29	ALT	0
3982.02	2002	2	28.4	HOWARD	A	44	COS	75
3982.03	2002	3	24.7	HOWARD	A	72	AGT	26
3982.04	2002	4	18.2	HOWARD	A	6	ALT	0
3982.05	2002	5	17.9	BATH	C	47	COS	51
3982.06	2002	6	16.5	LANGFORD	C	24	AGE	0
3982.07	2002	7	25.6	LANGFORD	C	23	COS	98
3982.08	2002	8	7.0	VALOIS	B	30	GIT	203
3982.09	2002	9	26.9	ERIE	C	53	GIT	197
628.10	2002	10	8.5	CHAGRIN	B	15	COS	100

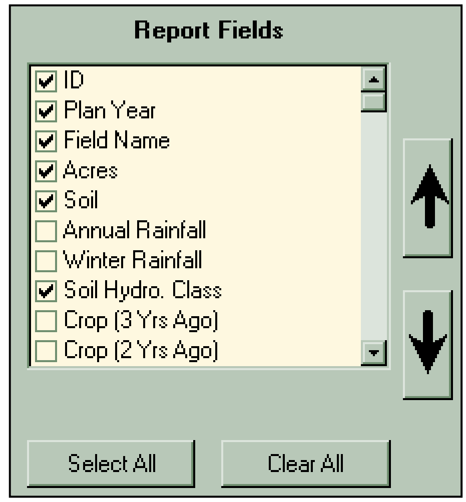
Use the Custom Report to create a report to your specifications, choosing the data and the order they appear while limiting the report to certain years, crops, soils and/or data ranges. The user defined report setup can be saved (Save Report Settings button) and retrieved (Load Report Settings button) for future use or to use in other farm nutrient management plans. The best way to see the value of the Custom Reports features is to dive in and play with it! See the Cropware tutorials for some ideas about useful custom reports.

Report Settings – Custom Report Tab

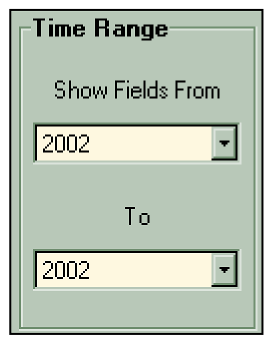


How to create a custom report

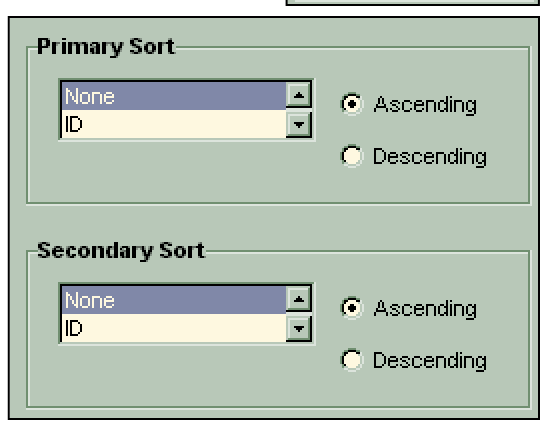
1. Check the Custom Report in the Reports Menu by clicking in the check box. Click the "View Report" button. The last custom report created will be displayed.



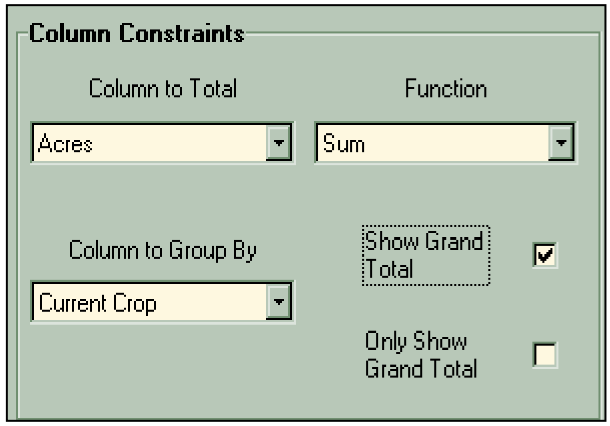
2. Click on "Settings" Button on the bottom of the screen.
3. Click on the Custom Report folder tab. You'll see the screen above.
4. In the Report Fields, point and click on the data items that you want to appear on the report. A complete list of data items available for display on the custom report is shown in Table 4.1. You can sort or limit data which are not displayed on the report. The vertical slide bar moves up and down through the list of data items. The large arrows change the order of the selected item up and down the list. The first, top checked, item will appear in the first, left hand, column of the custom report. The "Select All" button will check each of the data items. The "Clear All" button will clear all of the checked boxes. A list of all items which can be selected in the custom reports, see Table 4.1 Custom Report Fields.
5. Choose the range of plan years. The default limits data to the current plan year.



6. Set Sort order. Click the Ascending radio button if you want the data to be sorted from A to Z and 1, 2, 3. The Descending button will sort items Z to A and 3, 2, 1. The data will be sorted by the primary sort first and the secondary sort within the primary sort. For example, if the primary sort is Plan Year and the secondary sort is Current Crop, all of the fields in Plan Year 2002 would be listed first with the fields sorted by the current crop within each year.

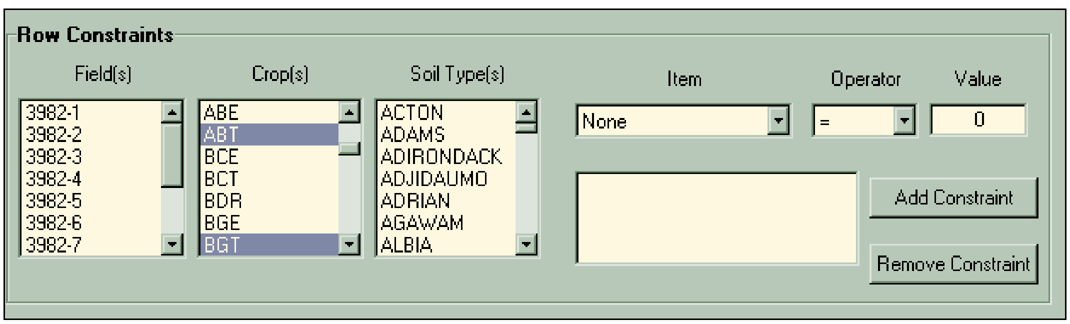


7. You can total, count, average, determine the minimum, maximum, standard deviation, variance and percent of total, for groups of data in the Column



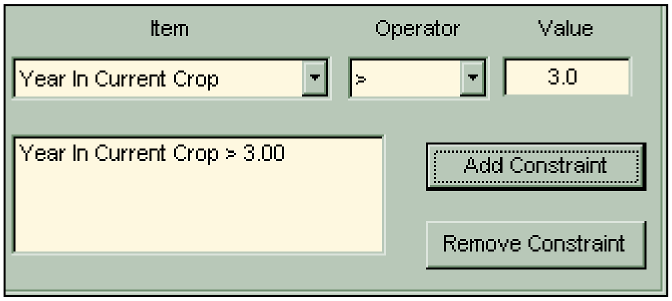
Constraints sections. Click on the "Column to Total" drop down box. Select a data item to sum (or any of the functions above). In this example, acres is selected. In the "Column to Group By" select the data set you want totaled (or any of the other functions). Choose the function. In the example, the total acres in each plan year crop will be totaled. Clicking on the "Show Grand Total" will also show a total of all of the acres for all of the crops. Clicking on "Only Show Grand Total" will not show subtotals for each crop but will show the total acres for all crops. *Note*: to have the column constraints work correctly, the Column to Group By item also has to be selected as the Primary Sort item.

8. Use the Row Constraints to limit the crop fields to only those selected or that meet a set criteria. Highlight the fields, crops or soil types that you want on the report. If you do not highlight any of the items in a group, there is no constraint and all fields, crops or soil types will be displayed.



The selection of multiple items is similar as in other Windows programs. You can click on a single item to select just that item. You can hold the control key down and click on several items, or you can click on an item, hold the shift key down and click on another item to select the range of items between the two selections. For example, if we are only interested in established hay fields for the custom report, control-click on the ABT, AGT, etc. in the Crop(s) box. This will limit the report to just those crops. If you want to see the number of years each of these fields has been in hay / pasture, check the "Show Year in Crop for All Crop Fields" box. Now, alfalfa in its fourth year of production will be listed "ALT4".

An even more powerful Row Constraint option gives you the ability to limit the fields shown by any of the report field items. Click the down arrow in the item



field. Choose from the list of report fields in the drop down list to limit the fields in the report. Click on "Year in Current Crop". In the Operator list choose from =, <, >, <=, >=, or NOT =. Enter the limiting value. Click on the "Add Constraint" button. In this example, the report will show all of the sod fields that have been in hay or pasture for more than three years. *Note*: you can add multiple constraints using the "Add Constraint" button. It is possible to add constraints which are mutually exclusive, in this case there will be no fields shown on the report. To remove a constraint, highlight the constraint in the window and click on "Remove Constraint."

Table 4.1. Custom Report Fields

ID	Plan Year
Field Name	Acres
Soil	Annual Rainfall (inches)
Winter Rainfall (inches)	Soil Hydrologic Group
Crop (3 years Ago)	Crop (2 years Ago)
Crop (1 year Ago)	Current Crop
Future Crop (1 year)	Future Crop (2 years)
Future Crop (3 years)	Gross N Required (lbs/acre)
N Required (lbs/acre)	P Required (lbs P_2O_5/acre)
K Required (lbs K_2O/acre)	Lime Required (tons/acre)
Lime Required (tons/field)	Primary Manure Application Method
Primary Manure Application Timing	Secondary Manure Application Method
Secondary Manure Application Timing	Field Access
Primary Manure Hydrologic Comment	Secondary Manure Hydrologic Comment
Fertilizer 1 Name	Fertilizer 1 Units
Fertilizer 1 Rate/acre	Fertilizer 1 (quantity) applied /field
Fertilizer 1 Incorporation Method	Fertilizer 1 Incorporation Timing
Fertilizer 2 Name	Fertilizer 2 Units
Fertilizer 2 Rate/acre	Fertilizer 2 (quantity) applied /field
Fertilizer 2 Incorporation Method	Fertilizer 2 Incorporation Timing
Fertilizer 3 Name	Fertilizer 3 Units
Fertilizer 3 Rate/acre	Fertilizer 3 (quantity) applied /field
Fertilizer 3 Incorporation Method	Fertilizer 3 Incorporation Timing
Fertilizer 4 Name	Fertilizer 4 Units
Fertilizer 4 Rate/acre	Fertilizer 4 (quantity) applied /field

Table 4.1. Custom Report Fields (continued)

Fertilizer 4 Incorporation Method	Fertilizer 4 Incorporation Timing
N Balance (lbs/acre)	P_2O_5 Balance (lbs/acre)
K_2O Balance (lbs/acre)	Phosphorus Index (DP)
Phosphorus Index (PI-PP)	Leaching Index
(soil) Sample Date	Comments
County	Township
Primary Manure Source	Primary Manure Analysis
Primary Manure Units (tons or gallons)	Primary Manure Rate Applied/acre
Primary Manure Quantity Applied/field	Secondary Manure Source
Secondary Manure Analysis	Secondary Manure Units (tons or gallons)
Secondary Manure Rate Applied/acre	Secondary Manure Quantity Applied/field
All Manure Applied/acre (gal)	All Manure Applied/acre (ton)
All Manure Applied/field (gal)	All Manure Applied/ field (ton)
Priority Nutrient	RUSLE
Flooding Frequency	Waterbody Type
Flow Distance	Drainage Class
Concentrated Flows	Sod
Tillage	Highly Erodible?
PSNT	Extraction Method
Lab ID	Soil pH
Soil P	Soil K
Soil Mg	Soil Ca
Soil Mn	Soil Zn
Soil Fe	Soil Al
Soil Organic Matter	Morgan Equivalent P (lbs/acre)
Morgan Equivalent K (lbs/acre)	Exchange Acidity
User Yield Potential Corn	Rotation
Residual Manure N (lbs/acre)	Residual Sod N (lbs/acre)
Fertilizer N (lbs)	Fertilizer N (lbs/acre)
Fertilizer P_2O_5 (lbs)	Fertilizer P_2O_5 (lbs/acre)
Fertilizer K_2O (lbs)	Fertilizer K_2O (lbs/acre)
Manure N (lbs)	Manure N (lbs/acre)
Manure P_2O_5 (lbs)	Manure P_2O_5 (lbs/acre)
Manure K_2O (lbs)	Manure K_2O (lbs/acre)
Manure + Fertilizer N (lbs)	Manure + Fertilizer N (lbs/acre)
Manure + Fertilizer P_2O_5 (lbs)	Manure + Fertilizer P_2O_5 (lbs/acre)
Manure + Fertilizer K_2O (lbs)	Manure + Fertilizer K_2O (lbs/acre)
N Balance (lbs)	P_2O_5 Balance (lbs)
K_2O Balance (lbs)	

4.4 Crop, Livestock and Nutrient Index Summary

Crop, Livestock, and Nutrient Index Summary

Crop Plan

	2002		2003		2004	
	Acres	Percent	Acres	Percent	Acres	Percent
FIELD CORN						
1st Year Corn	0.0	-	24.7	13%	19.6	10%
2nd Year Corn	46.3	24%	0.0	-	24.7	13%
3rd+ Year Corn	34.1	18%	54.8	28%	46.3	24%
Total Corn Silage	80.4	42%	79.5	41%	90.6	47%
Total Corn Grain	0.0	-	0.0	-	0.0	-
HAY						
1st Year Hay	16.5	9%	25.6	13%	8.5	4%
2nd Year Hay	18.2	9%	16.5	9%	25.6	13%
3rd Year Hay	19.6	10%	18.2	9%	16.5	9%
4th+ Year Hay	58.6	30%	53.5	28%	52.1	27%
Total Hay	112.9	58%	113.8	59%	102.7	53%
PASTURE	0.0	-	0.0	-	0.0	-
VEGETABLES	0.0	-	0.0	-	0.0	-
SMALL GRAINS	0.0	-	0.0	-	0.0	-
SOYBEANS	0.0	-	0.0	-	0.0	-
IDLE & OTHER	0.0	-	0.0	-	0.0	-
TOTAL ACRES	193.3		193.3		193.3	

Livestock

Animal Type	Animal Units		
	2002	2003	2004
Cattle	206	206	206
Poultry	0	0	0
Swine	0	0	0
Sheep	0	0	0
Horses	0	0	0
Total Animal Units	206	206	206
Animal Units/Crop Acre	1.1	1.1	1.1

Nutrient Index Summary

Farm Weighted Phosphorus Index (DP/PP): 30.54 / 21.72 Farm Weighted Leaching Index: 9.95

The purpose of this report is to give a multiple year overview of the farm's cropping plan, animal density and risk factors for leaching and run-off. A summary for each existing plan year is displayed.

The Crop Plan includes a summary of crops produced by total acres and as a percent of the total crop production acreage. Corn (crop code = COS and COG) is broken out by first, second and third or greater year in production. Totals for corn grain and corn silage are also shown. Hay is divided into first, second, third and fourth plus years in hay production and total hay. The following table indicates the crops grouped into each crop plan summary item.

Table 4.2. Crop Plan Group Categories, Crop Codes and Crop Names

Category	Crop Code and Name		Crop Code and Name	
Corn	COG	Corn-grain	COS	Corn-silage
Hay	ABE	Alfalfa-Trefoil-Grass	CGE	Clover-Grass
	ABT	Alfalfa-Trefoil-Grass	CGT	Clover-Grass
	AGE	Alfalfa-Grass Mix	CLE	Clover
	AGT	Alfalfa-Grass Mix	CLT	Clover
	ALE	Alfalfa	CSE	Clover-Seed Production
	ALT	Alfalfa	CST	Clover-Seed Production
	BCE	Birdsfoot Trefoil-Clover	CVE	Crownvetch
	BCT	Birdsfoot Trefoil-Clover	CVT	Crownvetch
	BGE	Birdsfoot Trefoil-Grass	GIE	Grass-Intensive Mgmt
	BGT	Birdsfoot Trefoil-Grass	GIT	Grass-Intensive Mgmt
	BSE	Birdsfoot Trefoil-Seed Prod	GRE	Grasses
	BST	Birdsfoot Trefoil-Seed Prod	GRT	Grasses
	BTE	Birdsfoot Trefoil		
	BTT	Birdsfoot Trefoil		
Pasture	PGE	Pasture w/Improved Grass	PLE	Pasture with Legumes
	PGT	Pasture w/Improved Grass	PLT	Pasture with Legumes
	PIE	Pasture-Intensively managed	PNT	Pasture Native Grass
	PIT	Pasture-Intensive Managed		

Table 4.2. Crop Plan Group Categories, Crop Codes and Crop Names (continued)

Category	Crop Code and Name		Crop Code and Name	
Vegetables	ASP	Asparagus	MML	Muskmelon
	BDR	Beans - Dry	MUS	Mustard
	BET	Beet	ONP	Onion-Transplant
	BNL	Beans - Lima	ONS	Onion-Seeded
	BNS	Beans - Snap	PEA	Pea
	BRP	Broccoli-Transplanted	PEP	Peppers
	BRS	Broccoli-Seeded	POP	Popcorn
	BUS	Brussels Sprouts	POT	Potato
	CAR	Carrots	PSL	Parsley
	CBP	Cabbage-Trans	PSN	Parsnips
	CBS	Cabbage - Seeded	PUM	Pumpkins
	CEL	Celery	RAD	Radishes
	CFP	Cauliflower - Transplanted	RHU	Rhubarb
	CFS	Cauliflower - Seeded	RUT	Rutabagas
	CHC	Chinese Cabbage	SPF	Spinach-Fall
	CKP	Cucumber - Transplanted	SPS	Spinach-Spring
	CKS	Cucumber - Seeded	SQS	Squash-Summer
	CRD	Chard	SQW	Squash-Winter
	EGG	Eggplant	SWC	Sweet Corn
	END	Endive	TOM	Tomato
	GAR	Garlic	TUR	Turnips
	LET	Lettuce	WAT	Watermelon
	MIX	Mixed Vegetables		
Small Grains	BSP	Barley-spring	OAT	Oats
	BSS	Barley-spring w/ legume	RYC	Rye-cover crop
	BUK	Buckwheat	RYS	Rye-Seed Production
	BWI	Barley-winter	SUN	Sunflower
	BWS	Barley-winter w/legume	TRP	Triticale/Peas
	MIL	Millet	WHS	Wheat Seeded w/Legume
	OAS	Oats-seeded w/legume	WHT	Wheat
Soybeans	SOY	Soybeans		
Idle & Other	IDL	Idle Land	SUD	Sudangrass
	OTH	Unlisted Crop	TRE	Christmas trees
	SOF	Sorghum-Forage	TRT	Christmas trees
	SOG	Sorghum-Grain	WPE	Waterways, Pond Dikes
	SSH	Sorghum-Sudan Hybrid	WPT	Waterways, Pond Dikes

The Nutrient Index Summary shows the weighted average NY Phosphorus Runoff Index and Leaching Index for each year. The Farm Weighted Average Phosphorus Index is calculated as:

PI_DP_Farm = Σ (PI_DP * Acres) for all fields / FarmCropAcres
PI_PP_Farm = Σ (PI_PP * Acres) for all fields / FarmCropAcres

The Farm Weighted Average Nitrogen Leaching Index is calculated as:

LI_Farm = Σ (LI * Acres) for all fields / FarmCropAcres

4.5 Crop Plan Summary

Cropware 2.0 Daily Spread Farm Tutorial

Crop Plan Summary

	Plan Year													
	1999	2000	2001	**2002**	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crop	---- Acres ----													
Total Corn	80	69	97	**80**	80	91	79	79	80	52	80	80	96	89
Corn Silage	80	69	97	**80**	80	91	79	79	80	52	80	80	96	89
Total Hay Crop	113	125	96	**113**	114	103	114	114	113	141	113	113	97	104
Legume Hay	28	48	38	**38**	38	18	28	28	28	48	38	38	38	18
Mixed Hay	51	43	25	**41**	42	51	52	52	51	59	41	41	26	52
Grass Hay	34	34	34	**34**	34	34	34	34	34	34	34	34	34	34
New Seedings*	25	20	18	**17**	26	9	46	0	25	36	18	0	26	26
Totals	193	193	193	**193**	193	193	193	193	193	193	193	193	193	193

* Note: Acres of New Seedings are also included in the Hay acreages above.

The Crop Plan Summary shows the planned crop rotation over 14 years. The crop acres for the current year, the past 3 years and the next 10 years are displayed. The objective of this report is to predict whole farm feedstuff production shifts and potential shortfalls given the current rotation plan. The current plan year column has bold text.

The acres of new hay crop seedings are indicated to help budget capital, labor and machinery needs and plan for yield reductions in years with large seeding acreages. The acres of new seedings are also accounted for in the hay crop acres in the above rows. The new seedings are all of the hay crops with an “E”, signifying Establishment Year, at the end of the crop code (Table 17.4). For example, in the current year, 2002, the 17 acres of new seedings are also part of the 41 acres of mixed hay acres and 113 total hay acres.

Soybeans and each of the vegetable crops are displayed individually if they are part of the rotation. Hay, Pasture, Small Grains, Sorghum/Sudangrass and Idle/Other crops are totaled and displayed as a group. The crop codes comprising each group are in Table 4.3.

Table 4.3. Crop Plan Summary Group Categories, Crop Codes and Crop Names

Category	Crop Code and Name		Crop Code and Name	
Legume Hay	ALE	Alfalfa	BTT	Birdsfoot Trefoil
	ALT	Alfalfa	CLE	Clover
	BCE	Birdsfoot Trefoil-Clover	CLT	Clover
	BCT	Birdsfoot Trefoil-Clover	CSE	Clover-Seed Production
	BSE	Birdsfoot Trefoil-Seed Prod	CST	Clover-Seed Production
	BST	Birdsfoot Trefoil-Seed Prod	CVE	Crownvetch
	BTE	Birdsfoot Trefoil	CVT	Crownvetch
Mixed Hay	ABE	Alfalfa-Trefoil-Grass	BGE	Birdsfoot Trefoil-Grass
	ABT	Alfalfa-Trefoil-Grass	BGT	Birdsfoot Trefoil-Grass
	AGE	Alfalfa-Grass Mix	CGE	Clover-Grass
	AGT	Alfalfa-Grass Mix	CGT	Clover-Grass
Grass Hay	GIE	Grass-Intensive Mgmt	GRE	Grasses
	GIT	Grass-Intensive Mgmt	GRT	Grasses
New Seedings	ABE	Alfalfa-Trefoil-Grass	CGE	Clover-Grass
	AGE	Alfalfa-Grass Mix	CLE	Clover
	ALE	Alfalfa	CSE	Clover-Seed Production
	BCE	Birdsfoot Trefoil-Clover	CVE	Crownvetch
	BGE	Birdsfoot Trefoil-Grass	GIE	Grass-Intensive Mgmt
	BSE	Birdsfoot Trefoil-Seed Prod	GRE	Grasses
	BTE	Birdsfoot Trefoil		
Pasture	PGE	Pasture w/Improved Grass	PLE	Pasture with Legumes
	PGT	Pasture w/Improved Grass	PLT	Pasture with Legumes
	PIE	Pasture-Intensively managed	PNT	Pasture Native Grass
	PIT	Pasture-Intensively managed		
Small Grains	BSP	Barley-spring	OAT	Oats
	BSS	Barley-spring w/ legume	RYC	Rye-cover crop
	BUK	Buckwheat	RYS	Rye-Seed Production
	BWI	Barley-winter	SUN	Sunflower
	BWS	Barley-winter w/legume	TRP	Triticale/Peas
	MIL	Millet	WHS	Wheat Seeded w/Legume
	OAS	Oats-seeded w/legume	WHT	Wheat
Sorghum/ Sudangrass	SOF	Sorghum-Forage	SSH	Sorghum-Sudan Hybrid
	SOG	Sorghum-Grain	SUD	Sudangrass
Soybeans	SOY	Soybeans		
Idle & Other	IDL	Idle Land	TRT	Christmas trees
	OTH TRE	Unlisted Crop Christmas trees	WPE WPT	Waterways, Pond Dikes Waterways, Pond Dikes

4.6 NUTRIENT BALANCE

Nutrient Balance Report

	2002	2003	2004
Nitrogen Balance (lbs N)			
Total (Gross) Nitrogen Required	15,205	15,098	17,925
Residual Nitrogen From Sod	1,558	4,001	3,436
Residual Nitrogen From Prior Year's Manure	3,380	3,944	4,129
Nitrogen Available From Manure	15,333	7,859	7,922
Nitrogen Available From Fertilizer	5,711	5,453	5,491
Nitrogen Balance	10,777	6,159	3,053
Ammonia Loss	14,030	21,507	21,685
Phosphorus Balance (lbs P_2O_5)			
P_2O_5 Required	1,562	2,156	1,558
P_2O_5 Supplied By Manure	19,620	19,615	19,789
P_2O_5 Supplied By Fertilizer	1,216	1,685	615
Phosphorus Balance	19,274	19,144	18,846
Potassium Balance (lbs K_2O)			
K_2O Required	909	1,091	749
K_2O Supplied By Manure	35,541	35,547	35,834
K_2O Supplied By Fertilizer	317	1,229	306
Potassium Balance	34,949	35,685	35,392

This report considers the manure and plant nutrient balances on a whole farm scale for multiple plan years. Plant requirements and residual sod N contributions are calculated given the planned rotation. The purpose of this report is to give the farmer and planner a broad view of the plant, soil and manure balance of the farm for the current and future plan years. Questions, like “Does the current rotation result in a nutrient imbalance in a future year?” can be answered with this report.

Use caution when viewing this report for more than three future years. Without current soil tests, the plant nutrient requirements are not accurate. Also note that when a new plan year is created the manure and fertilizer application rates are set to zero which will result in errors in the nutrients supplied by manure and fertilizer on this report, unless a complete nutrient management plan is created for each of the plan years displayed.

Descriptions of selected report items

Total (Gross) Nitrogen Required.

The N requirement for the crop given the rotation, yield potential, soil N, and soil N uptake efficiency. Where appropriate the Gross N Requirement has been adjusted for Residual Sod N in the program calculations. See Calculating Nitrogen Recommendations.

Residual Nitrogen from Sod

The N contribution from plowed or killed sod. The percent legume in the stand and the years since the sod was killed are used to calculate the nitrogen available to the plant from sod. See Legumes and Grass Sods.

Residual Nitrogen from Prior Year's Manure

The Residual Manure N is the residual nitrogen available for plan year plant use from previous years manure applications. The organic N in manure decomposes into inorganic N available for plant use. A decay series is used to estimate the fraction of manure organic N which will be available to the plant each year. For all species, Cropware uses a decay rate of 12% and 5% for manure applied last year and two years ago, respectively. See Table 17.6.

Nitrogen Available from Manure

Because not all the N in manure is available to plants immediately and some portion of the available N is lost to the air, the N available from manure is discounted using the following equations:

Sum for all manure applications (Nutrients from Applied Manure_N) =
Total lbs manure applied * ManureSupply_N * acres)

ManureSupply_N = (NH_4N_supply + OrganicN_supply)

OrganicN_supply is the entered manure organic N adjusted for current year mineralization. The degree of mineralization depends on several factors including the species and matter content of the manure (Table 17.6).

OrganicN_supply = ManureAnalysis_OrganicN * decay_current

Ammonium N supply is the entered manure NH_4-N value adjusted for ammonia volatilization. The percent of the NH_4-N remaining in the manure depends on the manure application method and incorporation timing (Table 17.5).

NH_4N_supply =ManureAnalysis_NH_4N * NH_4N_remain

Where:

Nutrients from Applied Manure_N is the nitrogen supplied to the field by manure applications in lbs/acre.

ManureSupply_N is the total of the ammonium and organic nitrogen available in manure as a percent (in decimal form).

OrganicN_supply is the entered manure organic N adjusted year mineralization.

decay_current is the percent of the organic manure fraction mineralized in the first year of application and available for plant use.

NH_4N_supply is the ammonium N adjusted for ammonia volatilization losses.

NH_4N_remain is the percent of the ammonium N remaining after volatilization losses.

Note: The total N available from manure is discounted by 15% if no-till production is used.

Nitrogen Available from Fertilizer

Nitrogen Available from Fertilizer =
Sum for all fertilizer applications (Fertilizer N % * Fertilizer Rate/a * Acres)

Nitrogen Balance

Nitrogen Balance = Required Nitrogen
less Residual Nitrogen from Prior Year's Manure
less Nitrogen Available from Manure
less Nitrogen Available from Fertilizer

Ammonia Loss

Ammonia loss is the portion of inorganic N lost to volatilization depending on the manure application method used. The Ammonia loss is calculated:

Sum for all manure applications:
NH_4N_loss =ManureAnalysis_NH_4N * (1-NH_4N_remain)

Where:

NH_4N_loss are the ammonium N volatilization losses.

NH_4N_remain is the percent ammonium N remaining after volatilization losses Table 17.5

P_2O_5 Required

The total phosphorus needs for all crops grown in the plan year.

P_2O_5 Supplied by Manure

The total P_2O_5 equivalent from all manure applications in lbs. For all waste sources sum the total quantity of manure multiplied by the P_2O_5 content of the manure used.

<u>P_2O_5 Supplied by Fertilizer</u>

The total P_2O_5 equivalent from all fertilizer applications in lbs (quantity * P_2O_5 concentrations).

<u>Phosphorus Balance</u>

The "P_2O_5 Required" less "P_2O_5 Supplied by Manure" less "P_2O_5 Supplied by Fertilizer".

<u>K_2O Required</u>

The total potassium needs for all crops grown in the plan year.

<u>K_2O Supplied by Manure</u>

The total K_2O equivalent from all manure applications in lbs. For all waste sources sum the total quantity of manure multiplied by the K_2O concentration of the manure used.

<u>K_2O Supplied by Fertilizer</u>

The total K_2O equivalent from all fertilizer applications in lbs.. For all fertilizer applications, sum the total quantity of fertilizer multiplied by the K_2O concentration of the fertilizer.

<u>Potassium Balance</u>

The K_2O Required less K_2O Supplied by Manure less K_2O Supplied by Fertilizer.

4.7 Nutrient Management Plan

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Nutrient Management Plan

	Total Tons	Total Gal	Main Barn	Heifer Barn
Manure Available for Application	900.00	977,274	977,274 gal	900.00 tons
Manure Allocated	895.20	973,950	973,950 gal	895.20 tons
Manure Balance	4.80	3,324	3,324 gal	4.80 tons

Field ID	Field Name	Acres	2003 Crop	Residual Sod N	Gross N Req.	Residual Manure N	Total Nutrients Required (lb/a)			Nutrients From Applied Manure (lb/a)			Nutrients From Fertilizer (lb/a)			Nutrient Balance (lb/a)			PI (DP/PP)	LI
							N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O		
3982.01	1	19.6	ALT4	0	0	14	0	0	0	60	60	96	25	0	0	85	60	96	31 / 11	15
3982.02	2	28.4	COS3	15	113	26	86	0	0	230	200	375	32	0	0	175	200	375	33 /8	15
3982.03	3	24.7	COS1	138	30	13	17	10	0	0	0	0	0	0	0	-17	-10	0	40 / 34	15
3982.04	4	18.2	ALT3	0	0	7	0	10	0	0	0	0	0	0	0	0	-10	0	6 / 3	15
3982.05	5	17.9	COS3	10	97	25	71	20	0	125	125	200	21	17	0	75	122	200	32 / 43	5
3982.06	6	16.5	AGT2	0	40	7	33	0	0	99	87	163	0	0	0	66	87	163	27 / 33	5
3982.07	7	25.6	AGE1	0	0	31	0	40	20	0	0	0	12	48	48	12	8	28	7 / 9	5
3982.08	8	7.0	GIT19	0	225	26	199	25	83	199	173	325	99	0	0	98	148	243	21 / 25	9
3982.09	9	26.9	GIT19	0	225	26	199	0	0	199	173	325	99	0	0	98	173	325	36 / 12	5
628.10	10	8.5	COS4	0	134	30	104	20	0	125	125	200	60	17	0	81	122	200	17 / 23	9

The Nutrient Management Plan is a key Cropware report. All of the critical elements of the nutrient management plan are on this report. At the top of the screen is a summary of total manure available and allocated. In the table, nutrient requirements, planned nutrients applied and the difference between them (nutrient balance) are given for each field. The field's phosphorus index, size, and current year crop are also displayed.

Look down the last four columns of the table. Negative numbers in the "Nutrient Balance" columns indicate a deficit of nutrients for that field's crop production. It is normal to see positive values in the P and K columns if the field's priority nutrient is N. However, if the Phosphorus Index (PI) column has values over 74 for either the DP or PP, you need to base P applications on crop removal or implement management practices that will decrease the field's PI. See Phosphorus Index documentation.

Descriptions of selected report items

Manure Available for Application

Manure Available for Application =

Sum for all sources (Amount at Start of Plan Year
plus Amount Added to System Annually
less Amount Exported from System Annually) as entered on the Manure screen for the whole farm.

Manure Allocated

The sum of the values entered in the "Manure Application User Selected" column, multiplied first by field acreage, (Allocation screen) for the whole farm.

Manure Balance

The Manure Available for Application less the Manure Allocated equals the Manure Balance.

Residual Sod N

The N contribution from plowed or killed sod. The percent legume in the stand and the years since the sod was killed are used to calculate the nitrogen available to the plant from sod. See Legumes and Grass Sods

Gross N Req.

The N requirement for the crop given the yield potential, soil N, sod N, and soil N uptake efficiency. Where appropriate the Gross N Requirement has been adjusted for Residual Sod N in the program calculations. See Calculating Nitrogen Recommendations.

Residual Manure N

The Residual Manure N is the residual nitrogen available for plan year plant use from previous years manure applications. The organic N in manure decomposes into inorganic N available for plant use at different rates. A decay series is used to estimate the fraction of manure organic N which will be available to the plant each year. For all species, Cropware uses a decay rate of 12% and 5% for manure applied last year and two years ago, respectively.

Total Nutrients Required-N

Total Nutrients Required- N = Gross N Required less Residual Manure N.

Total Nutrients Required-P_2O_5

See Phosphorus Recommendations.

Total Nutrients Required-K_2O

See Potassium Recommendations.

Nutrients from Applied Manure-N

Because not all the N in manure is available to plants immediately and some portion of the available N is lost to the air, the N available from manure is discounted using the following equations:

Nutrients from Applied Manure_N = Total lbs manure applied*ManureSupply_N

ManureSupply_N = (NH_4N_supply + OrganicN_supply)

OrganicN_supply is the entered manure organic N adjusted for current year mineralization. The degree of mineralization depends on several factors including the species and matter content of the manure (Table 17.6).

OrganicN_supply = ManureAnalysis_OrganicN * decay_current

Ammonium N supply is the entered manure NH_4-N value adjusted for ammonia volatilization. The percent of the NH_4-N remaining in the manure depends on the manure application method and incorporation timing (Table 17.5).

NH_4N_supply =ManureAnalysis_NH_4N * NH_4N_remain

Where:

Nutrients from Applied Manure_N is the nitrogen supplied to the field by manure applications in lbs/acre.
ManureSupply_N is the total of the ammonium and organic nitrogen available in manure as a percent (in decimal form).
OrganicN_supply is the entered manure organic N adjusted year mineralization.
decay_current is the percent of the organic manure fraction mineralized in the first year of application and available for plant use.
NH_4N_supply is the ammonium N adjusted for ammonia volatilization losses.

NH_4N_remain is the percent of the ammonium N remaining after volatilization losses.
Note: The total N available from manure is discounted by 15% if no-till production is used.

Nutrients from Applied Manure – P_2O_5

For each field, the total amount of P_2O_5 equivalent from all manure applications in lbs. This is the sum of manure applied multiplied by the P_2O_5 concentration of the manure used for each manure application.

Nutrients from Applied Manure – K_2O

For each field, the total amount of K_2O equivalent from all manure applications in lbs. This is the sum of manure applied multiplied by the P_2O_5 concentration of the manure used for each manure application.

Nutrients from Fertilizer

The N, P_2O_5 and K_2O from fertilizer applications for each field.

Nutrient Balance

The difference between the "Total Nutrients Required" and the nutrients supplied in manure and fertilizer applications for N, P_2O_5 and K_2O.

PI

The NY Phosphorus Runoff Index is a risk assessment tool that ranks the field's potential for particulate and dissolved phosphorus runoff. The NY P Index assigns two scores to each field based upon its characteristics and the producer's intended management practices. Dissolved P Index (DP), addresses the risk of loss of water-soluble P from a field (flow across the field or through the soil profile) while Particulate P Index (PP) estimates the risk of loss of P attached to soil particles and manure.

LI

The Leaching Index is a risk assessment tool that ranks the field's potential for nutrient loss from ground water leaching. The leaching index is a function of annual and season precipitation, the soil's hydrologic group and field artificial drainage.

4.8 Manure Analysis, Collection and Storage

The purpose of this report is to give a summary of the manure nutrient quantity, composition and storage capacity for each waste source. The Manure Analysis section shows the manure test nutrient composition with the most recent test date for each manure source. If the most recent test is not being displayed, make sure the "test date" in the Manure screen is entered in a date recognizable format, i.e. "9-2001" or "9/1/2001".

The Annual Nutrient Collection section shows the total quantity of manure added to and exported from each source in tons and gallons. The total nutrients collected are listed for each source in pounds. The labs of Total N, Ammonium N, Organic N, P_2O_5 and K_2O equivalent collected are calculated by multiplying the "Quantity" added times the nutrient content from the most recent manure analysis test. For example, if the 50 tons are added to the "Bedded Pack" and the P_2O_5 analysis value in the most recent manure test for this source was 0.20 %, the total P_2O_5 (lbs) = 200 lbs.

The Waste Storage section shows waste storage information such as storage dimension, units, storage capacity, amount added annually, solids accumulation and volume needed if 25 year, 24 hour precipitation is added to the source.

Descriptions of selected report items

Dimensions (ft)

The storage facility dimensions, in feet, as entered in the Calculate Waste Storage Capacity screen.

Units

Waste Source selected units, tons or gallons, as entered in the Manure screen.

Storage Capacity

The program calculated or user entered storage capacity. For program calculations, see Waste Storage Capacity calculations.

Amount Added Annually

The "Amount Added Annually" as entered on the Manure screen.

Solids Accumulation

Solids accumulation is the solid accumulation in the storage facility that limits the total volume which can be added to the structure. The solids accumulation, in feet, is entered to the Calculate Waste Storage Capacity screen. The total volume used by the solids accumulation is calculated by the program and shown here. For program calculations, see Waste Storage Capacity calculations.

25 Yr 24 hr Storm Precip/Runoff

The 25 year 24 hour storm precipitation and run off are calculated and used to estimate the total waste storage volume required for 12 months. Unlike the run-off from normal annual precipitation, it is assumed that all of the runoff from a 25 year 24 hour storm goes into the waste storage system. The county selected in the Contact screen is used to lookup the 25 year, 24 hour storm precipitation in Table 17.11. *Note*:

The 25 yr 24 hour storm addition uses the “Uncovered Waste Storage Area” and “Waste Storage Drainage Area” entries from the Estimate Waste Quantity Using Animal Parameters screen. If you estimated the waste quantity using a different method, you can add these values on the Animal Parameters screen, but you will have to re-enter your (previously) entered “Annual Waste Quantity”.

25 year runoff = WasteStorageDrainage * (storm/12) * 7.48
25 year precipitation = (storm/12) * WasteStorageArea * 7.48
25 year Storm = 25 year runoff + 25 year precipitation

Where:

WasteStorageArea is the uncovered surface area size of the storage in sq ft.
WasteStorageDrainage is the entered area draining runoff into the storage in sq ft.
Storm is the precipitation from 25 yr 24 hour storm by county in inches (Table 17.11).
25 year Storm is the 25 yr 24 hr storm precipitation and runoff added to storage in gallons.

Total Volume Required (12 mon)

The total volume of manure storage required in a year =
Amount added to Source Annually
+ Solids Accumulation
+ 25 Year 24 hour storm precipitation and runoff.

This value does not include manure remaining in storage from previous plan years. It is just to estimate the 12 month storage required in a worst case year.

Maximum Storage Duration (mon)

The Maximum Storage Duration is the number of months the currently defined structure could contain the “Total Volume (of waste) Required”. This value is calculated “Total Volume Required” /12.

4.9 MANURE ANALYSES

Manure Analyses

Source Name/Test Description	Total N (%)	Ammonia N (%)	Organic N (%)	P2O5 (%)	K2O (%)	Total Solids (%)	Analysis Date
Main Barn							
Default Dairy Cattle	0.37	0.08	0.29	0.18	0.23	8.00	8-2001
Main 2000	0.35	0.17	0.18	0.15	0.26	6.00	8/19/99
Main 2001	0.41	0.20	0.21	0.18	0.33	6.50	8/15/00
Main 2002	0.37	0.18	0.19	0.16	0.30	6.50	5/15/01
Heifer Barn							
Default Dairy Cattle	0.37	0.08	0.29	0.18	0.23	8.00	7-2001
Heifer 2000	0.58	0.27	0.31	0.23	0.44	18.00	8/19/99
Heifer 2001	0.50	0.17	0.33	0.17	0.43	16.00	8/15/00
Heifer 2002	0.60	0.25	0.35	0.25	0.40	18.00	5/15/01

This report is a list of all the manure nutrient tests entered for each waste source. The data shown can be averaged to develop an aggregate seasonal or plan test.

4.10 FERTILIZER AND MANURE MANAGEMENT REPORT

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Fertilizer and Manure Management Report

Field ID	Field Name	Crop	Acres	Manure Application	Manure App. Timing	Fertilizer Application (Qty/Acre) #1	#2	#3	#4	Lime Req. (tons 100% ENV Lime/acre)	Latest Soil Sample	Comments
3982.01	1	ALT3	19.6							0.0	4/11/01	
3982.02	2	COS2	28.4	Main Barn: 10,000 gal/acre	Nov-Jan	6 gal Urea Ammonium Nitrate				0.0	4/11/01	
3982.03	3	AGT4	24.7	Heifer Barn: 15 tons/acre	Sep-Oct					1.0	3/30/00	
3982.04	4	ALT2	18.2							0.0	4/11/01	
3982.05	5	COS2	17.9	Main Barn: 6,500 gal/acre	Feb-Apr	9 gal 21-17-0				0.0	4/11/01	
3982.06	6	AGE1	16.5			80 lbs 6-24-24				0.0	4/11/01	
3982.07	7	COS4	25.6	Heifer Barn: 15 tons/acre	Feb-Apr	6 gal Urea Ammonium Nitrate	15 gal Urea Ammonium Nitrate			0.0	4/11/01	
3982.08	8	GIT19	7.0	Main Barn: 5,000 gal/acre Main Barn: 5,000 gal/acre	Main Barn: May-Aug Main Barn: May-Aug	200 lbs Urea	130 lbs Urea			2.0	11/1/99	

The Fertilizer and Manure Management Report shows a summary of fertilizer and manure information for all of the fields. In addition to fertilizer and manure application rates, lime requirement and the latest soil sample date are also shown. This report can be used when formulating fertilizer blends and in developing a tactical fertilizer management plan, i.e. planning fertilizer timing and application methods for groups of fields. The lime requirement is the User Selected Lime Requirement (tons/acre) as entered on the Allocation Screen.

4.11 FERTILIZER SHOPPING LIST

Cropware 2.0 Daily Spread Farm Tutorial

Fertilizer Shopping List

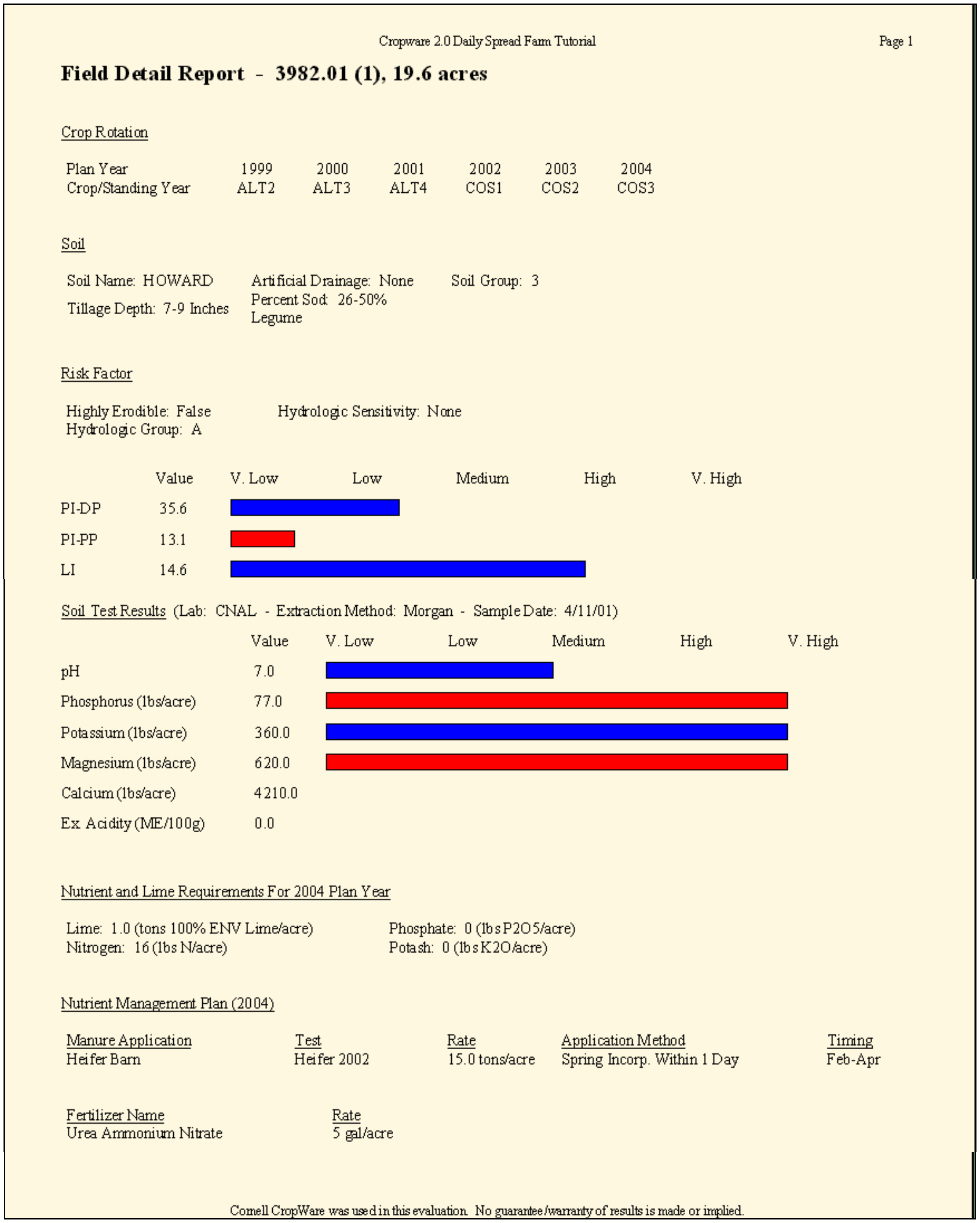
	2002		2003		2004	
	Amt	**Cost**	**Amt**	**Cost**	**Amt**	**Cost**
Urea Ammonium Nitrate	708 gal	$708	350 gal	$350	478 gal	$478
Urea	5.6 tons	$1,398	3.6 tons	$911	3.6 tons	$911
21-17-0	238 gal	$261	238 gal	$261	161 gal	$177
6-24-24	0.7 tons	$165	2.6 tons	$640	0.6 tons	$159
Total Fertilizer Cost	---	$2,532	---	$2,162	---	$1,725
Lime*	72.7 tons	---	72.7 tons	---	120.7 tons	---

* Tons of 100% ENV Lime

The Fertilizer Shopping List is a list of the total quantity and cost of each fertilizer and the total amount of lime used in each of the plan years. The total fertilizer cost for each year is reported.

This report can be used to plan fertilizer purchases or re-evaluate the fertilizer selection. For instance, if there was a very small quantity of a given fertilizer blend, you may choose to not use that blend and apply a different fertilizer to the fields using that blend.

4.12 FIELD DETAIL REPORT



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Field Detail Report - 3982.01 (1), 19.6 acres

Crop Rotation

Plan Year	1999	2000	2001	2002	2003	2004
Crop/Standing Year	ALT2	ALT3	ALT4	COS1	COS2	COS3

Soil

Soil Name: HOWARD
Tillage Depth: 7-9 Inches
Artificial Drainage: None
Percent Sod: 26-50% Legume
Soil Group: 3

Risk Factor

Highly Erodible: False
Hydrologic Group: A
Hydrologic Sensitivity: None

	Value	V. Low	Low	Medium	High	V. High
PI-DP	35.6					
PI-PP	13.1					
LI	14.6					

Soil Test Results (Lab: CNAL - Extraction Method: Morgan - Sample Date: 4/11/01)

	Value	V. Low	Low	Medium	High	V. High
pH	7.0					
Phosphorus (lbs/acre)	77.0					
Potassium (lbs/acre)	360.0					
Magnesium (lbs/acre)	620.0					
Calcium (lbs/acre)	4210.0					
Ex. Acidity (ME/100g)	0.0					

Nutrient and Lime Requirements For 2004 Plan Year

Lime: 1.0 (tons 100% ENV Lime/acre)
Nitrogen: 16 (lbs N/acre)
Phosphate: 0 (lbs P2O5/acre)
Potash: 0 (lbs K2O/acre)

Nutrient Management Plan (2004)

Manure Application	Test	Rate	Application Method	Timing
Heifer Barn	Heifer 2002	15.0 tons/acre	Spring Incorp. Within 1 Day	Feb-Apr

Fertilizer Name	Rate
Urea Ammonium Nitrate	5 gal/acre

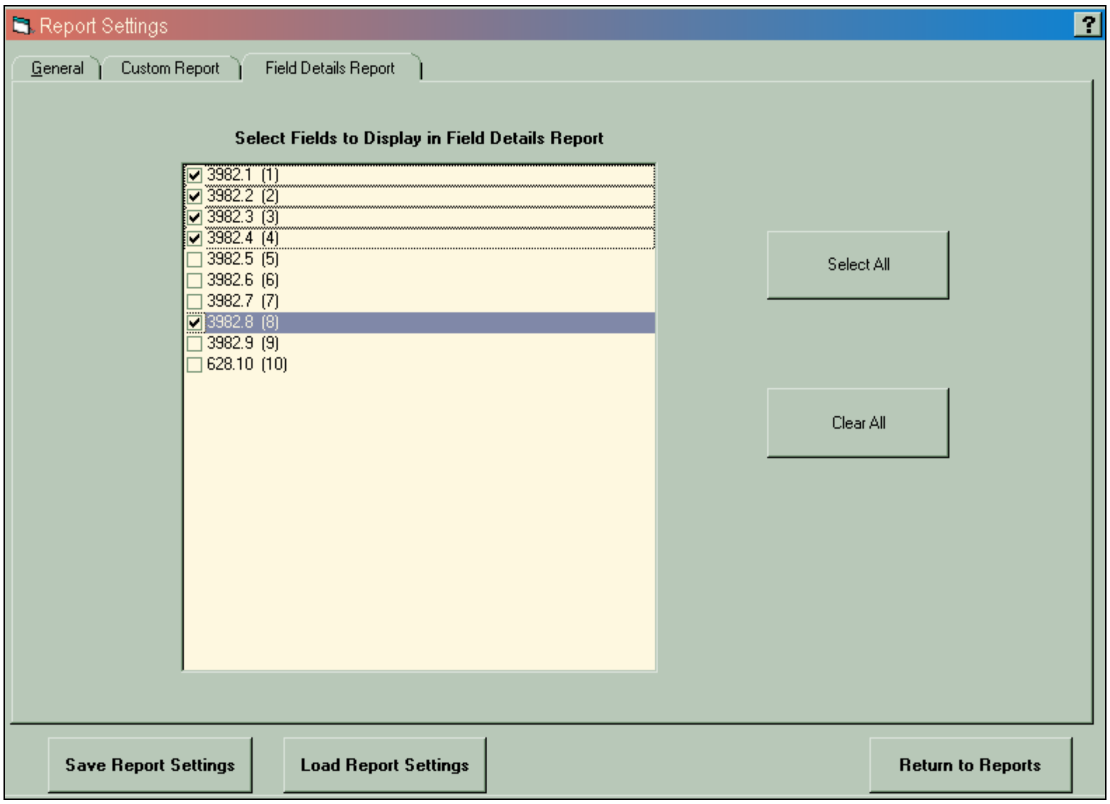
Cornell CropWare was used in this evaluation. No guarantee/warranty of results is made or implied.

This report is a detailed description of a selected field including crop rotation, soil test data, field hydrological risk factors, nutrient requirements and planned manure and fertilizer applications. This field information may be useful when the farmer and planner are making crop plan decisions.

If you see a message “No fields currently selected for this report.”, follow the steps below:

How to select and view a Field Detail Report:

1. On the Reports Screen, check the box next to Field Detail Report.
2. Click “View Report” button.
3. Click on “Settings” button.
4. Click on Field Details Report folder tab.
5. Check all of the fields that you would like to have a Field Detail Report for.
6. Click “Return to Reports” button.



5. MANURE TOPICS

5.1 MANURE TESTING

The total amount of N, P, and K produced in manure each year is usually not appreciated until calculated. When comparing nutrient requirements of the crop rotation with the quantity of nutrients produced in manure, it becomes evident manure can satisfy much of the nutrient demand of the farm. The amount of nutrients contained in manure and their eventual uptake by plants varies considerably from farm to farm. Major factors determining nutrient content and availability are:

1. Composition of the feed ration.
2. Amount of bedding and water added or lost.
3. Manure collection, handling and storage practices.
4. Method and time of land application.
5. Climate.

Table 5.1 shows the average nutrient content and range found in dairy manure. Because the nutrient content can vary considerably, average values are often misleading and should not be used to develop a nutrient management plan. The best way to determine nutrient content is to have the manure analyzed. A minimum manure analysis should include percentages of dry matter, ammonium N (NH_4-N), total N (NH_4-N + organic N), phosphorus (P or P_2O_5), and potassium (K or K_2O). In Cropware, the percent (wet basis) of Total N, Ammonia Nitrogen, Organic Nitrogen, Phosphate Equivalent (P_2O_5), Potash Equivalent (K_2O), and Total Solids (dry matter) are required data entries. You can enter multiple manure test analyses for each waste source. Because the composition of manure from a given source may change over time, you can specify which test analysis best describes the manure applied. For instance, if manure was applied to field 1 from the "milkbarn pit" in October 2003 and applied to Field 2 in April 2004, you could enter the application of milkbarn pit – Fall 2003 test for field 1 and Spring 2004 test for field 2 resulting in two nutrient application densities depending on each test's entered manure composition.

Table 5.1. Approximate average and range of nutrients in dairy manure in N.Y. (*From*: Klausner. Nutrient Management: Crop Production and Water Quality. NRAES 101. 1995).

Nutrient	Solid or semi-solid Average	Range	Liquid Average	Range
	------*lbs/ton*------		-----*lbs/1000 gal.*-----	
Total N	11	6-17	32	9-63
Ammonium-N	4	1- 7	15	2-42
Organic-N	7	4-11	17	3-35
P_2O_5	5	3-12	14	4-34
K_2O	9	2-15	30	3-56

The key to an accurate manure analysis is proper sampling. Samples should be taken just before spreading to account for nutrient losses during handling and storage. Sample frequently to obtain a reasonable estimate of the nutrient content. See "Do you know and monitor the nutrient content of manure ?".

5.2 DO YOU KNOW AND MONITOR THE NUTRIENT CONTENT OF MANURE?

From: Manure Management: Nutrient Management and Field Application by Barbara Bellows, February, 2001.

- Assess nutrient content by sending representative samples to laboratories for analysis.
- Manage nutrient content by changing feeding rations to enhance efficiency of feed use by animals.
- Use appropriate bedding practices and manure storage methods to manage nutrient content and availability of nutrients from manure.
- Keep records of manure nutrient content and land application practices to maintain an accurate nutrient management plan and efficient use of commercial fertilizers.

To measure the nutrient content of manure at the time of application, take a representative sample in a load of manure before spreading. This sample can be sent to the Dairy One Laboratory (Fee-based testing of manure for N, P, K nutrients, 800-496-3344) for analyses. Results of analyses will include:

- Total solids.
- Ammonia N.
- Organic N.
- Phosphorus (P_2O_5).
- Potassium (K_2O).

Manure samples taken from the same farm at different times of the year may vary in nutrient concentration owing to dilution, addition of bedding materials, or length of storage. To calculate a reliable average nutrient value for applications, sample and analyze manure three or more times throughout the year.

Use records of manure nutrient levels to calibrate application rates and determine impacts of feed and manure handling practices on manure nutrients.

To sample manure from liquid storages, thoroughly mix the manure in the spreader tank before sampling. Using a dipper, take one or two samples and mix them in a clean pail. Put a subsample in the freezer in a clean, freezer-safe plastic bottle. Take two or three similar samples on subsequent days or acquire several samples throughout a day of manure unloading. Mix these samples together and keep them frozen until the sample can be analyzed.

To sample manure from nonliquid storages or daily spread operations, use a trowel to take several small samples from a load of manure. Include any bedding materials within the sample. Mix the samples together, take a representative subsample, and place it in the freezer in a clean, freezer-safe plastic bottle. Take two or three similar samples on subsequent days. Mix these samples together and keep them frozen until the sample can be analyzed.

Nutrient content and availability from manure are affected by bedding practices, storage methods, and application practices.

Bedding materials

Bedding materials contain some nutrients, mainly in organic form. Straw, sawdust, paper, and other bedding materials with a high carbon content require nitrogen for decomposition to occur. This process can temporarily immobilize N and hence decrease the availability of nitrogen for plant uptake.

Application practice

Fresh manure that is directly applied and incorporated into the soil can retain much of the nitrogen excreted from the animal. Some losses may occur as the ammoniacal nitrogen associated with the manure volatilizes in the gutter. Stored manure usually has lower nitrogen concentrations than fresh manure.

5.3 DO YOU CALIBRATE FERTILIZER AND MANURE APPLICATION EQUIPMENT?

From: Manure Management: Nutrient Management and Field Application by Barbara Bellows, February, 2001.

Determine the amount of nutrients applied to land as manure based on load size of the spreader, the area over which manure is spread at an even rate, and its nutrient content. Application rates are most accurately determined if truck scales are available and the nutrient content of the manure has been analyzed at least three times over one year. If scales are available:

- Obtain the average weight per load of manure.
- Measure the average length and width of the spread pattern developed by the application equipment for each ground speed used.

If scales are not available:

- Calibrate each manure spreader and tractor combination.
- Determine the gallon capacity of the liquid manure spreader being used.

Or

- Weigh the amount of solid or semisolid manure applied across a measured piece of plastic sheeting placed on the ground.

To calculate tons per acre of solid or semisolid manure applied

To calculate tons per acre of solid or semisolid manure applied, use the weight of the manure on the plastic sheet through the following equation:

tons/acre = lbs of manure on sheet x 21.8/size of sheet in square feet

Or

acres covered in one spreader load = tons of manure in spreader/(weight of manure on the plastic x 21.8/size of sheet in square feet)

where the weight of manure in one spreader load is determined by first subtracting the weight of the empty spreader from the weight of the spreader when carrying a load of manure.

To calibrate liquid manure spreaders

To calibrate liquid manure spreaders, determine the capacity of the spreader in tons or gallons based on its volume:

1) While in the field, mark a point on a wheel of the spreader.
2) Count the number of revolutions the tire makes while the load of manure is being spread.
3) Multiply the number of revolutions counted by the distance the spreader travels in one revolution.
4) Measure the width of the spread, then multiply the length by the width.
5) Divide this number by 43,560 (square feet per acre) to get the number of acres covered by the spreader in one load. To determine the amount of manure applied per acre, use the following equation: tons or gallons per acre = spreader capacity/acres covered by spreader.

Note: Many irrigation systems, tank spreaders, and box spreaders do not allow for even application of manure across the field. The poor distribution may be caused by the mechanics of the system or the effects of wind. Tank spreaders tend to provide the most uniform spreading. V-spreaders generally distribute manure more evenly than box spreaders. Klausner (1995) provides additional guidelines for calibrating manure spreaders and contacts for laboratories that can analyze the nutrient value of manure.

5.4 MEASURING MANURE DENSITY

B*y* Peter Wright, ProDairy, Cornell University, August 14, 2001.

The density of manure containing only water and manure (including organic bedding, feces, urine, etc.) is 8.34 lbs per gallon. Sand Laden Dairy Manure (SLDM), because it contains sand that has a specific gravity of 2.6 (compared to 1 for water), can weigh up to 12 lbs./gallon. Typical density of SLDM would be around 10 lbs/gal.

How To determine the density of SLDM. (Weight/Volume in Lbs/Gallon):

1. Choose a bucket from 2 to 10 gallons in size.
2. Weigh the bucket empty. Let this be the bucket weight (bw).
3. Fill the bucket to the top or to a specific mark with water.
4. Weigh the bucket and the water. Let this be the bucket weight and the water weight (bw+ww).
5. Determine the volume: (bw+ww) – bw = ww
   ww (Lbs)/8.34Lbs/gallon = bucket Volume (bV) in gallons
6. Then fill the bucket to the top or the specific mark with a representative sample of SLDM. Weigh the SLDM and the bucket. Let this be the weight of the SLDM and the bucket. (SLDM+ bw).
7. Determine the weight of the SLDM: (SLDM+bw) – bw = SLDM Lbs.
8. Determine the density: SLDM/bV in Lbs/gallon.

5.5 SILAGE LEACHATE VOLUMES

From: Wright, P.E. "Silage Leachate Control" 1997. Silage: Field to Feedbunk. Northeast Regional Agricultural Engineering Service. NRAES-99.

Table 5.2 shows the amount of leachate from various tower silos at different moisture contents. Both the initial moisture content and the pressure generated in the silo influence the amount of effluent. Moisture contents, from 62 to 68 percent, that produce the optimum silage quality in tower silos will produce little leachate.

Table 5.2 Annual Effluent Production From Various Tower Silos In Gallons.

% M	20' x40'	20' x 60'	25' x 40'	25' x 60'	30' x 40'	30' x60'
80 %	1,315	3,465	2,380	6,585	3,770	9,840
75 %	610	2,210	1,250	4,535	2,100	6,975
70 %	72	979	290	2,440	650	4,060
65 %	0	85	0	655	0	1,520
60 %	0	0	0	0	0	44

Table 5.3 and 5.4 show estimated amounts of leachate from bunk silos. Again the moisture contents, from 68 to 70 percent, that produce the best quality silage in a bunk don't produce much leachate.

Table 5.3 Annual Effluent Production From Bunk Silos (Bastiman, 1985)

% Moisture	Gallons Per Ton Of Haylage
80 %	20
75 %	5
70 %	0

The amount of effluent from silage can vary significantly. It is dependent primarily on the moisture content of the silage and the pressure on the silage. The size of the silage particles and the speed of the ensilaging process affect the rate of effluent production but may not have much effect on the total amount (Savoie). The effectiveness of additives that speed up the ensilaging process can also influence the rate of effluent production. Estimates from SCS (Silage draft) are given below.

Table 5.4. Annual Effluent Production From Silos (SCS (Silage draft)).

% Moisture	Gallons Per Ton Of Silage
>85 %	100 to 50
85 to 80%	50 to 30
80 to 75 %	30 to 5
<75 %	<5

A recommendation of one cubic foot of storage for each ton of silage is given by SCS (NRCS) when including silage juice in manure storage systems (SCS Ag Waste Handbook). The use of other effluent producing commodities may cause additional problems for producers. By-products from food processing plants are often used on a dairy farm as cheap feed. Wet by-products include sweet corn waste, apple pumice, and brewer's grain. These wet materials can produce additional effluent that leaves the bunk area.

Adding silage juice to a manure storage will increase the micro biological activity in the manure storage since it will increase the energy available to the microbes. This reaction may cause an increase in gas production that may cause objectionable odors or even dangerous gases in an enclosed storage area. Most open air earthen waste storage ponds will not be affected significantly with the addition of the concentrated silage leachate. A good trash pump can be used to pump silage juice to a long-term storage. Adding all the runoff from a bunk silo to manure storage can take up a significant amount of the storage.

Catching, storing and field applying the effluent, the runoff and the drainage water may be an overwhelming task on a farm. If a farm had a bunk silo with silage piled an average of 15 feet high that covered one acre, they would store about 21,500 tons of silage (Pitt, 1990). Using SCS's recommendation of providing storage for 1 cubic foot of leachate for each ton of silage 21,500 cubic feet of storage would be needed. In addition to the silage juice the farm would catch the runoff from the one acre of bunk area, any drainage water intercepted by the drains, and need to be prepared to store the 25 year 24 hour storm (EPA 1993). Only 45 percent of the precipitation falling on the bunk would result in runoff since some of the precipitation would be evaporated from the surface (SCS Ag Waste Handbook). For an annual rainfall of 36 inches approximately 16.2 inches would runoff in New York State's climate. Over the one acre area this becomes 58,800 cubic feet. A 4 inch 25 year 24 hour storm would require a storage volume of 14,520 cubic feet. There could be additional water collected from the drainage system around and under the bunk. If the average flow from the drainage system was one gallon per minute, and flow occurred for a nine month portion of the year, the volume needed to store the drainage water would be 51,300 cubic feet. These volumes are summarized in table 5.5.

Table 5.5 Potential storage volumes for an acre bunk silo.

Source	Cubic feet of storage
Juice from 21,500 tons of silage	21,500
Runoff from 36 inch precipitation	58,800
4 inch 25 year 24 hour storm	14,500
Drainage averaging 1 gallon per minute for 9 months	51,300
Total	146,100

The farmer could empty the storage periodically to reduce the amount of storage needed but room for the 25 year 24 hour storm event would always be required. Using a 3800 gallon tank spreader would take 260 tank loads to empty the storage if the 25 year 24 hour storm did not occur. This is a lot of storage. Most of the storage volume required is for relatively clean water.

Separating the concentrated leachate from the other volumes of water would provide pollution control at a reasonable cost. This high flow low concentrate runoff from silos can be treated in a Vegatative Filter area NRCS practice standard. This would result in only 2 times the volume in tables 5.3 and 5.4 being added to the manure storage system.

Prevention

Prevention of leachate production is one way to control this problem. Harvesting and storing silage at the correct moisture content is the best way to prevent production and subsequent pollution from silage leachate. Unfortunately weather conditions may require harvest before the crop can be matured or dried to these levels. The quality of forage is improved if these levels are achieved. If the farm consistently harvests silage that is too wet, switch to earlier maturing varieties.

5.6 ESTIMATING MANURE ON PASTURE

Based on: Application of the Cornell Net Carbohydrate and Protein System on a Pasture-Based Dairy Farm, by Paul Cerosaletti, MS Thesis. Cornell University, Ithaca N.Y. 1998.

Accounting for nutrients distributed by pastured animals is a challenge when developing a comprehensive nutrient management plan. The total quantity of manure, manure nutrient composition and manure distribution on pasture are variables which are difficult to estimate.

Total Manure Quantity

Cropware requires that total manure quantity produced by grazing animals be entered as a manure source. Traditionally, pasture manure production was assumed to be the total daily production that would be deposited in proportion with the number of hours spent on pasture. However, recent work has indicated that this assumption may be overly simplistic. Cows on a high producing dairy farm, using intensive rotational grazing, in Delaware County, New York, spent 17 to 38 percent of the time in the barn but deposited an average of 45 percent of the total manure in the barn.

Grazing Animal Manure Composition

Estimating the grazing animal's manure composition is difficult. The Cropware program requires that manure composition for Total N, Ammonia N, Organic N, P_2O_5 Equivalent, K_2O Equivalent and Total Solids be entered for each manure source, including grazing animals. However, sampling manure on pasture is problematic as feces and urine are deposited independently and are not mixed.

Manure Distribution

The distribution of manure on pasture can be a concern for nutrient management planners both spatially and temporally. The spatial distribution of manure by animals is not uniform; substantially more manure is applied by grazing animals near water sources, shade, gates and lanes than in the rest of the pasture. Lanes and congregation areas are especially vulnerable to erosion and runoff as there is often have little or no vegetative cover in these areas. Even when pasture vegetation is adequate, nutrients may be deposited in rates exceeding plant requirements. On a case study farm in Delaware County, the soil P and K levels were significantly higher (42% and 62%, respectively) in high traffic areas than in the rest of the pasture. In a temporal sense, grazing animal manure may be applied at times of minimum plant utilization. For an example of accounting for manure nutrients from grazing animals, see Help section 16, Tutorial: Grazing Farm.

6. Nutrient Guidelines: Nitrogen

from

Nitrogen Guidelines for Field Crops in New York

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For copies of this document

The full document is downloadable from the Nutrient Management Spear Program at: http://nmsp.css.cornell.edu/. For bound hardcopies contact Pam Kline by e-mail (pak1@cornell.edu), phone (607-255-2177) or regular mail (234 Emerson Hall, Department of Crop and Soil Sciences, Cornell University, Ithaca, NY 14853).

6.2 INTRODUCTION

Nitrogen (N) is an essential and often growth-limiting plant nutrient. Crops take up N that is released to the soil solution as a result of atmospheric deposition, soil organic matter mineralization, crop residue decomposition and animal manure and inorganic fertilizer addition. Furthermore, N may become available through biological fixation.

Only inorganic N, principally nitrate (NO_3^-) and ammonium (NH_4^+) is available for plant growth. Nitrite (NO_2^-) can be taken up but this N form is toxic to plants and is generally present in trace quantities only.

A deficiency in nitrogen leads to yield declines or even a complete crop failure. An excess of nitrogen may lead to excessive vegetative growth, lodging, delayed maturity, increased disease susceptibility, low crop quality, and nitrate accumulation. Excesses may contribute to acid rain, destruction of the ozone layer in the stratosphere, the greenhouse effect, eutrophication of surface waters, contamination of ground water, and fish and other marine life kills, as well as blue baby syndrome in infants and amphibian mortality and deformations. The nitrate concentration in ground and surface waters is an important water-quality index. The U.S. Environmental Protection Agency (EPA) has set the Federal Standard for the maximum permitted amount of nitrate N in drinking water at 10 mg N per L or 43 mg NO_3^- per L.

It is important from both an economic and an environmental standpoint to manage N optimally. Thus, the two primary objectives of N management are: (1) to have adequate inorganic N available during the growing season; and (2) to minimize the availability of inorganic N during the fall, winter, or early spring, when N may be transported to surface and groundwater.

6.3 NITROGEN REACTIONS IN SOIL

Fixation

The atmosphere is about 78% N_2 by volume. This gaseous N is chemically stable and unavailable to most biological organisms. However, some species of bacteria can convert N_2 to N containing organic compounds. This process is called biological fixation and it is the primary mechanism by which atmospheric N_2 is added to the soil. Legumes such as alfalfa and clover have root nodules that contain N-fixing bacteria that convert atmospheric N_2 to protein. The legume, upon its death, will increase the amount of organic N in the soil as decomposition proceeds.

$$\underset{\textit{(nitrogen gas)}}{N_2} \rightarrow \underset{\textit{(ammonia)}}{NH_3} \rightarrow \underset{\textit{(organic nitrogen)}}{R\text{-}NH_2}$$

Mineralization

Organic N exists in plants, soil organic matter, soil microorganisms, animal manure, etc. When organic N decomposes, it is converted into ammonium. This process, facilitated by microorganisms, is called mineralization. Because ammonium is positively charged, it is generally adsorbed by the negatively charged soil particles that dominate soils. Thus, the ammonium leaching potential is minimal.

R-NH_2	→	NH_3	→	NH_4^+
(organic nitrogen)		*(ammonia)*		*(ammonium)*

Nitrification

Certain microorganisms in the soil convert ammonium to nitrite and then to nitrate by a process called nitrification. Nitrification occurs rapidly when the soil is moist, warm, and well aerated. These conditions coordinate well with early summer when crop N needs are on the rise. Nitrification will significantly increase soil acidity (decrease pH) by producing H^+ ions. Liming materials may be needed to counteract the added acidity. Nitrification is affected by soil temperature: nitrification rates are virtually zero below 41°F and above 122°F. Optimum temperature range for nitrification is 67-86°F. The nitrifying bacteria require oxygen. Thus, soil drainage and aeration stimulate nitrification. Although ammonium is not very prone to leaching losses, fertilizer-ammonium applications may still lead to large leaching losses because of rapid nitrification.

NH_4^+	→	NO_2^-	→	NO_3^-
(ammonium)		*(nitrite)*		*(nitrate)*

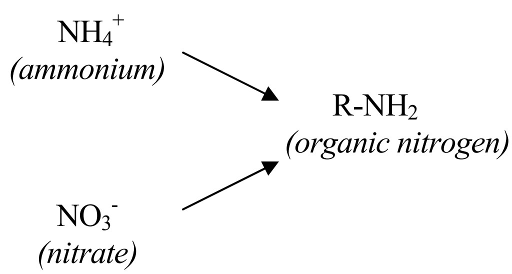
Denitrification

When there is a depletion of oxygen in the soil, anaerobic bacteria can convert nitrate into gaseous forms of N including nitric oxide gas, nitrous oxide gas, and dinitrogen gas. This process, called denitrification, results in a loss of plant available N from the soil and its return to the atmosphere. Denitrification is accelerated in poorly aerated (<10% oxygen), and/or waterlogged soils. The optimum temperature for denitrification is between 77 and 95°F. Denitrification ceases to take place at temperatures <33°F and >122°F. Dinitrogen gas is environmentally harmless. However, NO and N_2O can contribute to the formation of nitric acid (an important component of acid rain) and are also contributors to the greenhouse effect. N_2O, in addition, contributes to the destruction of ozone.

NO_3^-	→	NO_2^-	→	NO	→	N_2O	→	N_2
(nitrate)		*(nitrite)*		*(nitric oxide)*		*(nitrous oxide)*		*(dinitrogen gas)*

Immobilization

Soil microbes compete with plants for available ammonium and nitrate. Immobilization refers to the process by which inorganic N is bound in the microbial biomass, thus making it unavailable to plants until the microbes die and decompose, in which case the N re-enters the mineralization process. Immobilization and mineralization occur simultaneously in the soil. Whether the net effect is an increase or a decrease in inorganic N depends on which process dominates. A high (>25) carbon to nitrogen ratio of the organic material that is being decomposed may result in a (temporary) net immobilization of N. This may be observed when large amounts of straw or sawdust bedding are included with manure applications. It may also occur when low N containing stubble is tilled into the soil.



Ammonia volatilization

Nitrogen can be lost to the atmosphere by volatilization, a process whereby a substance is converted from a solid or liquid to a gas. Typically, N is lost by volatilization of ammonia when urea-containing fertilizers or manure are applied on the soil surface and not incorporated. Little or no ammonia loss occurs from surface applications of acidic fertilizers such as ammonium nitrate or ammonium sulfate, unless the soil pH is very high. Ammonia volatilization increases with increasing soil pH and decreasing moisture content. High temperatures also stimulate volatilization. As much as 50% of the total amount of manure N may be lost if the manure is not incorporated after application.

$$\underset{\text{(urea)}}{H_2N\text{-}\overset{\overset{\displaystyle O}{\|}}{C}\text{-}NH_2} \rightarrow \underset{\text{(ammonium)}}{NH_4^+} \rightarrow \underset{\text{(ammonia)}}{NH_3}$$

6.4 SOURCES OF NITROGEN

There are four main sources of N: (1) native soil organic matter; (2) organic amendments (animal and green manure, compost, plowed under sods); (3) biologically fixed N; and (4) inorganic fertilizer N. To calculate the inorganic N requirement for optimum economic yield, adjustments need to be made for biologically fixed N and/or N released from one or more of the organic sources. Procedures used to estimate N release from plowed under sods and from manure applications are discussed below.

Soil organic matter

Soil organic matter consists of plant and animal residues, living soil organisms, and substances synthesized by these organisms. Organic matter is decomposed by soil microorganisms and results in the release of many essential plant nutrients. Soils in New York can typically supply 40 to 80 pounds of N per acre annually depending on soil type, organic matter content, and previous management. In spite of its variable nature, soil organic matter is an important source of available N and must be accounted for when determining fertilizer requirements.

The soil's nitrogen supplying capacity (SoilN in lbs N/acre) is a function of soil type and artificial drainage class:

$$SoilN = N\_sup\_ud + ((N\_sup\_dr - N\_sup\_ud) * (ArtificialDrainage/3)) \quad [1]$$

Where:

N_sup_ud is the amount of N supplied by an undrained soil (lbs N/acre).

N_sup_dr is the amount of N supplied by the same soil with excellent rated artificial drainage (lbs N/acre).

ArtificialDrainage is a factor to adjust soil N supply for field artificial drainage conditions:

If artificial drainage = "none" then ArtificialDrainage = 0
If artificial drainage = "inadequate" then ArtificialDrainage = 1
If artificial drainage = "adequate" then ArtificialDrainage = 2
If artificial drainage = "excellent" then ArtificialDrainage = 3

Table 6.A in the Appendix lists estimates of soil N supply for each New York soil type.

Legumes and grass sods

Legumes can, through biological N fixation, acquire enough N to meet their requirements, assuming that proper inoculation and nodulation occur. Grasses, including corn, cannot fix atmospheric N and therefore require N addition either supplied by companion legumes, animal or green manures, soil organic matter mineralization, or fertilizer application. Sod crops that are credited for N in the nitrogen recommendations are listed in Table 6.1. Nitrogen is bound in the roots and above ground biomass of grasses and legumes. When the legume, grass, or legume/grass sod is killed, the organic N will become available to subsequent crop(s) through mineralization. The amount of N available from these crop residues is a function of the sod density and quality, the percent legume, and time since the sod crop was plowed or killed. If a good quality sod is 100% grass, the amount of organic N is estimated to approach 150 lbs/acre. Legumes contribute a greater amount of N because of their greater N content; for good stands with 1-25% legume, the total amount of organic N may reach 200 lbs N/acre. A stand with 26-50% legume will yield approximately 250 lbs N/acre while a >50% legume containing sod is estimated to contain about 300 lbs N/acre (Table 6.2).

Table 6.1: Cornell crop codes and descriptions of "sod" crops.

Crop Codes*	Crop Description	Crop Codes*	Crop Description
ABE & ABT	Alfalfa Trefoil Grass	CLE & CLT	Clover
AGE & AGT	Alfalfa Grass	CSE & CST	Clover Seed Production
ALE & ALT	Alfalfa	CVE & CVT	Crownvetch
BCE & BCT	Birdsfoot Trefoil Clover	GIE & GIT	Grasses Intensively Managed
BGE & BGT	Birdsfoot Trefoil Grass	GRE & GRT	Grasses
BSE & BST	Birdsfoot Trefoil Seed	PGE & PGT	Pasture with Improved Grasses
BTE & BTT	Birdsfoot Trefoil	PIT	Pasture Intensively Grazed
CGE & CGT	Clover Grass	PLE & PLT	Pasture with Legumes

* A crop with a crop code ending with an "E" is in its establishment year while a crop code ending with a "T" implies an established sod.

Table 6.2: Expected N credits from plowed down sods.

		Available N		
Legume in sod %	Total N pool lbs N/acre	Year 1* lbs N/acre	Year 2 lbs N/acre	Year 3 lbs N/acre
0	150	83	18	8
1-25	200	110	24	10
26-50	250	138	30	13
50 or more	300	165	36	15

* First year following plow down.

The N contribution from sod is discounted depending on the number of years since the sod crop was plowed down. Of the total amount of organic N contained in the sod, 55%

is expected to be available to the first crop after plowdown, 12% to the next crop and 5% to the third crop or year. This N contribution reduces the N requirement of subsequent crops accordingly. Thus, 55% or 83 lbs N/acre of an estimated 150 lbs N/acre in a good grass sod is expected to be available to the next crop. No N credits are expected for crops planted more than three years after sod plowdown.

Manure

There are primarily two forms of N in manure: inorganic (ammonium) N and organic N (Figure 6.1). The ammonium N is initially present in urine as urea and may account for about 50% of the total N. Urea in manure is no different from urea in commercial fertilizer. It hydrolyzes rapidly to ammonium. In principle, all of the ammonium from urea in manure is available for plant growth. However, parts or all of it may be lost because ammonium is rapidly converted to ammonia as the pH increases and the manure begins to dry. Atmospheric exposure of manure on the barn floor, in the feedlot, in storage, or after spreading increases N loss. Thus, an analysis of the manure is useful to determine how much inorganic N may be conserved before spreading. Table 6.3 shows the fraction of the ammonium N remaining for plant use from various livestock manures given alternative application methods and timing of application.

Table 6.3: Estimated ammonia-N losses as affected by manure application method.

Manure Application Method	Ammonium N Utilized by the Crop (%)
Injected during growing season	100
Incorporated within 1 day	65
Incorporated within 2 days	53
Incorporated within 3 days	41
Incorporated within 4 days	29
Incorporated within 5 days	17
No conservation/Injected in fall	0

The more stable organic N is present in the feces and is only slowly released. The decomposition of stable organic N to a plant-available inorganic form occurs at different rates. The less resistant organic N decomposes during the year of application, and the more resistant organic N decomposes very slowly in future years. Repeated application to the same field results in an accumulation of a slow release manure N source.

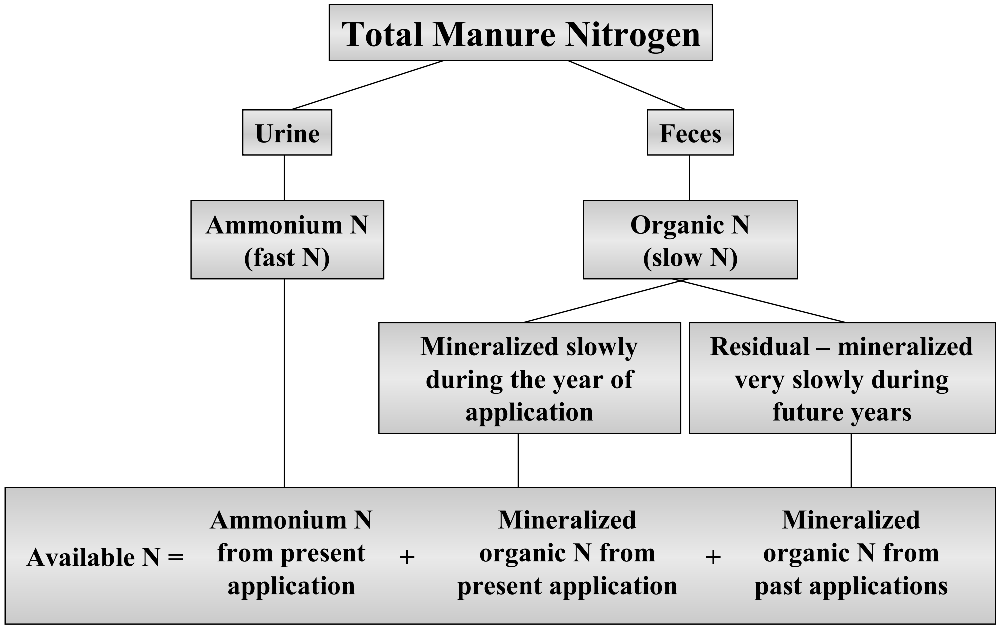


Figure 6.1: Manure N consists of ammonium and organic N (modified from Klausner, 1997).

Table 6.4: Decay series for stable organic N in manure by animal type. A "last year release rate" of 12% indicates that an estimated 12% of the organic N applied in the manure is expected to be utilized by the crop a year after application.

		Release rate for organic N in manure (%)		
Source	Dry Matter Content (%)	Present Year "Decay_current"	Last Year "Decay_lastyr"	Two Years Ago "Decay_2yrs"
Cows	<18	35	12	5
Cows	≥18	25	12	5
Poultry	<18	55	12	5
Poultry	≥18	55	12	5
Swine	<18	35	12	5
Swine	≥18	25	12	5
Horses	<18	30	12	5
Horses	≥18	25	12	5
Sheep	<18	35	12	5
Sheep	≥18	25	12	5

A decay or mineralization series is commonly used to estimate the rate of N availability from stable organic N. A decay series of 35, 12, and 5% is used to estimate the rate of decomposition of organic N in liquid (<18% dry matter) dairy manures in New York. This sequence of numbers means that 35% of the organic N is mineralized and potentially taken up by the growing crop during the year the manure was applied, 12% of the initial organic N application is mineralized and taken up during the second year, and 5% is mineralized and taken up in the third year. There is evidence that manure containing large amounts of bedding may mineralize at a slower rate than fresh manure. Therefore, the estimated availability of N during the year applied is reduced from 35 to 25% when the dry matter content of bedded manure exceeds 18%. These decay series and those for other animal manures are listed in Table 6.4.

Fertilizer recommendations from Cornell University are adjusted for the release of N from previous years' applications. The following calculations are used to determine the residual manure N contribution (ResidualN_manure):

ResidualN_manure = ResidN1 + ResidN2
ResidN1 = Decay_lastyr/100 * (Organic N/100) * ManureRate_lastyr
ResidN2 = Decay_2yrs/100 * (Organic N/100) * ManureRate_2yrs [2]

Where:

ResidualN_manure is the total residual N from manure (lbs N/acre).
ResidN1 is the residual N from manure applied last year (lbs N/acre).
ResidN2 is the residual N from manure applied two years ago (lbs N/acre).
Decay_lastyr is the organic N decay last year (%, see Table 6.4).
Decay_2yrs is the organic N decay 2 years ago (%, see Table 6.4).
ManureRate_lastyr is the amount of manure applied last year (lbs/acre).
ManureRate_2yrs is the amount of manure applied 2 years ago (lbs/acre).
Organic N is the organic N content of the applied manure on an as sampled basis.

6.5 Calculating Nitrogen Recommendations For Specific Field Crops

There is currently no reliable soil test for N other than the Pre-Sidedress Nitrogen Test (see section 6.7). Research efforts in the past have focused on the major agronomic crops in New York State (including corn) leading to more site-specific recommendations for these crops than for minor ones (such as buckwheat). Recommendations can be met by inorganic N application or a combination of inorganic and manure application. Independent of how much of the requirement is satisfied with manure or other organic sources that need to be mineralized, for some crops, a minimum inorganic N requirement is recommended for optimal economic yields (Table 6.5). In the following section, the approach and specific equations for several agronomic crops are outlined.

Table 6.5: Recommended minimum inorganic N application.

Crop	Recommended minimum inorganic N application (lbs/acre)
Triticale peas (TRP)	40
Grasses:	
Topdressing (GRT)	50
Topdressing intensively managed (GIT)	100
Pastures:	
Native and improved grasses (PNT, PGT)	50
Intensively managed grass (PIT)	90

Grain corn and corn silage

The N requirements for corn silage (COS) and grain corn (COG) are identical. Requirements depend on the corn yield potential, nitrogen content of the soil, and nitrogen content of sod crops on the field in the past three years adjusted for the soil's specific nitrogen uptake efficiency (ability of that soil to actually deliver N to the crop). For grain corn the equation is:

$$NetRequiredN = (YP\_corngrain*1.2 - SoilN - SodN)/(N\_eff/100) \quad [3]$$

Where:

NetRequiredN is the total amount of N (lbs N/acre) from any source required for optimum crop production.

YP_corngr is the yield potential of corn grain in bushels (85% dry matter) per acre (see Appendix Table 6.A).

SoilN and SodN are the amounts of N (lbs N/acre) released from mineralization of soil organic matter and a plowed-down sod, respectively (see the section 6.4 on soil organic matter and sods).

N_eff is the soil type and drainage dependent uptake efficiency (listed for each soil type in Appendix Table 6.A).

The yield potential for corn is soil type and artificial drainage specific:

$$YP\_corngr = Corngr\_ud + (Corngr\_dr - Corngr\_ud) * (ArtificialDrainage/3) \quad [4]$$

Where:

Corngr_ud is the expected yield of grain corn (an average over a ten year period in bushels of 85% dry matter grain per acre) grown on this undrained soil under excellent management (see Appendix Table 6.A).

Corngr_dr is the expected yield of grain corn (bushel/acre) grown on the same soil that has excellent artificial drainage (see Appendix Table 6.A).

ArtificialDrainage is an adjustment factor for artificial drainage identical to those reported in section 6.4 on soil organic matter.

Estimated yields are converted to total N per acre assuming that 100 bushels of grain (85% dry matter) equals 10,000 lbs of dry matter (5,000 lbs in grain and 5,000 lbs in stover) and that the average N content at optimum yield is 1.2%. For corn silage, the net N requirement is calculated assuming that 17 tons of silage (35% dry matter) equals 100 bushels of grain (85% dry matter). Silage yield potential in tons per acre (35% dry matter) is converted to yield potential in bushels of grain per acre by multiplying by 5.9 prior to estimation of N requirements:

1 ton silage (35% dry matter) = 5.9 bushels of corn (85% dry matter) [5]

Plants are not able to take up 100% of the inorganic N supplied to the soil, although 100% efficiency for fertilizer additions and inorganic N from manure can be approached when small quantities are directly delivered to the growing crop (e.g., as sidedress). The percentage of applied fertilizer that does become part of the plant is called the uptake efficiency. The estimates for New York State soils range from 50 to 75 percent (Appendix Table 6.A). In general, N uptake efficiencies (N_eff in percentage, see Appendix Table 6.A) are soil type and artificial drainage class specific:

$$N\_eff = N\_eff\_ud + (N\_eff\_dr - N\_eff\_ud) * (ArtificialDrainage/3) \quad [6]$$

Where:

N_eff_ud is the estimated percentage of inorganic fertilizer N that is taken up by the corn crop when the soil is left in its original, undrained state.

N_eff_dr is the expected percentage of applied N that is taken up by the plant when the soil is artificially drained.

The amount of N required to obtain the desired yield potential (NetRequiredN in lbs N/acre) can be supplied in the form of inorganic N or a combination of inorganic and manure N. The N requirement is increased by 20 lbs/acre for a no-till crop production system due to slower soil warming in the spring. The N requirement of corn grain and corn silage on soil management group 6 soils (mucks) is 95 lbs/acre.

Grain sorghum, sorghum forage, sudangrass, sorghum sudan hybrid, and millet

The N requirements for grain sorghum (SOG), sorghum forage (SOF), sudangrass (SUD), sorghum sudan hybrid (SSH), and millet (MIL) are equal to or a fraction of the N requirement for a grain corn crop:

NetRequiredN = (YP_corngr*1.2 – SodN – SoilN)/(N_eff/100)
If NetRequiredN > 50 lbs N/acre then NetRequiredN = NetRequiredN * 0.8

[7]

The latter equation indicates that if the net N requirement calculated using the corn yield potential is >50 lbs/acre, it is adjusted to 80% of the corn requirement. The N requirement is increased by 20 lbs/acre for a no-till crop production system.

Stands of alfalfa, alfalfa grass, birdsfoot trefoil, birdsfoot trefoil-clover, and clover-grass

To establish a legume or legume-grass sod, no N is required. Thus, the N recommendation for establishment of alfalfa (ALE), alfalfa grass (AGE), birdsfoot trefoil (BTE), birdsfoot trefoil-clover (BCE), and clover-grass (CGE) is zero. Nitrogen requirements for topdressing of legume stands (ALT, BTT, BST, CLT, CST, and CVT) are also zero. Nitrogen requirements for topdressing of legume-grass stands (AGT, ABT, BCT, BGT, and CGT) depend on the percentage of legume in the sod:

If the stand is 100% grass:	NetRequiredN = 75 lbs/acre	
If the stand is 1 to 25 % legume:	NetRequiredN = 40 lbs/acre	
If the stand is more than 25% legume:	NetRequiredN = 0 lbs/acre	[8]

In the current recommendations, these requirements are not adjusted for N releases from previous sods or soil organic matter.

Establishment and topdressing of grass

To establish a grass stand (GIE and GRE), 50 lbs N/acre is recommended. For topdressing, the recommendation depends on the intensity of management of the grass. Recommended N rate for topdressing of intensively managed grass is 225 lbs N/acre. For grass that is not managed intensively (1-2 cut system) this recommendation is reduced to 75 lbs N/acre.

Establishment of a grass sod (GIE< GRE):	50 lbs N/acre	
Topdressing of an intensively managed grass (GIT):	225 lbs N/acre	
Topdressing of grass in a 1-2 cut system (GRT):	75 lbs N/acre	[9]

Wheat, wheat seeded with legume, winter barley, and winter barley with legume

The nitrogen recommendations for wheat (WHT), wheat seeded with legume (WHS), winter barley (BWI), and winter barley seeded with legume (BWS) depend on the number of years since sod was grown on this field and the soil management group. If it is less than 1 year ago that a sod was plowed under, the recommended N rate is 20 lbs/acre independent of soil management group because N residual from sod is built into these recommendations. If it was two years or more ago that a sod was plowed down, the recommendations increase (see Table 6.6). Unlike corn, the recommendations for these crops do not consider the % legume or soil N contributions. Soil_group is the soil management group determined by clay content, the soil rooting depth and the soil structure (Appendix Table 6.B). Clayey soils tend to fall in group 1, while sandy soils tend to be in group 5. Most of the silt loam soils of the central plains are group 2's and the silt loam soils of the southern tier are group 3's. Soils in management group 6 are muck soils.

Table 6.6: N recommendations for wheat, wheat seeded with legume, winter barley, and winter barley with legume following sods.

Soil_group	Sod plowed under <1 year ago	Sod plowed under 1-2 year ago	Sod plowed under >2 years ago
1-4	20	50	60
5	20	60	70
6	20	70	80

Oats, oats with legume, barley-spring, barley-spring with legume and rye seed production

Similar to wheat and wheat/barley crops described above, the nitrogen recommendations for oats (OAT), oats with legume(OAS), barley-spring (BSP), barley-spring with legume (BSS) and Rye Seed Production (RYS) depend on the number of years since sod was grown on this field and the soil management group (see Table 6.7). Unlike corn, the recommendations for these crops do not consider the % legume or soil N contributions.

Table 6.7: N recommendations for oats, oats with legume, barley-spring, barley-spring with legume and rye seed production following sods.

Soil_group	Sod plowed under <1 year ago	Sod plowed under 1-2 year ago	Sod plowed under >2 years ago
1-4	20	40	60
5	20	50	70
6	20	60	80

Sunflowers

The N requirement for sunflowers is estimated as 66% of the corn N requirement, given an average corn yield potential of 120 bushels (85% dry matter) per acre. The N requirement increases by 20 pounds per acre for a no-till crop production system. The minimum nitrogen requirement for sunflowers is 20 lbs N/acre.

NetRequiredN = {(YP_corngr*1.2–SodN–SoilN)/(N_eff/100)}*0.66 [10]

Christmas trees

The nitrogen requirement for Christmas tress (TRE and TRT) increases with each year of growth from establishment to 5 years (Table 6.8).

Table 6.8: N recommendations for Christmas trees (TRE and TRT).

Crop code	Years since planting	N recommendation
TRE	establishment year	0
TRT	1	30
TRT	2	40
TRT	3	50
TRT	4+	60

Other field crops

Nitrogen requirements for all other field crops are constant values (Table 6.9).

Table 6.9: Nitrogen requirements for selected field crops.

Crop Name	Crop Code	N Requirement (lbs/acre)
Buckwheat	BUK	20
Idle land	IDL	0
Pasture with improved grasses, establishment phase	PGE	50
Pasture with improved grasses, established (top-dress)	PGT	75
Pasture-rotational grazing, establishment phase	PIE	50
Pasture-rotational grazing, established (top-dress)	PIT	150
Pasture with legumes, establishment phase	PLE	40
Pasture with legumes, established (top-dress)	PLT	40
Pasture with native grasses, established (top-dress)	PNT	75
Rye-cover crop	RYC	20
Soybeans	SOY	0
Triticale/peas	TRP	80
Waterways, pond dikes, establishment phase	WPE	50
Waterways, pond dikes, established (top-dress)	WPT	70

6.6 NITROGEN FERTILIZERS

Inorganic N requirements can be met using a variety of N containing fertilizers. 6.10 lists common fertilizer materials and their N, P_2O_5, K_2O, S, Ca, and Mg concentrations as well as their salt hazards, acid-forming tendency, and additional notes.

Table 6.10: N, P_2O_5, K_2O, S, Ca, and Mg contents as well as the salt hazard and acid forming tendency of commonly used N containing fertilizers (adapted from Brady and Weil, 1996; Jokela et al., 1999; Beegle, 1996; Cornell Field Crops and Soils Handbook, 1987).

Fertilizer	N	P_2O_5	K_2O	S	Ca	Mg	Salt hazard	CCE*	Additional notes
Ammonium nitrate (NH_4NO_3)	33-34	0	0	0	0	0	high	-59	Dry material. Can be left on surface or incorporated into soil. Absorbs moisture from the air. It can be blended but not with urea. High risk of fire or explosions if mixed with oxidizable forms of C (e.g., fuel oil).
Ammonium sulfate ($[NH_4]_2S0_4$)	20-21	0	0	24	0	0	high	-110	Dry material. Used for direct application and blended fertilizers. Can be left on surface or in-corporated into soil. Rapidly lowers the soil pH.
Urea - ammonium nitrate (UAN)	28-32	0	0	0	0	0	medium	-52	Liquid fertilizer. Urea N comprises about 50% of the N. Once applied, UAN behaves as dry urea and NH_4NO_3. To minimize N loss, incorporate into soil. May cause leaf burn. UAN weighs 11-12 lbs per gallon.
Potassium nitrate (KNO_3)	13	0	36	0.2	0.4	0.3	very high	+26	Dry crystalline material. A specialty fertilizer used for direct application or as blended fertilizer.
Anhydrous ammonia (NH_3)	82	0	0	0	0	0	low	-148	A high-pressure liquid. It turns into a gas when released. The gas is toxic. Needs pressurized equipment. Must be injected 6-8 inches deep on friable, moist soil to avoid N losses. Weighs about 5 lbs per gallon. Rapidly lowers the soil pH.

Fertilizer	N	P_2O_5	K_2O	S	Ca	Mg	Salt hazard	CCE*	Additional notes
Urea (NH_2-CO-NH_2)	45-46	0	0	0	0	0	medium	-84	Dry material that should be incorporated. Urea-N rapidly hydrolyzes to NH_4^+. Used for direct application, in mixed fertilizers, and in liquid nitrogen. Not recommended as a starter.
Sulfur coated urea	30-40	0	0	13-16	0	0	low	-110	Dry material. Variable slow rate of release. Rapidly lowers soil pH.
Mono-ammonium phosphate (MAP) ($NH_4H_2PO_4$)	11-13	48-52	0	1-2			low	-65	A dry material. Used for direct application and in blended fertilizers. Makes an excellent starter fertilizer, either alone or with a small amount of potash although the N:P ratio may be to low for high P soils.
Di-ammonium phosphate (DAP) ($[NH_4]_2HP0_4$)	18-21	46-53	0	0-1			medium	-70	A dry material. Used for direct application and in blended fertilizers. Produces free ammonia and is hence not a good starter fertilizer.

* Acid forming tendency expressed as lb $CaCO_3$/100 lb of fertilizer. A positive number indicates an increase in pH upon application. A negative number implies a fertilizer induced decrease in pH.

6.7 Pre-Sidedress Nitrogen Test (PSNT)

The pre-sidedress nitrogen test (PSNT) provides a way to determine if there will be enough available nitrogen in the soil from organic sources for maximum economic yield of corn. Thus, in certain circumstances, PSNT results can help a producer decide whether or not to add extra N at sidedress time. The PSNT result is a measure of the nitrate level in the top 12 inches of soil based on a sample taken when corn is 6 to 12 inches tall (measured from the soil surface to the whorl). The test is calibrated for corn fields (second year or more) assuming the following:

- Fertilizer N at planting is limited to 40 lbs N/acre in the band.
- Pre-plant or early post-plant broadcast N is *NOT* used.
- Sampling is done no earlier than 2-3 days after significant rainfall.

On the other hand, the PSNT is not relevant when:

- Fields are in continuous corn and manure or other organic amendments are not used.
- PSNT samples are collected when corn is less than 6" or more than 12" tall at the whorl.
- Soil samples are taken from less than 12 inch depth.

- More than 40 lbs of N is band applied at planting.
- Pre-plant or early post plant broadcast N is applied.
- Sampling took place too soon after rainfall.

The PSNT is a great tool to use when there is uncertainty as to the actual amount of manure applied or when there is uncertainty as to whether enough manure was actually applied to meet expected corn crop N requirements. The PSNT provides an indication of the pool of readily mineralizable organic N in the soil. This is why the presence of broadcast N can cause the PSNT to overestimate the readily mineralizable organic N pool, rendering the test useless.

To obtain a representative soil sample for the PSNT, 10 to 20 soil cores per field should be taken to a depth of 12 inches when the corn is 6-12 inches tall. Samples should be taken between rows to avoid sampling the starter fertilizer band. The samples should be mixed thoroughly and a subsample dried immediately following sampling to stop further nitrification. Drying can be done in an oven at about 200^{o}F or in a microwave. Samples can also be air dried if spread out thinly. It will reduce drying time if a fan is used to enhance air circulation above the thinly spread sample. It is important not to put wet samples on top of absorbent materials as those materials will absorb nitrate.

Samples should be sent to the Cornell Nutrient Analysis Laboratory along with the information sheet that is supplied with the purchase of the sample bag. Soil test bags can be obtained from the laboratory (804 Bradfield Hall, Ithaca, NY 14853, phone: (607) 255-4540, fax: (607) 255-7656, or e-mail: soiltest@cornell.edu). Information sheets can also be downloaded from the laboratory's website (http://www.css.cornell.edu/soiltest/).

The interpretations of the PSNT in New York are based on 115 field experiments conducted between 1986 and 1995 (Klausner, 1996). These experiments showed with an 80% accuracy that fields with a PSNT value of 25 ppm nitrate or greater did not need additional N. Fields testing below 21 ppm needed additional N for maximum economic yield and PSNT values between 21 and 24 ppm were borderline. A disadvantage of the PSNT is its inability to estimate *how much* fertilizer N needs to be applied for optimum economic yield if the test results indicate a response to additional N can be expected. This is due to the large amount of variation in relative yield for any given PSNT value below the critical level of 25 ppm. However, for fields with PSNT values of 21-24 ppm, there is a reasonable probability of a response to some N, and the recommendation for these fields is to add 25-50 lbs N per acre as a sidedress application. For fields with PSNT values less than 21 ppm, the standard N recommendations as outlined in section 5 should be used to determine how much N to apply (Table 6.11).

Table 6.11: Interpretation of the pre-sidedress nitrogen test (PSNT) for New York.

PSNT (ppm)	Probability of an economic response	N recommendation
<21	High	Follow Cornell N recommendations for corn
21-24	About 10%	Consider sidedressing 25-50 lbs N/acre
25 or more	Very low	No extra N needed

6.8 APPENDIX

Table 6.A: Soil management group (SMG), hydrologic group (HG), inorganic nitrogen uptake efficiencies (N-Eff in %), soil N supply (N-Sup, in lbs N/acre) and corn yield potential (YP in bushels/acre) for undrained (UD) and artificially drained (DR) New York State soils.

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
ACTON	4	C	65	70	65	65	120	125
ADAMS	5	A	70	70	40	40	95	95
ADIRONDACK	4	D	75	75	70	70	75	75
ADJIDAUMO	1	D	55	60	65	75	75	105
ADRIAN	6	A/D	55	65	90	120	60	120
AGAWAM	4	B	75	75	65	65	140	140
ALBIA	3	C	60	65	60	70	100	120
ALBRIGHTS	2	C	70	70	75	75	110	120
ALDEN	3	D	50	60	65	80	65	90
ALLAGASH	5	B	75	75	65	65	105	105
ALLARD	3	B	75	75	70	70	135	135
ALLENDALE	3	D	55	60	60	70	80	100
ALLIS	3	D	60	65	65	75	80	100
ALLUVIAL LAND	3	C	60	65	70	75	75	100
ALMOND	3	C	60	65	65	75	90	95
ALPS	3	C	70	70	75	75	110	115
ALTMAR	5	B	65	70	50	60	100	115
ALTON	5	A	75	75	65	65	125	125
AMBOY	4	C	75	75	60	60	140	140
AMENIA	4	B	70	70	65	65	135	140
ANGOLA	2	C	60	65	70	80	95	110
APPLETON	2	C	60	65	65	75	105	125
ARKPORT	4	B	75	75	50	50	125	125
ARMAGH	2	D	55	60	70	80	80	100
ARNOT	3	C/D	70	70	70	70	90	100
ASHVILLE	3	D	50	55	65	75	75	95
ATHERTON	3	B	55	60	55	75	90	105
ATKINS	3	D	50	60	65	75	70	105
ATSION	5	C	60	65	60	70	70	95
AU GRES	5	B	55	65	60	65	90	100
AURELIE	3	D	55	60	70	80	75	95
AURORA	2	C	70	70	70	70	110	115
BARBOUR	3	B	75	75	75	75	140	140
BARCELONA	3	C	60	65	65	75	90	115
BARRE	1	D	55	65	70	80	80	105

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
BASH	3	C	60	65	65	75	105	130
BASHER	3	B	70	70	70	70	140	140
BATH	3	C	75	75	75	75	125	125
BECKET	4	C	75	75	60	60	100	100
BECRAFT	3	B	70	70	75	75	150	150
BELGRADE	3	B	70	70	80	80	140	145
BENSON	4	D	70	70	65	65	80	80
BERKSHIRE	5	B	75	75	65	65	125	125
BERNARDSTON	4	C	75	75	65	65	135	135
BERRIEN	5	C	70	70	55	55	120	120
BERRYLAND	5	B	50	60	70	75	60	90
BESEMAN	6	A	50	65	90	130	60	130
BICE	5	B	75	75	65	65	130	130
BIDDEFORD	2	D	50	60	70	75	65	95
BIRDSALL	3	D	50	55	70	75	70	90
BLASDELL	3	A	75	75	70	70	125	125
BOMBAY	4	B	70	70	65	65	135	135
BONAPARTE	4	A	70	70	50	50	100	100
BONO	1	D	50	60	70	80	60	100
BOOTS	6	A	55	65	90	130	60	130
BOROSAPRISTS	6	A/D	55	65	90	140	60	150
BOYNTON	3	D	55	65	70	75	80	100
BRACEVILLE	4	C	70	70	75	75	115	120
BRAYTON	4	C	60	65	70	70	90	105
BRIDGEHAMPTON	3	B	70	70	70	70	150	150
BRIDPORT	2	D	60	65	65	75	105	120
BRIGGS	4	A	75	75	60	60	100	100
BRINKERTON	2	D	55	65	70	80	80	100
BROADALBIN	4	C	75	75	65	65	130	130
BROCKPORT	1	D	60	65	70	80	95	120
BROOKFIELD	3	B	75	75	75	75	130	130
BUCKLAND	3	C	70	70	70	70	90	90
BUCKSPORT	6	D	55	65	90	140	60	150
BUDD	4	B	75	75	40	40	105	105
BURDETT	2	C	60	65	70	80	100	120
BURNHAM	3	D	60	65	70	80	70	95
BUSTI	3	C	60	65	60	70	100	120
BUXTON	2	C	70	70	70	70	120	120
CAMBRIA	2	D	55	60	65	75	80	105
CAMBRIDGE	3	C	70	70	70	70	120	125
CAMILLUS	3	B	70	70	75	75	120	125

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
CAMRODEN	3	C	60	65	70	75	100	110
CANAAN	4	C	70	70	65	65	75	75
CANAAN-ROCK OUTCROP	4	C	70	70	65	65	75	75
CANADICE	2	D	55	65	60	70	80	110
CANANDAIGUA	3	D	55	65	70	80	90	110
CANASERAGA	3	C	70	70	80	80	125	125
CANASTOTA	2	C	70	70	75	75	120	125
CANEADEA	2	D	60	65	65	75	105	120
CANFIELD	3	C	70	70	75	75	115	120
CANTON	4	B	75	75	60	60	130	130
CARBONDALE	6	A	55	65	90	130	60	130
CARLISLE	6	A/D	55	65	90	130	60	130
CARROLLTON	3	C	75	75	75	75	105	105
CARVER	5	A	70	70	40	40	75	75
CARVER-PLYMOUTH	5	A	70	70	40	40	75	75
CASTILE	4	B	75	75	75	75	135	135
CATHRO	6	A	55	65	90	140	60	150
CATHRO-GREENWOOD	6	A	55	65	90	140	60	150
CATTARAUGUS	3	C	75	75	75	75	125	125
CAVODE	2	C	60	65	70	75	105	120
CAYUGA	2	C	70	70	75	75	135	135
CAZENOVIA	2	B	70	75	75	75	135	135
CERESCO	3	B	70	70	75	75	145	145
CHADAKOIN	3	B	75	75	75	75	130	130
CHAGRIN	3	B	75	75	75	75	140	140
CHAMPLAIN	5	A	70	70	50	50	75	75
CHARLES	3	C	55	60	70	80	75	90
CHARLTON	4	B	75	75	65	65	130	130
CHATFIELD	4	B	70	70	50	50	100	100
CHATFIELD	4	B	70	70	65	65	100	100
CHAUMONT	1	D	55	65	65	75	80	100
CHAUTAUQUA	3	C	70	70	75	75	125	125
CHEEKTOWAGA	5	D	55	65	55	75	80	105
CHENANGO	3	A	70	70	70	70	130	130
CHESHIRE	4	B	75	75	75	75	125	125
CHIPPENY	6	D	55	65	90	130	60	130
CHIPPEWA	3	D	55	65	70	75	80	100
CHURCHVILLE	2	D	60	65	70	80	105	120
CICERO	2	C	60	65	70	75	100	115

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
CLARKSON	2	B	70	70	75	75	135	140
CLAVERACK	4	C	70	70	70	70	120	120
CLYMER	4	B	75	75	70	70	110	120
COHOCTAH	4	B	55	65	70	80	80	100
COLLAMER	3	C	70	70	75	75	140	140
COLONIE	5	A	70	70	50	50	105	105
COLOSSE	4	A	70	70	50	50	70	70
COLRAIN	4	A	75	75	65	65	130	130
COLTON	5	A	70	70	50	50	85	85
COLWOOD	3	D	55	65	70	80	90	110
CONESUS	2	B	70	70	75	75	135	140
CONOTTON	3	A	75	75	70	70	125	125
CONSTABLE	5	A	70	70	50	50	75	75
COOK	5	D	50	60	70	80	70	90
COPAKE	4	B	75	75	65	65	135	135
CORNISH	3	C	60	65	65	75	95	110
COSAD	4	C	60	70	60	70	105	120
COSSAYUNA	4	C	75	75	65	65	135	135
COVERT	4	A	70	70	60	60	115	120
COVEYTOWN	4	C	65	70	65	75	90	110
COVINGTON	1	D	55	60	70	75	75	95
CRARY	4	C	65	70	60	70	110	120
CROGHAN	5	B	70	70	50	50	100	100
CULVERS	3	C	70	70	75	75	115	125
DALBO	3	C	70	70	75	75	95	115
DALTON	3	C	60	65	70	75	95	105
DANLEY	2	C	70	70	75	75	120	125
DANNEMORA	4	D	55	65	65	75	75	90
DARIEN	2	C	60	65	70	75	100	115
DAWSON	6	A	55	65	90	140	60	150
DEERFIELD	5	B	70	70	60	65	105	110
DEFORD	4	A	55	60	65	75	75	100
DEKALB	4	A	75	75	70	70	100	100
DEPEYSTER	3	C	70	70	75	75	140	140
DEPOSIT	3	B	70	70	75	75	125	130
DERB	3	C	60	65	70	75	95	115
DIXMONT	5	C	70	70	65	65	115	120
DORVAL	6	A	55	65	90	140	60	150
DOVER	4	B	75	75	70	70	125	125
DUANE	4	B	70	70	60	60	95	95
DUNKIRK	3	B	75	75	75	75	140	140

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
DUTCHESS	4	B	75	75	65	65	135	135
DUXBURY	4	A	75	75	65	65	95	95
EDWARDS	6	B	55	65	90	130	60	130
EEL	2	B	65	70	75	75	140	140
EELWEIR	4	C	70	70	50	50	130	135
ELKA	4	C	75	75	70	70	115	115
ELLERY	3	D	55	65	70	75	80	100
ELMRIDGE	5	C	70	70	60	60	135	135
ELMWOOD	4	C	70	70	60	60	130	130
ELNORA	5	B	70	70	50	50	110	110
EMPEYVILLE	4	C	70	70	60	60	100	105
ENFIELD	3	B	75	75	75	75	150	150
ENSLEY	3	B	55	60	65	75	75	95
ERIE	3	C	60	65	65	75	95	115
ERNEST	3	C	75	75	75	75	75	75
ESSEX	5	C	75	75	70	70	95	95
FAHEY	5	B	70	70	55	65	100	100
FARMINGTON	3	C	75	75	65	65	90	90
FARNHAM	4	C	70	70	70	70	120	125
FERNLAKE	4	A	70	70	60	60	75	75
FONDA	2	D	50	60	70	80	70	100
FREDON	4	C	55	65	70	75	90	115
FREETOWN	6	D	50	65	90	130	60	130
FREMONT	2	C	60	65	65	75	100	110
FRENCHTOWN	3	D	55	60	65	75	70	105
FREWSBURG	3	C	60	65	65	75	80	95
FRYEBURG	3	B	75	75	70	70	95	95
GAGE	3	D	55	60	65	75	90	95
GALEN	4	B	70	70	60	60	130	130
GALESTOWN	5	A	70	70	40	40	90	90
GALOO	4	C	70	70	50	50	75	75
GALOO-ROCK OUTCROP	4	C	70	70	50	50	75	75
GALWAY	4	B	75	75	70	70	130	130
GENESEE	2	B	75	75	80	80	155	155
GEORGIA	4	C	70	70	75	75	135	140
GETZVILLE	3	D	55	60	65	75	75	90
GILPEN	3	C	75	75	75	75	120	120
GILPIN	3	C	75	75	70	70	110	110
GLEBE	4	C	70	70	70	70	75	75
GLEBE-SADDLEBACK	4	C	70	70	70	70	75	75

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
GLENDORA	4	A/D	75	75	70	70	75	75
GLENFIELD	3	B	50	60	65	75	90	110
GLOUCESTER	4	A	70	70	50	50	120	120
GLOVER	4	D	70	70	60	60	90	90
GOUGEVILLE	5	A	50	60	65	75	75	100
GRANBY	5	A/D	55	60	60	65	75	100
GRATTAN	5	A	70	70	50	50	105	105
GREENE	3	C	60	65	65	75	90	110
GREENWOOD	6	A	50	65	90	140	60	150
GRENVILLE	4	B	75	75	75	75	140	140
GRETOR	3	C	60	65	65	75	75	90
GROTON	4	A	70	70	70	70	105	110
GROVETON	4	A	70	70	65	65	95	95
GUFF	1	D	50	55	60	75	75	90
GUFFIN	1	D	50	60	60	65	60	75
GULF	4	B	55	60	65	75	75	90
HADLEY	3	B	75	75	70	70	140	140
HAIGHTS	3	B	60	70	50	60	95	100
HAIGHTS-GULF	3	B	60	70	50	60	95	100
HAILESBORO	3	C	60	65	65	75	110	125
HALCOTT	2	C/D	70	70	75	75	75	80
HALSEY	4	C/D	50	60	70	75	90	100
HAMLIN	2	B	75	75	80	80	155	155
HAMPLAIN	2	B	75	75	80	80	150	150
HANNAWA	4	D	55	60	60	70	85	100
HARTLAND	4	B	75	75	75	75	155	155
HAVEN	4	B	75	75	65	65	150	150
HAWKSNEST	3	C/D	70	70	75	75	75	80
HEMPSTEAD	4	B	75	75	65	65	150	150
HENRIETTA	6	B	55	65	90	130	60	150
HERKIMER	3	B	70	70	75	75	130	130
HERMON	4	A	70	70	50	50	105	105
HERO	4	B	70	70	70	70	130	135
HEUVELTON	2	C	70	70	75	75	115	135
HILTON	2	B	70	70	75	75	135	140
HINCKLEY	5	A	70	70	50	50	95	95
HINESBURG	4	C	75	75	60	60	105	105
HOGANSBURG	4	B	70	70	75	75	135	140
HOGBACK	5	C	75	75	50	50	75	75
HOGBACK-RICKER	5	C	75	75	50	50	75	75

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
HOLDERTON	3	B	60	65	65	75	105	115
HOLLIS	4	C	60	65	50	60	75	95
HOLLY	2	C/D	55	60	60	75	70	95
HOLYOKE	3	C	70	70	70	70	75	75
HOLYOKE-ROCK OUTCR	3	C	70	70	70	70	75	75
HOMER	2	B	60	65	65	75	105	125
HONEOYE	2	B	75	75	75	75	140	140
HOOSIC	4	A	75	75	60	60	105	105
HORNELL	2	D	65	70	70	75	95	105
HORNELLSVILLE	3	D	60	65	65	75	85	95
HOUGHTONVILLE	5	C	75	75	65	65	105	105
HOUGHTONVILLE -RAWSON	5	C	75	75	65	65	105	105
HOUSATONIC	3		55	65	70	75	80	115
HOUSEVILLE	2	C	60	65	65	75	105	125
HOWARD	3	A	75	75	70	70	135	135
HUDSON	2	C	70	70	80	80	135	135
HULBERTON	2	C	60	65	70	80	105	125
ILION	2	D	60	65	70	80	90	105
INSULA	4	B	75	75	60	65	90	90
IPSWICH	6	D	50	65	90	99	60	130
IRA	4	C	70	70	65	65	115	120
ISCHUA	3	B	70	70	75	75	100	105
IVORY	2	C	60	65	65	75	90	100
JEBAVY	5	A	55	60	60	70	75	95
JOLIET	4	D	55	65	65	75	60	100
JUNIUS	5	C	55	65	50	60	80	100
KALURAH	4	B	70	70	75	75	135	140
KANONA	2	D	55	65	60	70	77	95
KARS	4	A	70	70	65	65	125	125
KEARSARGE	3	B	70	70	70	70	90	90
KENDAIA	2	C	60	65	65	75	105	125
KIBBIE	3	B	60	65	65	75	110	125
KINGSBURY	1	D	60	65	65	75	95	110
KINZUA	3	B	75	75	75	75	130	130
KNICKERBOCKER	5	A	70	70	65	65	105	105
LACKAWANNA	3	C	75	75	75	75	125	125
LAGROSS	3	A	75	75	75	75	115	115
LAGROSS-HAIGHTS	3	A	75	75	75	75	115	115

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
LAIRDSVILLE	2	D	70	70	75	75	120	120
LAKEMONT	1	D	55	60	65	75	80	105
LAKEWOOD	5	A	70	70	40	40	75	75
LAMSON	4	B/D	55	65	65	75	75	110
LANESBORO	3	C	70	70	75	75	75	75
LANGFORD	3	C	70	70	75	75	120	120
LANSING	2	B	75	75	75	75	140	140
LECK KILL	3	B	75	75	75	75	115	115
LEICESTER	4	C	55	65	65	75	75	105
LEON	5	C	60	65	60	70	70	95
LEWBATH	3	C	75	75	75	75	95	95
LEWBEACH	3	C	75	75	75	75	125	125
LEYDEN	2	C	70	70	75	75	120	125
LIMA	2	B	70	70	75	75	135	140
LIMERICK	3	C	55	65	70	75	80	115
LINDEN	4	B	75	75	75	75	135	135
LINLITHGO	3	B	65	65	70	75	105	115
LIVINGSTON	1	D	50	55	65	75	65	85
LOBDELL	3	B	65	70	75	75	135	135
LOCKPORT	2	D	60	65	70	80	95	120
LORDSTOWN	3	C	75	75	70	70	105	105
LOVEWELL	2	B	70	70	75	75	130	140
LOWVILLE	4	B	75	75	75	75	135	135
LOXLEY	6	A	50	65	90	130	60	130
LUCAS	2	C	70	70	80	80	135	135
LUDLOW	4	C	70	70	75	75	115	120
LUPTON	6	A	55	65	90	140	60	150
LYMAN	4	C	70	70	60	60	75	75
LYMAN-BECKET-BERKSHI	4	C	70	70	60	60	75	75
LYME	5	C	55	65	60	70	75	100
LYONS	2	D	55	60	65	75	80	105
MACHIAS	4	B	70	70	70	70	115	115
MACOMBER	4	C	75	75	75	75	85	85
MACOMBER-TACONIC	4	C	75	75	75	75	85	85
MADALIN	1	D	55	60	65	75	75	105
MADAWASKA	5	B	70	70	60	60	115	115
MADRID	4	B	75	75	65	65	135	135
MALONE	4	C	60	65	65	75	105	125
MANAHAWKIN	6	D	55	65	90	130	60	130

Appendix Table 6.A (Continued)

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
MANDY	3	C	75	75	75	75	105	105
MANHEIM	2	C	60	65	65	75	105	125
MANHONING	2	D	60	65	65	75	90	115
MANLIUS	3	C	70	70	70	70	105	105
MANSFIELD	3	D	50	60	65	75	65	90
MAPLECREST	2	B	75	75	75	75	130	130
MARCY	3	D	55	60	65	75	90	95
MARDIN	3	C	70	70	75	75	115	120
MARILLA	3	C	70	70	75	75	120	120
MARKEY	6	A/D	55	65	90	130	60	150
MARLOW	4	C	75	75	60	60	120	120
MARTISCO	6	B	50	65	90	120	60	120
MASSENA	4	C	60	65	65	75	105	125
MATOON	1	D	60	60	65	75	100	120
MATUNUCK	6	D	50	65	90	130	60	130
MEDIHEMISTS	6	A/D	55	65	90	130	60	150
MEDOMAK	3	D	50	55	65	75	60	80
MELROSE	4	C	75	75	50	50	120	120
MENLO	4	D	55	60	60	70	80	95
MENTOR	4	B	75	75	60	60	125	125
MERRIMAC	4	A	70	70	75	75	105	105
MIDDLEBROOK	3	C	70	70	75	75	105	110
MIDDLEBROOK-MONGAUP	3	C	70	70	75	75	105	110
MIDDLEBURY	3	B	65	70	75	75	135	135
MILLIS	4	C	75	75	60	60	120	120
MILLSITE	4	C	70	70	65	65	100	100
MINEOLA	4	A	70	70	75	75	125	130
MINER	1	D	55	60	65	75	75	105
MINO	4	C	60	65	50	60	100	125
MINOA	4	C	60	65	50	60	100	125
MOHAWK	2	B	70	70	75	75	140	140
MOIRA	4	C	70	70	70	70	100	110
MONADNOCK	4	B	75	75	60	60	95	95
MONARDA	4	D	60	65	65	70	95	115
MONGAUP	3	C	75	75	70	70	105	105
MONTAUK	4	C	70	70	65	65	135	135
MOOERS	5	B	70	70	60	60	95	100
MOROCCO	4	C	55	65	60	65	90	115
MORRIS	3	C	60	65	65	75	95	105
MOSHERVILLE	4	C	60	65	60	70	100	125

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
MUCK	6	D	55	65	90	130	60	150
MUCK-PEAT	6	D	55	65	90	130	60	150
MUNDAL	4	C	75	75	60	60	65	65
MUNDALITE	3	C	75	75	70	70	105	105
MUNDALITE-RAWSONVILL	3	C	75	75	70	70	105	105
MUNSON	2	D	60	65	65	75	105	120
MUNUSCONG	4	B	55	65	60	65	60	95
MUSKEGO	6	A/C	55	65	90	130	60	150
MUSKELLUNGE	3	D	60	65	65	75	90	115
NAPOLEON	6	A	55	65	90	130	60	150
NAPOLI	3	C	60	65	65	75	80	90
NASSAU	4	C	70	70	50	50	85	85
NAUMBURG	5	C	55	65	60	65	90	100
NEHASNE	4	B	75	75	70	70	130	130
NELLIS	4	B	75	75	70	70	140	140
NEVERSINK	4	D	55	60	60	70	75	90
NEWFANE	4	B	75	75	50	50	125	125
NEWSTEAD	4	C	55	65	60	70	95	115
NEWTON	5	A/D	50	60	50	60	80	90
NIAGARA	3	C	60	65	65	75	110	125
NICHOLVILLE	4	C	70	70	70	70	105	110
NINIGRET	4	B	70	70	70	70	130	135
NORCHIP	3	D	55	60	70	80	60	80
NORWELL	5	C	60	65	60	70	100	120
NORWICH	3	D	55	60	60	70	70	90
NUNDA	2	C	70	70	75	75	125	130
OAKVILLE	5	A	70	70	50	50	90	100
OCCUM	4	B	75	75	75	75	140	140
ODESSA	2	D	60	65	75	75	105	115
OGDENSBURG	4	C	55	65	60	70	95	115
OLEAN	2	B	70	70	75	80	125	130
ONDAWA	4	B	75	75	75	75	135	135
ONEIDA	4	C	60	65	65	75	105	125
ONOVILLE	3	C	70	70	70	75	105	115
ONTARIO	2	B	75	75	75	75	140	140
ONTEORA	3	C	60	65	65	75	90	115
ONTUSIA	3	C	60	65	60	70	95	105
OQUAGA	3	C	70	70	65	65	100	100
ORAMEL	2	C	70	70	75	75	130	130
ORGANIC	6	A/D	50	65	90	130	60	130

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
ORPARK	2	C	60	65	65	75	100	110
ORWELL	2	D	55	60	65	75	90	100
OSSIPEE	6	D	55	65	90	130	60	150
OTEGO	2	B	70	70	70	75	140	150
OTISVILLE	4	A	70	70	50	50	95	95
OTSEGO	3		70	70	75	75	115	120
OTTAWA	5	A	70	70	50	50	115	115
OVID	2	C	65	70	70	75	105	125
PALATINE	2	B	65	70	65	70	100	100
PALMS	6	A/D	50	65	90	140	60	150
PALMYRA	3	B	75	75	70	70	140	140
PANTON	1	D	55	65	65	75	90	105
PAPAKATING	2	D	55	60	60	75	70	95
PARISHVILLE	4	C	70	70	70	70	100	110
PARSIPPANY	1	D	50	60	60	75	80	105
PATCHIN	3	D	55	60	65	75	65	85
PAWCATUCK	6	D	50	65	90	130	60	130
PAWLING	4	B	70	70	75	75	140	140
PAXTON	4	C	75	75	65	65	125	125
PEACHAM	3	D	55	60	70	80	60	75
PEAT	6	A/D	55	65	90	130	60	150
PEAT-MUCK	6	A/D	55	65	90	130	60	150
PERU	4	C	70	70	60	60	115	120
PETOSKEY	4	A	75	75	50	50	125	125
PHELPS	3	B	70	70	70	70	140	140
PHILO	3	B	70	70	75	75	135	135
PILLSBURY	4	C	60	65	65	75	70	100
PINCKNEY	3	C	70	70	75	75	115	120
PIPESTONE	5	B	60	65	55	65	70	100
PITTSFIELD	4	B	75	75	75	75	140	140
PITTSTOWN	4	C	65	70	70	70	125	135
PLAINBO	5	A	70	70	50	50	80	80
PLAINFIELD	5	A	70	70	30	30	90	90
PLESSIS	3	D	60	65	65	75	80	95
PLYMOUTH	4	A	70	70	50	50	75	75
PODUNK	4	B	70	70	75	75	130	130
POLAND	2	B	75	75	75	75	140	140
POMPTON	4	B	70	70	50	50	115	115
POOTATUCK	4	B	70	70	65	65	130	130
POPE	4	B	75	75	75	75	140	140
POTSDAM	4	C	70	70	70	70	120	120

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
POYGAN	1	D	50	60	60	70	70	90
PUNSIT	3	C	60	65	65	75	95	110
PYRITIES	4	B	75	75	75	75	140	140
QUETICO	4	D	70	70	50	50	65	65
QUETICO-ROCK OUTCRO	4	D	70	70	50	50	65	65
RAQUETTE	4	B	60	70	60	70	105	120
RAWSONVILLE	5	C	75	75	50	50	75	75
RAWSONVILLE-BESEMAN-	5	C	75	75	50	50	75	75
RAYNE	3	B	75	75	75	75	130	130
RAYNHAM	3	C	55	65	65	75	95	125
RAYPOL	3	C	55	60	60	75	75	90
RED HOOK	4	C	60	65	65	75	105	125
REDWATER	3	B	65	70	75	75	135	135
REMSEN	2	D	60	65	65	75	90	115
RETSOF	2	C	60	65	65	75	95	115
REXFORD	4	C	50	65	65	75	90	110
RHINEBECK	2	D	60	65	65	75	105	120
RICKER	4	A	70	70	60	60	75	75
RICKER-LYMAN	4	A	70	70	60	60	75	75
RIDGEBURY	4	C	55	65	60	70	90	110
RIFLE	6	A	50	65	90	130	60	130
RIGA	2	D	70	70	75	75	120	120
RIPPOWAM	4	C	55	65	60	70	80	105
RIVERHEAD	4	B	75	75	40	40	105	105
ROCKAWAY	2	C	75	75	75	75	125	125
ROMULUS	2	D	55	60	60	75	80	100
ROSS	2	B	75	75	75	75	155	155
ROUNDABOUT	3	C	60	60	60	70	95	110
RUMNEY	2	C	55	65	65	75	85	115
RUNEBERG	4	C	50	55	60	70	70	90
RUSE	4	D	55	60	55	65	75	90
RUSHFORD	3	B	70	70	75	75	120	125
SACO	3	D	50	55	65	75	65	95
SALAMANCA	3	B	70	70	75	75	100	105
SALMON	4	B	75	75	70	70	115	115
SAPRISTS	6	A/D	55	65	90	130	60	150
SAUGATUCK	5	C	60	65	60	70	70	95
SCANTIC	2	D	55	60	65	75	90	100
SCARBORO	4	D	55	65	60	70	75	105

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
SCHOHARIE	1	C	70	70	75	75	135	135
SCHROON	5	B	70	70	50	50	130	130
SCHUYLER	3	B	70	70	75	75	115	115
SCIO	3	B	70	70	75	75	135	140
SCITUATE	4	B	70	70	75	75	115	115
SCRIBA	4	C	60	65	65	75	94	105
SEARSPORT	4	D	55	65	60	70	75	105
SHAKER	2	C	60	65	65	75	105	125
SHOREHAM	2	D	50	60	70	70	65	95
SISK	4	C	55	60	65	75	60	85
SKERRY	5	C	60	65	65	75	95	100
SLOAN	3	B	50	55	65	75	70	90
SODUS	4	C	75	75	75	75	120	120
SOMERSET	5	C	60	65	65	75	90	105
ST JOHNS	4	D	55	65	60	70	75	105
STAATSBURG	3	C	75	75	70	70	90	90
STAFFORD	4	C	60	65	50	60	95	110
STEAMBURG	3	B	70	70	75	75	100	105
STETSON	5	B	75	75	70	70	110	110
STISSING	4	C	60	65	60	70	90	115
STOCKBRIDGE	3	C	75	75	75	75	140	140
STOCKHOLM	5	C	60	60	60	70	90	100
STOWE	4	B	75	75	65	65	110	110
SUDBURY	4	B	60	65	65	65	105	110
SUFFIELD	2	B	70	70	80	80	135	135
SUMMERVILLE	4	D	70	70	50	50	80	80
SUN	4	D	55	60	60	70	75	100
SUNAPEE	4	B	70	70	65	65	95	110
SUNCOOK	5	A	70	70	40	40	90	90
SUNY	4	D	50	55	60	70	70	110
SURPLUS	4	C	55	60	65	75	60	90
SURPLUS-SISK	4	C	55	60	65	75	60	90
SUTTON	4	B	70	70	70	70	130	130
SWANTON	4	C	60	65	50	60	95	125
SWARTSWOOD	4	C	75	75	70	70	120	120
SWORMVILLE	1	C	60	65	65	75	90	115
TACONIC	3	C	75	75	75	75	75	90
TACONIC-MACOMBER	3	C	75	75	75	75	75	90
TAWAS	6	A	50	65	90	130	60	130
TEEL	2	B	65	70	75	75	140	140

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
TOLEDO	2	D	50	60	70	80	70	100
TONAWANDA	2	D	60	65	65	75	105	120
TOR	4	D	60	60	65	75	60	85
TORULL	3	D	60	65	65	75	90	110
TOWERVILLE	3	B	70	70	75	75	115	115
TRESTLE	3	B	75	75	75	75	145	145
TROUT RIVER	5	A	70	70	50	50	95	95
TROY	3	C	70	70	70	70	120	125
TRUMBULL	1	D	55	60	65	75	75	105
TUGHILL	4	D	50	55	55	65	60	85
TULLER	3	D	60	65	65	75	80	95
TUNBRIDGE	4	C	75	75	70	70	90	90
TUNBRIDGE-ADIRONDACK	4	C	75	75	70	70	90	90
TUNKHANNOCK	3	A	75	75	75	75	120	120
TURIN	2	C	60	65	70	80	105	125
TUSCARORA	4	C	70	70	50	50	125	125
UNADILLA	3	B	75	75	75	75	140	140
VALOIS	3	B	75	75	75	75	130	130
VARICK	2	D	55	60	75	75	80	100
VARYSBURG	2	B	70	70	75	75	130	130
VENANGO	3	C	60	65	60	70	100	120
VERGENNES	1	C	70	70	75	75	115	120
VLY	3	C	75	75	75	75	90	90
VOLUSIA	3	C	60	65	60	70	95	105
WADDINGTON	4	A	75	75	60	60	125	125
WAINOLA	5	B	60	65	60	70	85	125
WAKELAND	3	C	60	65	75	75	90	115
WAKEVILLE	3	B	60	65	65	75	95	110
WALLACE	5	B	70	70	40	40	90	100
WALLINGTON	3	C	60	65	65	75	105	115
WALLKILL	3	C	50	60	65	80	65	125
WALPOLE	4	C	65	68	55	60	80	105
WALTON	3	C	75	75	75	75	125	125
WAMPSVILLE	3	B	75	75	75	75	140	140
WAPPINGER	3	B	75	75	75	75	140	140
WAREHAM	5	C	60	65	65	75	90	105
WARNERS	3	C	50	60	70	75	75	90
WASSAIC	4	B	70	70	65	65	120	120
WATCHAUG	4	B	70	70	70	70	120	120
WAUMBECK	4	B	70	70	65	65	95	105

Appendix Table 6.A (Continued).

Soil Name	SMG	HG	N_Eff UD (%)	N_Eff DR (%)	N_Sup UD (lbs N/a)	N_Sup DR (lbs N/a)	YP UD (bu/a)	YP DR (bu/a)
WAYLAND	2	C/D	55	60	60	75	70	95
WEAVER	3	C	70	70	75	75	120	130
WEGATCHIE	3	D	55	65	70	80	90	110
WELLSBORO	3	C	70	70	75	75	115	125
WENONAH	4	C	75	75	65	65	130	130
WESTBURY	4	B	60	65	60	70	80	100
WESTLAND	2	C	50	55	60	75	90	110
WETHERSFIELD	4	C	75	75	75	75	120	120
WHARTON	2	C	70	70	75	75	120	120
WHATELY	4	D	50	60	60	70	60	105
WHIPPANY	2	C	60	65	65	75	105	115
WHITELAW	4	B	75	75	65	65	135	135
WHITMAN	4	D	50	60	60	75	76	90
WILBRAHAM	4	C	60	65	60	65	95	110
WILLDIN	3	C	70	70	75	75	115	120
WILLETTE	6	A	50	65	90	130	60	130
WILLIAMSON	4	C	70	70	70	70	115	120
WILLOWEMOC	3	C	70	70	75	75	115	125
WILMINGTON	4	D	55	60	60	70	75	110
WILPOINT	1	D	70	70	80	80	105	110
WINDSOR	5	A	70	70	40	40	90	90
WINOOSKI	4	B	70	70	75	75	135	135
WOLCOTTSBURG	1	D	55	60	65	75	75	105
WONSQUEAK	6	D	55	65	90	130	60	150
WOODBRIDGE	4	C	70	70	75	75	120	125
WOODLAWN	4	B	75	75	75	75	80	80
WOODSTOCK	4	D	70	70	60	60	75	75
WOODSTOCK-ROCK OUTCR	4	D	70	70	60	60	75	75
WOOSTER	3	C	75	75	75	75	125	125
WOOSTERN	3	C	75	75	75	75	130	130
WOOSTERN-BATH-VALOIS	3	C	75	75	75	75	130	130
WORDEN	4	C	60	60	65	75	60	75
WORTH	4	C	75	75	70	70	105	105
WURTSBORO	4	C	70	70	70	70	115	120
WYALUSING	3	D	55	60	65	75	75	95
YALESVILLE	4	C	75	75	60	60	105	105
YORKSHIRE	3	C	70	70	75	75	100	110

Appendix Table 6.B: Soil management groups for New York State.

Soil Management Group	General Description
I (1)	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
II (2)	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
III (3)	Moderately coarse textured soil developed from glacial outwash and recent alluvium and medium-textured acid soil developed on glacial till.
IV (4)	Coarse- to medium-textured soils formed from glacial till or glacial outwash.
V (5)	Coarse- to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas.
VI (6)	Organic or muck lands.

7. Nutrient Guidelines: Phosphorus

from

Phosphorus Guidelines for Field Crops in New York

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The full document is downloadable from the Nutrient Management Spear Program (NMSP) at: http://nmsp.css.cornell.edu/. For bound hardcopies contact Pam Kline by e-mail (pak1@cornell.edu), phone (607-255-2177) or regular mail (234 Emerson Hall, Department of Crop and Soil Sciences, Cornell University, Ithaca NY 14853).

7.2 INTRODUCTION

Phosphorus (P) is a macronutrient belonging to the group of 17 nutrients that are essential for plant growth and crop production. It is a key component of cell membranes and cellular compounds such as adenosine triphosphate (ATP, energy-rich compounds used as "fuel" for cell activity), deoxyribonucleic acid (DNA, the genetic code), and ribonucleic acid (RNA, essential in the production of proteins). Phosphorus is important for animals and humans as well. It is used to make bones, teeth, and shells and to strengthen muscles in addition to being essential for production of ATP, DNA, RNA, and cell membranes. In plants, phosphorus plays an essential role in photosynthesis, respiration, N fixation, root development, maturation, flowering, fruiting, and seed production. An adequate supply of P in the early life of a plant is essential for development of reproductive parts (seeds and fruits contain large quantities of P). A deficiency in P results in reduced plant growth, delay of maturity, and harvest declines or even failures. Because P is mobile in the plant, deficiency symptoms are expressed in the older leaves. In corn and some other grass species, P deficiency symptoms can be recognized by a purple discoloration of the leaves or leave edges. For other crops, deficiency symptoms are less distinctive.

Phosphorus accumulation in soil on dairy farms is common. Klausner found that on typical New York State dairy farms 70 to 80% of the annual input of P remained on the farm (Klausner, 1997). Phosphorus can also accumulate in soils on cash crop, vegetable, and fruit farms when there is a history of high fertilization rates. Soil tests confirm the medium to very high P levels on many dairy farms. Soil test levels can vary widely from field to field depending on the distribution of manure and past fertilizer practices. Manure application rates calculated to meet N requirements will usually result in an over application of P because the P to N ratio in manure is higher than the requirements of most agronomic crops.

Phosphorus, like nitrogen, needs careful management to maximize economic returns and prevent losses to the environment. Phosphorus is the most limiting nutrient for the growth of aquatic plants in temperate lakes and, as a result, an overabundance of dissolved P in water can cause eutrofication resulting in oxygen deficiency and fish kills. The concentration of Morgan extractable P above which the loss of P is unacceptable, even when excellent management practices are followed, is unknown, but a reduction in the amount of surplus P in the soil will minimize the potential for loss. Phosphorus inputs could be reduced if:

- P content in the feed can be reduced and uptake efficiency can be increased without harming production or animal health.
- Manure application rates are reduced to match P removal of the crop.
- Manure is removed from farms having a surplus and transported to those having a deficit.

Although there is a limited amount of data, much of the annual P loss from fields appears to be associated with one or two severe runoff events that usually occur during the winter or very early spring. Soil management, timing of manure applications, fertilizer management, and the use of soil erosion and surface runoff control measures are crucial to ensure P loss is minimized.

7.3 PHOSPHORUS FORMS AND PLANT AVAILABILITY

Phosphorus is the least mobile of the major plant nutrients and exists in soils in many different forms:

- Dissolved P
    - Inorganic P (PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$, H_3PO_4 and some soluble organic compounds).
- Particulate P
    - Calcium phosphorus minerals.
    - Phosphorus attached to clay minerals and to iron and aluminum oxides.
    - Phosphorus incorporated into iron and aluminum oxides.
    - Phosphorus in soil organisms and in active and stable organic matter.

Plants take up dissolved HPO_4^{2-}, $H_2PO_4^-$, and some soluble organic P compounds from the soil. The plant converts these forms of P into organic P forms. When plants die, this plant-P is returned to the soil through decomposition by microorganisms. Other pathways through which P can be made available are:

- Weathering of soil minerals.
- Desorption from clay minerals.
- Mineralization of and desorption from manure and plant residues.
- Inorganic fertilizer.

The various forms of P are continually undergoing change with the general tendency towards less soluble or less available forms. When relatively soluble P is added to the soil in fertilizer or manure, the soluble fractions increase, but with time these slowly transform to less soluble and therefore less plant available forms. Phosphorus is in its most available form in near neutral soils. At pH 7.2, the amount of $H_2PO_4^-$ and HPO_4^{2-} are approximately equal. At low pH, soluble forms of iron, aluminum, manganese, and their hydrous oxides fix inorganic P. At high pH, P is mostly fixed as calcium phosphates.

Soils can hold large amounts of P. However, they are not bottomless pits and can reach a point where it is difficult to hold more P. Phosphorus can be lost from a field with crop harvest and through leaching, runoff, and erosion. Research is being conducted to determine the soil test level beyond which runoff and leaching risks become unacceptable.

7.4 CALCULATING PHOSPHORUS RECOMMENDATIONS FOR SPECIFIC FIELD CROPS

Phosphorus fertilizer recommendations are based on agronomic soil tests. These soil test results do not reflect the total amount of plant available P but are relative indices of plant available nutrients. At Cornell University, soil test P levels are classified as “Very Low”, “Low”, “Medium”, “High” and “Very High”. These classifications may differ depending on the crop. For example, for corn, Cornell University classifies soil test P

(STP) levels of 9-39 and ≥40 lbs P/acre (Morgan extractable P) as "High" and "Very High", respectively (See Table 7.1). Soil test levels <1 lb P/acre are considered "Very Low", 1-3 lbs P/acre is classified as "Low", and 4-8 lbs P/acre constitutes "Medium". Yield benefits from applied P are greatest for soils with a very low or low agronomic soil test. Once a high STP reading is reached, minimal P fertilization, from any source is required to support optimum yields. For most field crops, Cornell recommends little or no P fertilizer additions to fields with STP levels of 40 lbs P/acre or higher for two reasons: (1) P addition to these soils is not likely to result in yield gains; and (2) over-application may lead to P losses to surface and ground waters and thus contribute to environmental degradation.

Table 7.1: Classification of phosphorus status using the Cornell Morgan P soil test.

Cornell Morgan Test P	Classification*	Likeliness of an economic yield response to fertilizer P addition
<1	Very Low	Very High
1-3	Low	High
4-8	Medium	Medium
9-39	High	Low
≥40	Very High	Very Low

*Cornell P test classifications differ for winter grains (high is 9-20 and very high is ≥20 lbs P/acre).

Cornell's P recommendations for NY are based on soil P level extracted with the Morgan solution (Morgan, 1941). If soil tests are conducted at a laboratory other than Cornell University's Nutrient Analysis Laboratory (CNAL), a Cornell Morgan equivalent needs to be determined. See section 7.4 for details on the use of conversion equations.

In the following sections, Cornell University recommendations are listed for agronomic field crops grown in New York. For each of these crops, the crop codes that are used in Cornell University's nutrient management software (Cropware) and the nutrient analyses laboratory (CNAL) are listed as well. For a complete overview of crops and crop codes, see Table 7.A in the Appendix. Recommendations are expressed in lbs of P_2O_5 per acre. This is a legacy from old chemistry when fertilizers were thought to exist as oxides. In reality P_2O_5 does not exist but the oxide notation continues to be used to express fertilizer value. A fertilizer blend characterized as "10-20-20" contains 10%N, 20% P_2O_5 and 20% K_2O on a weight basis. Thus, when 200 lbs/acre of this fertilizer is applied, the actual application rate is 20 lbs of N (200*10%), 40 lbs of P_2O_5 (200*20%), and 40 lbs of K_2O (200*20%). One lb of P equals 2.3 lbs of P_2O_5. One lb of P_2O_5 equals 0.44 lb of P. A Cornell soil test result of 40 lbs P/acre does not mean that, for example, a corn crop will take up 40 lbs/acre only. Nor does it mean that there is only 40 lbs of P/acre. It simply implies that phosphorus is not limiting yields and that further addition is not needed (See also section 7.3). For all field crops, if the recommendation exceeds 25 lbs of P_2O_5, 25 lbs P_2O_5 may be applied as banded starter fertilizer and the remainder as manure or additional fertilizer. For topdressing, manure or inorganic fertilizer may be broadcast to meet the requirements. Careful timing is advised to prevent manure from being transported to surface waters (see section 13 on the New York P Runoff Index).

Grain corn and corn silage

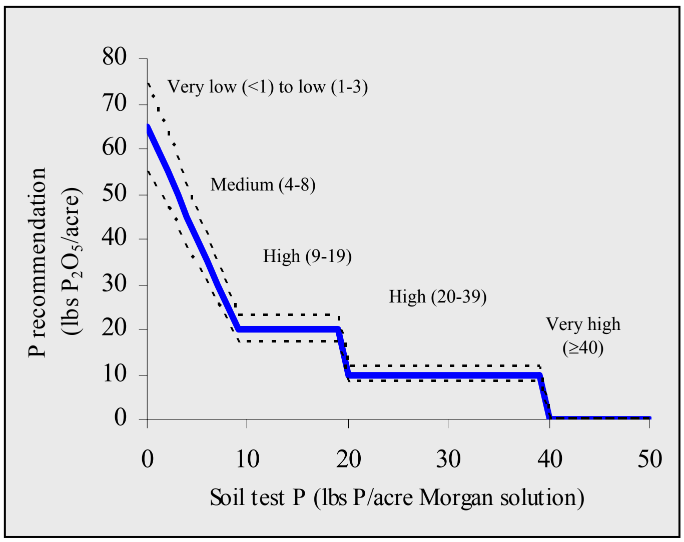
Phosphorus recommendations for grain corn (COG) and corn silage (COS) on soils with STPs <50 lbs P/acre are presented in Figure 7.1. The solid line is the "average" recommended fertilizer P application derived from the following equation:

$$\text{P recommendation (lbs } P_2O_5\text{/acre)} = 65 - (5 * STP) \qquad [1]$$

In this equation, STP stands for the Cornell Morgan soil phosphorus test results expressed in lbs P/acre. The dashed lines on the chart imply that recommendations are ranges rather than absolute values. Thus, optimum economic recommendations fall with the dashed lines for each soil test P level.

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)
<1	65
1	60
2	55
3	50
4	45
5	40
6	35
7	30
8	25
9-19	20
20-39	10
>40	0

* CNAL Morgan solution.



The solid line is the recommendation derived from fertilizer-response curves. Recommendations are optimal when between the dashed lines.

Figure 7.1: Phosphorus recommendations for grain corn (COG) and silage (COS) in NY.

Alfalfa, alfalfa birdsfoot-trefoil, and alfalfa grass

Recommendations for alfalfa (ALE, ALT), alfalfa/birdsfoot-trefoil (ABE, ABT), and alfalfa/grass (AGE, AGT) are given in Table 7.2. Note that once an alfalfa stand is established, the P requirements can be reduced by about 30 lbs of P_2O_5 per acre for a given

STP level. These recommendations can also be derived using the following set of equations:

For ALE, ABE and AGE:

If STP ≥ 80, P recommendation = 0 lbs P_2O_5/acre
If STP ≥ 40 but <80, P recommendation = 10 lbs P_2O_5/acre
If STP ≥ 20 but <40, P recommendation = 20 lbs P_2O_5/acre
If STP ≥ 10 but <20, P recommendation = 40 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [2]

For ALT, ABT and AGT:

If STP ≥20, P recommendation = 0 lbs P_2O_5/acre
If STP ≥9 but <20, P recommendation = 10 lbs P_2O_5/acre
If STP <9, P recommendation (lbs P_2O_5/acre) = 55 – (5 * STP) [3]

For topdressing, the P in broadcasted manure is considered to be as efficient as P in fertilizer. For establishment, optimum results can be achieved by applying the first 25 lbs of the recommendations in a band-placed fertilizer. Manure can be used to supply the rest.

Table 7.2: P recommendation for alfalfa (ALE, ALT), alfalfa/birdsfoot-trefoil (ABE, ABT), and alfalfa/grass mixtures (AGE, AGT).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)	
	Establishment (ALE, ABE, AGE)	Established (ALT ABT, AGT)
<1	85	55
1	80	50
2	75	45
3	70	40
4	65	35
5	60	30
6	55	25
7	50	20
8	45	15
9	40	10
10-19	40	10
20	20	10
21-39	20	0
40-79	10	0
80 or more	0	0

* CNAL Morgan solution.

Birdsfoot-trefoil, birdsfoot-trefoil/grass, birdsfoot-trefoil/clover, birdsfoot-trefoil seed, and crownvetch

Phosphorus recommendations for birdsfoot trefoil, birdsfoot trefoil grass, birdsfoot trefoil clover, birdsfoot trefoil seed, and crownvetch are listed in Table 7.3. As with alfalfa stands, recommendations are lowered by about 30 lbs P_2O_5/acre once the stands have been established.

Table 7.3: P recommendation for birdsfoot-trefoil (BTE, BTT), birdsfoot-trefoil/grass (BGE, BGT), birdsfoot-trefoil/clover (BCE, BCT), birdsfoot-trefoil seed (BSE, BST), and crownvetch (CVE, CVT).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)	
	Establishment (BTE, BGE, BCE, BSE, CVE)	Established (BTT, BGT, BCT, BST, CVT)
<1	85	50
1	80	45
2	75	40
3	70	35
4	65	30
5	60	25
6	55	20
7	50	15
8	45	10
9	40	5
10-20	40	0
21-29	30	0
30-39	20	0
40-49	10	0
50 or more	0	0

* CNAL Morgan solution.

These recommendations can also be derived using the following set of equations:

<u>For BTE, BGE, BCE, BSE, and CVE:</u>

If STP ≥ 50, P recommendation = 0 lbs P_2O_5/acre
If STP ≥ 40 but <50, P recommendation = 10 lbs P_2O_5/acre
If STP ≥ 30 but <40, P recommendation = 20 lbs P_2O_5/acre
If STP ≥ 20 but <30, P recommendation = 30 lbs P_2O_5/acre
If STP ≥ 10 but <20, P recommendation = 40 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [4]

For BTT, BGT, BCT, BST, and CVT:

If STP ≥ 10, P recommendation = 0 lbs P_2O_5/acre

If STP <10, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [5]

The P in broadcasted manure is about as efficiently used as P in broadcasted fertilizer so for topdressing (established fields), the requirement can be met with either manure or fertilizer P. For establishment of these field crops, banded applications are far more efficient than broadcast P applications and are thus more likely to result in a yield response.

Spring or winter barley with legumes, oats with legumes, and wheat with legumes

Phosphorus recommendations for spring barley with legumes (BSS), winter barley with legumes (BWS), oats with legumes (OAS), wheat with legumes (WHS), and triticale/peas (TRP) are listed in Table 7.4.

Table 7.4: P recommendation for spring barley with legumes (BSS), winter barley with legumes (BWS), oats with legumes (OAS), wheat with legumes (WHS), and triticale/peas (TRP).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)
<1	85
1	80
2	75
3	70
4	65
5	60
6	55
7	50
8	45
9	40
10-20	40
21-29	30
30-39	20
40-49	10
50 or more	0

* CNAL Morgan solution.

These recommendations can also be derived using the following set of equations:

If STP ≥ 50, P recommendation = 0 lbs P_2O_5/acre

If STP ≥ 40 but <50, P recommendation = 10 lbs P_2O_5/acre

If STP ≥ 30 but <40, P recommendation = 20 lbs P_2O_5/acre

If STP ≥ 20 but <30, P recommendation = 30 lbs P_2O_5/acre

If STP ≥ 10 but <20, P recommendation = 40 lbs P_2O_5/acre

If STP <10, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [6]

Buckwheat, oats, sorghum forage, soybeans, sorghum sudan hybrid, and sudangrass.

Phosphorus recommendations for buckwheat (BUK), oats (OAT), sorghum forage (SOF), soybeans (SOY), sorghum/sudan hybrids (SSH), and sudangrass (SUD) as a function of soil test P level are listed in Table 7.5.

These recommendations can also be derived using the following set of equations:

If STP $\geq$ 40, P recommendation = 0 lbs P_2O_5/acre
If STP $\geq$ 6 but <40, P recommendation = 20 lbs P_2O_5/acre
If STP <6, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [7]

Table 7.5: P recommendation for buckwheat (BUK), oats (OAT), sorghum forage (SOF), soybeans (SOY), sorghum/sudan hybrid (SSH), and sudangrass (SUD).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)
<1	50
1	45
2	40
3	35
4	30
5	25
6-39	20
40 or more	0

* CNAL Morgan solution.

Spring barley, winter barley, millet, sorghum grain, wheat, and sunflowers.

Phosphorus recommendation for spring barley (BSP), winter barley (BWI), millet (MIL), sorghum grain (SOG), wheat (WHT), and sunflowers (SUN) are given in Table 7.6. These recommendations can also be derived using the following set of equations:

If STP $\geq$ 40, P recommendation = 0 lbs P_2O_5/acre
If STP $\geq$ 9 but <40, P recommendation = 20 lbs P_2O_5/acre
If STP <9, P recommendation (lbs P_2O_5/acre) = 65 - (5 * STP) [8]

Table 7.6: P recommendation for spring barley (BSP), winter barley (BWI), millet (MIL), sorghum grain (SOG), wheat (WHT), and sunflowers (SUN).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)
<1	65
1	60
2	55
3	50
4	45
5	40
6	35
7	30
8	25
9-39	20
40 or more	0

* CNAL Morgan solution.

Clover, clover grass, and clover seed production

Recommendations for clover (CLE and CLT), clover grass (CGE and CGT), and clover seed production (CSE, CST) can be found in Table 7.7.

Table 7.7: P recommendation for clover (CLE, CLT), clover grass (CGE, CGT), and clover seed production (CSE, CST).

Soil test P	Recommendation (lbs P_2O_5/acre)	
(lbs P/acre*)	Establishment (CGE, CLE, CSE)	Established (CGT, CLT, CST)
<1	65	50
1	60	45
2	55	40
3	50	35
4	45	30
5	40	25
6	35	20
7	30	15
8	25	10
9	20	5
10-19	20	0
20-39	10	0
40 or more	0	0

* CNAL Morgan solution.

These recommendations can also be derived using the following set of equations:

For CGE, CLE, and CSE:

If STP ≥ 40, P recommendation = 0 lbs P_2O_5/acre
If STP ≥ 20 but <40, P recommendation = 10 lbs P_2O_5/acre
If STP ≥ 10 but <20, P recommendation = 20 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 65 - (5 * STP) [9]

For CGT, CLT and CST:

If STP ≥10, P recommendation = 0 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [10]

Intensively managed grasses, grasses, pasture, pastures with improved grasses, intensively grazed pasture, pasture with native grasses, and pastures with legumes.

Table 7.8 lists the recommendation for intensively managed grasses (GIE and GIT), grasses (GRE and GRT), pastures with improved grasses (PGE and PGT), intensively grazed pasture (PIE and PGT), and pasture with native grasses (PNT). No distinction is made between requirements for establishment and topdressing. These recommendations can also be derived using the following set of equations:

For GIE, GIT, GRE, GRT, PGE, PGT, PIE, PIT, and PNT:

If STP ≥10, P recommendation = 0 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [11]

Table 7.8: P recommendation for intensively managed grasses (GIE, GIT), grasses (GRE, GRT), pastures with improved grasses (PGE, PGT), intensively grazed pasture (PIE, PIT), and pasture with native grasses (PNT).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)
<1	50
1	45
2	40
3	35
4	30
5	25
6	20
7	15
8	10
9	5
10 or more	0

* CNAL Morgan solution.

Recommendations for establishing and topdressing pasture with legumes (PLE and PLT) are listed in Table 7.9. These recommendations can also be derived using the following set of equations:

For PLE:

If STP ≥40, P recommendation = 0 lbs P_2O_5/acre
If STP <40, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [12]

For PLT:

If STP ≥10, P recommendation = 0 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [13]

Table 7.9: P recommendation for pasture with legumes (PLE, PLT).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)	
	Establishment (PLE)	Established (PLT)
0	85	50
1	80	45
2	75	40
3	70	35
4	65	30
5	60	25
6	55	20
7	50	15
8	45	10
9	40	5
10-39	40	0
40 or more	0	0

* CNAL Morgan solution.

Rye cover crops and rye seed production

Recommendations for rye cover crops (RYC) and for rye seed production (RYS) are given in Table 7.10. Note that the recommendations for seed production are 35 to 40 lbs P_2O_5 higher than those for cover crop growth. These recommendations can also be derived using the following set of equations:

For RYC:

If STP ≥10, P recommendation = 0 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 50 - (5 * STP) [14]

For RYS:

If STP ≥10, P recommendation = 40 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [15]

Table 7.10: P recommendation for rye cover crop (RYC) and seed production (RYS).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)	
	Cover Crop (RYC)	Seed Production (RYS)
<1	50	85
1	45	80
2	40	75
3	35	70
4	30	65
5	25	60
6	20	55
7	15	50
8	10	45
9	5	40
10 or more	0	40

* CNAL Morgan solution.

Idle land, Christmas trees, and waterways.

No P is recommended for idle land. Recommendations for Christmas trees and waterways are given in Table 7.11. These recommendations can also be derived using the following set of equations:

For Christmas trees:

For TRE:

If STP ≥4, P recommendation = 0 lbs P_2O_5/acre
If STP <4, P recommendation (lbs P_2O_5/acre) = 100 - (25 * STP) [16]

For TRT:

If STP ≥3, P recommendation = 0 lbs P_2O_5/acre
If STP <3, P recommendation (lbs P_2O_5/acre) = 75 - (25 * STP) [17]

For waterways:

For WPE:

If STP ≥40, P recommendation = 0 lbs P_2O_5/acre
If STP ≥10 and <40, P recommendation = 40 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 85 - (5 * STP) [18]

For WPT:

If STP ≥40, P recommendation = 0 lbs P_2O_5/acre
If STP ≥10 and <40, P recommendation = 40 lbs P_2O_5/acre
If STP <10, P recommendation (lbs P_2O_5/acre) = 90 - (5 * STP) [19]

Table 7.11: P recommendation for Christmas trees (TRE, TRT) and waterways (WPE, WPT).

Soil test P (lbs P/acre*)	Recommendation (lbs P_2O_5/acre)			
	Christmas Trees		Waterways	
	Establishment (TRE)	Established (TRT)	Establishment (WPE)	Established (WPT)
<1	100	75	85	90
1	75	50	80	85
2	50	25	75	80
3	25	0	70	75
4	0	0	65	70
5	0	0	60	65
6	0	0	55	60
7	0	0	50	55
8	0	0	45	50
9	0	0	40	45
10-39	0	0	40	40
40 or more	0	0	0	0

* CNAL Morgan solution.

7.5 Soil Test conversion Equations

Cornell University fertilizer recommendations are based on decades of field research in NY showing soil nutrients extracted by Morgan solution (sodium acetate buffered at pH 4.8) are correlated well with nutrient response for the vast array of soil types in NY. However, several private soil-testing laboratories that serve NY producers (i.e., Brookside Laboratories Inc., Spectrum Analytic, Inc., A&L Eastern Laboratories Inc., and A&L Laboratories Canada) use the Mehlich-III extraction solution (an unbuffered solution of acetate, ammonium nitrate, ammonium fluoride, and ethylenediaminetetraacetic acid) for soil test P determination. Another laboratory used by Northern New York growers is the laboratory of the University of Vermont. This laboratory uses the modified Morgan extraction (ammonium acetate buffered at pH 4.8). The same test is also offered (on request) by Spectrum Analytic, Inc. and A&L Eastern Laboratories Inc.

Compliance with USDA-NRCS (Nutrient Management Standard 590) requires that comprehensive nutrient management plans be based on land grant recommendations. In New York, this implies that Mehlich-III and modified Morgan soil test results need to be converted to Cornell Morgan equivalents prior to calculating the soil P contribution to the NY P Index and P fertilizer recommendations.

Cornell Cropware allows Mehlich-III inputs from the above mentioned laboratories with a warning that states that the user should realize that conversion equations add uncertainty to the recommendations and that the user assumes all risk. Currently, Cornell Cropware does not currently allow for the use of soil test data from laboratories other than those listed above because it is unknown how those results compare to Cornell University's Nutrient Analysis Laboratory. Additionally, a downloadable MS Excel-based soil test conversion tool as well as a web-based conversion tool were developed. The conversion tool and Cropware can be accessed through the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). Studies to derive Morgan equivalents for soil test results from other laboratories in the Northeast are ongoing. An article on the initial conversion equation derived for Brookside Laboratory soil test data was published in the December 2002 issue of Soil Science (Ketterings et al., 2002).

Mehlich-III: conversion for Brookside Laboratories Inc.

Mehlich-III soil test P data from Brookside Laboratories Inc. can be used to estimate Morgan P equivalents in lbs/acre if Mehlich-III Ca, Al, and the pH of the soil are known:

$$\text{Morgan STP (lbs P/acre)} = 3.3957 + (1.1705*B\_P) - (0.003799*B\_Ca) - (27.24*pH) + (0.1218*B\_Al) - (0.00005760*B\_Al^2) + (2.6867*pH^2) + (0.00009335*B\_P*B\_Ca) - (0.001940*B\_P*B\_Al) + (0.00000080*B\_P*B\_Al^2)$$

$(r^2=0.88, n=235)$ [20]

In this equation *all input data are in ppm.* Morgan STP is Morgan extractable soil test P in lbs P per acre, B_P is Mehlich-III extractable P, B_Al is Mehlich-III extractable Al, B_Ca is Mehlich-III extractable Ca, and pH is the soil pH in water. If the model predicts a negative Morgan equivalent, a value of 2 lbs/acre is assumed. This model predicted 86% of the dataset within 5 ppm (10 lbs/acre) of the measured value.

Mehlich-III: conversion for Spectrum Analytic Inc.

Soil test results for the same soil sample analyzed for Mehlich-III Ca, P, and Al differ between Brookside Laboratories Inc., A&L Eastern Laboratories Inc., and Spectrum Analytic Inc. due to differences in analytical procedures and reporting. Brookside Laboratories Inc. and A&L Laboratories report a Mehlich-III result while Spectrum Analytic Inc. conducts the Mehlich-III test but reports Bray-1 P equivalents obtained by multiplying the Mehlich-III result by a factor of 0.7. Morgan P equivalents for soil test results *reported* by Spectrum Analytic Inc. can be derived using the following equation:

$$\text{Morgan STP (lbs P/acre)} = -49.2971 + (0.7850*Sp\_P) - (0.002174*Sp\_Ca) - (11.8281*pH) + (0.1350*Sp\_Al) - (0.00006742*Sp\_Al^2) + (1.5452*pH^2) + (0.00004146*Sp\_P*Sp\_Ca) - (0.001353*Sp\_P*Sp\_Al) + (0.00000057*Sp\_P*Sp\_Al^2)$$

(r^2=0.88, n=235) [21]

In this equation *all input data are in lbs/acre except for Morgan extractable Al* which is reported in ppm on a standard soil test report from Spectrum Analytic Inc. Morgan STP is Cornell University's Morgan extractable soil test P in lbs P per acre, Sp_P and Sp_Ca are soil test P and Ca in lbs/acre as reported by Spectrum Analytic and Sp_Al is Mehlich-III extractable Al (ppm). If the model predicts a negative Morgan equivalent, a value of 2 lbs/acre is assumed.

Mehlich-III: conversion for A&L Eastern Laboratories Inc.

Mehlich-III soil test P data from A&L Eastern Laboratories Inc. can be used to estimate Morgan P equivalents in lbs/acre if Mehlich-III Ca, Al and the pH of the soil are known:

$$\text{Morgan STP (lbs P/acre)} = 45.52106614 + (1.44109538*AE\_P) - (0.00250878*AE\_Ca) - (42.04727550*pH) + (0.09744870*AE\_Al) - (0.00003732*AE\_Al^2) + (4.00344858*pH^2) + (0.00006744*AE\_P*AE\_Ca) - (0.00220826*AE\_P*AE\_Al) + (0.00000084*AE\_P*AE\_Al^2)$$

(r^2=0.88, n=235) [22]

In this equation *all input data are in ppm.* Morgan STP is Cornell Morgan extractable soil test P in lbs P per acre, AE_P is Mehlich-III extractable P, AE_Al is Mehlich-III extractable Al, AE_Ca is Mehlich-III extractable Ca, and pH is the soil pH in water. If the model predicts a negative Morgan equivalent, a value of 2 lbs/acre is assumed. This model predicted 86% of the dataset within 5 ppm (10 lbs/acre) of the measured value.

Mehlich-III: conversion for A&L Canada Laboratories Inc.

Mehlich-III soil test P data from A&L Canada Laboratories Inc. can be used to estimate Morgan P equivalents in lbs/acre if Mehlich-III Ca, Al, and the pH of the soil are known:

Morgan STP (lbs P/acre) =

$$41.06969994 + (1.49813232*AC\_P) - (0.00282226*AC\_Ca) - (45.0073006*pH) + (0.13061109*AC\_Al) - (0.00005684*AC\_Al^2) + (4.31119254*pH^2) + (0.00007159*AC\_P*AC\_Ca) - (0.00247840*AC\_P*AC\_Al) + (0.00000102*AC\_P*AC\_Al^2)$$

(r^2=0.89, n=228) [23]

In this equation *all input data are in ppm*. Morgan STP is Cornell Morgan extractable soil test P in lbs P per acre, AC_P is Mehlich-III extractable P, AC_Al is Mehlich-III extractable Al, AC_Ca is Mehlich-III extractable Ca, and pH is the soil pH in water. If the model predicts a negative Morgan equivalent, a value of 2 lbs/acre is assumed.

(Modified) Morgan: conversions for A&L Eastern Laboratories Inc., Spectrum Analytic Inc., and the University of Vermont.

Modified Morgan P extraction data from A&L Eastern Laboratories Inc. (AE_MP in ppm) should be multiplied by 1.8 to obtain Cornell Morgan soil test equivalents prior to deriving fertilizer recommendations:

A&L Eastern Laboratories:

Morgan STP (lbs P/acre) = 1.8*AE_MP (n=235, r^2=0.97) [24]

Morgan P test results from Spectrum Analytic Inc. can be converted to Cornell Morgan equivalents according to the following equations (Sp_MP is the modified Morgan test result in lbs/acre):

Spectrum Analytic Inc.:

For Sp_MP < 106 lbs P/acre:

Morgan STP (lbs P/acre) = 1.2*Sp_MP – 8 (n=64, r^2=0.97)

For Sp_MP ≥ 53 lbs P/acre:

Morgan STP (lbs P/acre) = 1.5*Sp_MP – 42 (n=18, r^2=0.65)

[25]

Modified Morgan P test results from the University of Vermont (UVM) can be converted to Cornell Morgan equivalents according to the following equation (UVM_MP is the modified Morgan test result in ppm):

University of Vermont:

Morgan STP (lbs P/acre) =1.7*UVM_MP – 1

(n=232, r^2=0.92) [26]

If these models predict a negative Morgan equivalent, a value of 2 lbs/acre is assumed.

7.6 SOURCES OF PHOSPHORUS

Manure

Manure P is primarily in the organic form and must mineralize to an inorganic form before being available to a crop. Repeated manure applications at rates beyond crop removal will increase soil test P levels. Thus, soil sampling should be done regularly (at least once in 3 years, ideally once every year) to monitor soil test P levels when manure is being applied. Placement of P is important when establishing a crop. Broadcasted manure P cannot be substituted for a banded starter fertilizer P placed in close proximity to the seed. If manure will be applied after the soil test was taken, the following P, K, and micronutrient guidelines are offered:

- ***For crop establishment:***
  - If the P recommendation is less than 25 lbs/acre, apply the entire amount as a band placed starter fertilizer.
  - If the P recommendation exceeds 25 lbs/acre, apply 25 lbs as a band placed starter fertilizer and use manure to supply the rest.

- ***For topdressing:***
  - If the P recommendation is less than 30 lbs/acre, use fertilizer to supply the entire P requirement.
  - If the P recommendation exceeds 30 lbs/acre, apply 30 lbs in a topdressed fertilizer and use manure to supply the rest.

When manure is applied at a rate to supply the needed N, both P and K are likely to be applied in excess of crop requirements. The excess can be used by a later crop in the rotation. However, continuous application of manure to the same field will result in an accumulation of soil P to a high enough level that crops will no longer respond to added manure or fertilizer P. The excessive inputs of P result in a very high soil test value. Further additions of fertilizer P are costly and are not expected to lead to a yield increase. The potential for P loss increases with an increase in the soil P content.

Phosphorus containing fertilizers

Table 7.12 lists common P fertilizers. Single super and triple super phosphates contain P in the form of calcium orthophosphate. Ammoniated superphosphate is obtained by reacting superphosphates with anhydrous ammonium. Superphosphates are considered neutral because their application does not appreciably affect the soil pH. Both ammoniated superphosphates and monoammonium phosphate make excellent sources of N and P for band application.

To avoid fertilizer injury, it is recommended that fertilizer band application rates remain lower than: 1) 30 lbs of P_2O_5 from diammonium phosphate; 2) 20-30 lbs of urea N plus N from diammonium phosphate; and 3) 30-40 lbs of ammonium N from all sources in combination with diammonium phosphate.

Table 7.12: Phosphorus containing inorganic fertilizers.

	%N	$\%P_2O_5$	$\%K_2O$	%S
Single superphosphate (SSP)	0	20	0	14
Triple superphosphate* (TSP or CSP)	0	46	0	2
Ammonium polyphosphate	10	34	0	0
Ammoniated superphosphate	5	40	0	12
Monoammonium phosphate (MAP)	13	52	0	2
Diammonium phosphate (DAP)	18	46	0	0
Urea-ammonium phosphate (UAP)	28	28	0	0
Monopotassium phosphate	0	50	40	0

* Also referred to as concentrated superphosphate.

7.7 APPENDIX

Appendix Table 7.A: Cornell Crop Codes.

Crop Code	Crop Description
	Alfalfa
ABE	Alfalfa trefoil grass, Establishment
ABT	Alfalfa trefoil grass, Established
AGE	Alfalfa grass, Establishment
AGT	Alfalfa grass, Established
ALE	Alfalfa, Establishment
ALT	Alfalfa, Established
	Birdsfoot
BCE	Birdsfoot trefoil clover, Establishment
BCT	Birdsfoot trefoil clover, Established
BGE	Birdsfoot trefoil grass, Establishment
BGT	Birdsfoot trefoil grass, Established
BSE	Birdsfoot trefoil seed, Establishment
BST	Birdsfoot trefoil seed, Established
BTE	Birdsfoot trefoil, Establishment
BTT	Birdsfoot trefoil, Established
	Barley
BSP	Spring barley
BSS	Spring barley with legumes
BUK	Buckwheat
BWI	Winter barley
BWS	Winter barley with legumes
	Clover
CGE	Clover grass, Establishment
CGT	Clover grass, Established
CLE	Clover, Establishment
CLT	Clover, Established
CSE	Clover seed production, Establishment
CST	Clover seed production, Established
	Corn
COG	Corn grain
COS	Corn silage

Appendix Table 7.A (continued)

Crop Code	Crop Description
	Grasses, pastures, covercrops
CVE	Crownvetch, Establishment
CVT	Crownvetch
GIE	Grasses intensively managed, Establishment
GIT	Grasses intensively managed, Established
GRE	Grasses, Establishment
GRT	Grasses, Established
PGE	Pasture, Establishment
PGT	Pasture improved grasses, Established
PIE	Pasture intensively grazed, Establishment
PIT	Pasture intensively grazed, Established
PLE	Pasture with legumes, Establishment
PLT	Pasture with legumes, Established
PNT	Pasture native grasses
RYC	Rye cover crop
RYS	Rye seed production
TRP	Triticale peas
	Small grains
MIL	Millet
OAS	Oats with legume
OAT	Oats
SOF	Sorghum forage
SOG	Sorghum grain
SOY	Soybeans
SSH	Sorghum sudangrass hybrid
SUD	Sudangrass
WHS	Wheat with legume
WHT	Wheat
	Vegetables
ASP	Asparagus
BDR	Beans - Dry
BET	Beet
BNL	Beans - Lima
BNS	Beans - Snap
BRP	Broccoli-Transplanted
BRS	Broccoli-Seeded
BUS	Brussels Sprouts

Appendix Table 7.A (continued)

Crop Code	Crop Description
CAR	Carrots
CBP	Cabbage-Trans
CBS	Cabbage - Seeded
CEL	Celery
CFP	Cauliflower - Transplanted
CFS	Cauliflower - Seeded
CHC	Chinese Cabbage
CKP	Cucumber - Transplanted
CKS	Cucumber - Seeded
CRD	Chard
EGG	Eggplant
END	Endive
GAR	Garlic
LET	Lettuce
MIX	Mixed Vegetables
MML	Muskmelon
MUS	Mustard
ONP	Onion-Transplant
ONS	Onion-Seeded
PEA	Pea
PEP	Peppers
POP	Popcorn
POT	Potato
PSL	Parsley
PSN	Parsnips
PUM	Pumpkins
RAD	Radishes
RHU	Rhubarb
RUT	Rutabagas
SPF	Spinach-Fall
SPS	Spinach-Spring
SQS	Squash-Summer
SQW	Squash-Winter
SWC	Sweet Corn
TOM	Tomato
TUR	Turnips
WAT	Watermelon
	Others
SUN	Sunflower
TRE	Christmas trees, Establishment
TRT	Christmas trees, Established

Appendix Table 7.B: Phosphorus Concentrations for Field Crops and Vegetable Crops[1].

Field Crops		%P	$\%P_2O_5$	Vegetable Crops*		%P	$\%P_2O_5$
		% of dry matter				% of dry matter	
ALT	Alfalfa	0.33	0.76	ASP	Asparagus	0.71	1.62
AGE/ AGT	Alfalfa-grass mix	0.23	0.53	BDR	Beans – Dry	0.53	1.22
ABE/ ABT	Alfalfa-trefoil-grass	0.23	0.53	BET	Beets	0.34	0.79
BTE/ BTT	Birdsfoot trefoil	0.23	0.53	BNL	Beans – Lima	0.45	1.03
BGE/ BGT	Birdsfoot trefoil-grass	0.23	0.53	BNS	Beans – Snap	0.50	1.14
BCE/ BCT	Birdsfoot trefoil-clover	0.23	0.53	BRP	Broccoli – Transplanted	0.75	1.73
BSE/ BST	Birdsfoot trefoil-seed	0.23	0.53	BRS	Broccoli – Seeded	0.75	1.73
CLE/ CLT	Clover	0.34	0.78	BUS	Brussels Sprouts	0.51	1.17
CGE/ CGT	Clover-grass	0.24	0.55	CAR	Carrots	0.33	0.75
CSE/ CST	Clover-seed production	0.34	0.78	CBP	Cabbage – Transplanted	0.36	0.82
CVE/ CVT	Crownvetch	0.34	0.78	CBS	Cabbage – Seeded	0.36	0.82
GRE/ GRT	Grasses	0.28	0.64	CEL	Celery	0.67	1.52
GIE/ GIT	Grass-intensive management	0.34	0.78	CFP	Cauliflower – Transplanted	0.66	1.52
PIE/ PIT	Pasture-grazing rotational	0.34	0.78	CFS	Cauliflower – Seeded	0.66	1.52

[1] All data on vegetable crops and the data on field crops marked with an asterisk (*) were obtained from the NRCS Plant Database (http://npk.nrcs.usda.gov). All other field crop data were obtained from DairyOne, Inc.

Appendix Table 7.B (continued)[2]

Field Crops		%P	%P_2O_5	Vegetable Crops*		%P	%P_2O_5
		% of dry matter				% of dry matter	
PGE/ PGT	Pasture with Improved grass	0.34	0.78	CKP	Cucumber – Transplanted	0.53	1.20
PLE/ PLT	Pasture with legumes	0.24	0.55	CKS	Cucumber – Seeded	0.53	1.20
PNT	Pasture with native grasses	0.34	0.78	EGG	Eggplant	0.31	0.72
WPE/ WPT	Waterways, pond dikes	0.15	0.34	END	Endive	0.45	1.03
BSP	Barley-spring	0.29	0.66	LET	Lettuce	0.60	1.37
BSS	Barley-spring with legume	0.29	0.66	MML	Muskmelon	0.22	0.50
BWI	Barley-winter	0.29	0.66	ONP	Onion – Transplanted	0.30	0.69
BWS	Barley-winter with legume	0.29	0.66	ONS	Onion – Seeded	0.30	0.69
BUK*	Buckwheat	0.36	0.82	PEA	Peas	0.49	1.13
COG	Corn-grain	0.31	0.71	PEP	Peppers	0.34	0.77
COS	Corn-silage	0.27	0.62	POT	Potato	0.24	0.55
MIL*	Millet	0.34	0.78	PSN	Parsnips	0.36	0.83
OAT*	Oats	0.31	0.71	PUM	Pumpkins	0.39	0.90
OAS	Oats-seeded with legume	0.30	0.69	RAD	Radishes	0.44	1.01

[2] All data on vegetable crops and the data on field crops marked with an asterisk (*) were obtained from the NRCS Plant Database (http://npk.nrcs.usda.gov). All other field crop data were obtained from DairyOne, Inc.

Appendix Table 7.B (continued)[3]

Field Crops		%P	$\%P_2O_5$	Vegetable Crops*		%P	$\%P_2O_5$
		% of dry matter				% of dry matter	
RYC	Rye-cover crop	0.36	0.82	RHU	Rhubarb	0.23	0.54
RYS	Rye-seed production	0.36	0.82	RUT	Rutabagas	0.41	0.94
SOG	Sorghum-grain	0.22	0.50	SPF	Spinach – Fall	0.54	1.24
SOF	Sorghum-forage	0.22	0.50	SPS	Spinach – Spring	0.54	1.24
SSH	Sorghum-sudan hybrid	0.50	1.15	SQS	Squash – Summer	0.49	1.12
SUD	Sudangrass	0.50	1.15	SQW	Squash – Winter	0.27	0.62
SOY	Soybeans	0.65	1.49	SWC	Sweetcorn	0.38	0.88
SUN	Sunflower	1.02	2.34	TOM	Tomato	0.47	1.08
TRP	Triticale/peas	0.30	0.69	TUR	Turnips	0.37	0.86
WHT	Wheat	0.29	0.66	WAT	Watermelon	0.11	0.26

Downloadable from: http://nmsp.css.cornell.edu/. Last updated: May 19, 2003.

To obtain P_2O_5 removal rates, multiply yield in lbs/acre with dry matter content in % and P_2O_5 concentration in % and divide the final answer by 10,000. Thus, estimated P_2O_5 removal by a 20 ton/acre corn silage harvest at 35% dry matter amounts to 20*2,000*35*0.61/10,000=85.4 lbs P_2O_5 (an estimated 4.3 lbs P_2O_5/ton of silage).

[3] All data on vegetable crops and the data on field crops marked with an asterisk (*) were obtained from the NRCS Plant Database (http://npk.nrcs.usda.gov). All other field crop data were obtained from DairyOne, Inc.

8. NUTRIENT GUIDELINES: POTASSIUM

from

POTASSIUM GUIDELINES FOR FIELD CROPS IN NEW YORK

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8.2 INTRODUCTION

After nitrogen and phosphorus, potassium (K) is the nutrient most likely to limit plant productivity. It is commonly applied to soils as a fertilizer. Potassium acts as an activator for cellular enzymes involved in processes such as energy metabolism, starch synthesis, nitrate reduction, photosynthesis, nitrogen fixation, and sugar degradation. Potassium plays an important role in lowering cellular osmotic potentials, allowing plants to reduce transpiration from leaves and to increase uptake through the roots. Plants with optimum potassium levels are known to be more resistant to environmental stresses including drought.

Presently, K is not considered a contaminant in water or a threat to water quality. However, K should be managed appropriately to improve crop production economics, reduce its loss, and to prevent excessive build up in soils. Excessive soil K may cause an accumulation of K in the feed ration and pose a health risk for transition cows.

8.3 POTASSIUM FORMS AND PLANT AVAILABILITY

Soil K can be divided into three major pools of availability. Unavailable or nonexchangeable potassium is contained in soil minerals (micas and feldspars). These primary minerals are the original source of potassium. Plants cannot use K in these crystalline insoluble forms. However, over long periods of time, these soil minerals weather and decompose, thereby releasing K. Most of the soil K is contained in this primary non-exchangeable mineral form.

Readily available K is composed of exchangeable and soil solution K. The total amount of K in this pool is relatively small (one or two percent of the total K in the soil). Potassium is a positively charged ion (cation). It does not leach readily because of its attraction to the soil's negative charge. However, K can leach in very sandy soils with a low cation exchange capacity.

Slowly available or exchangeable K is part of the internal structure of clay minerals of the soil. Some of the readily soluble K applied in fertilizer and manure may be temporarily converted to a more slowly available form within the clay structure.

Much of the K required for crop production can be derived from the pool of exchangeable K. Some potassium may be returned to the soil as a result of leaching from plant foliage by rainwater or irrigation.

8.4 SOIL MANAGEMENT GROUPS

New York agricultural soils are divided into five mineral soil management groups and a sixth group that includes organic (muck) soils, urban soils, the Adirondack Mountains, Tug Hill, and primarily rock land (Figure 8.1). There is a good correlation between the groups and their ability to supply K. The five mineral groups are classified according to texture of the surface and subsoil and parent material (lake sediments, calcareous glacial till, glacial outwash and recent alluvium). Table 8.1 gives an overview of the five mineral soil management groups. A complete list of New York soils and their soil management group classification can be found in Table 17.1. In the following sections, each of the soil management groups is discussed briefly.

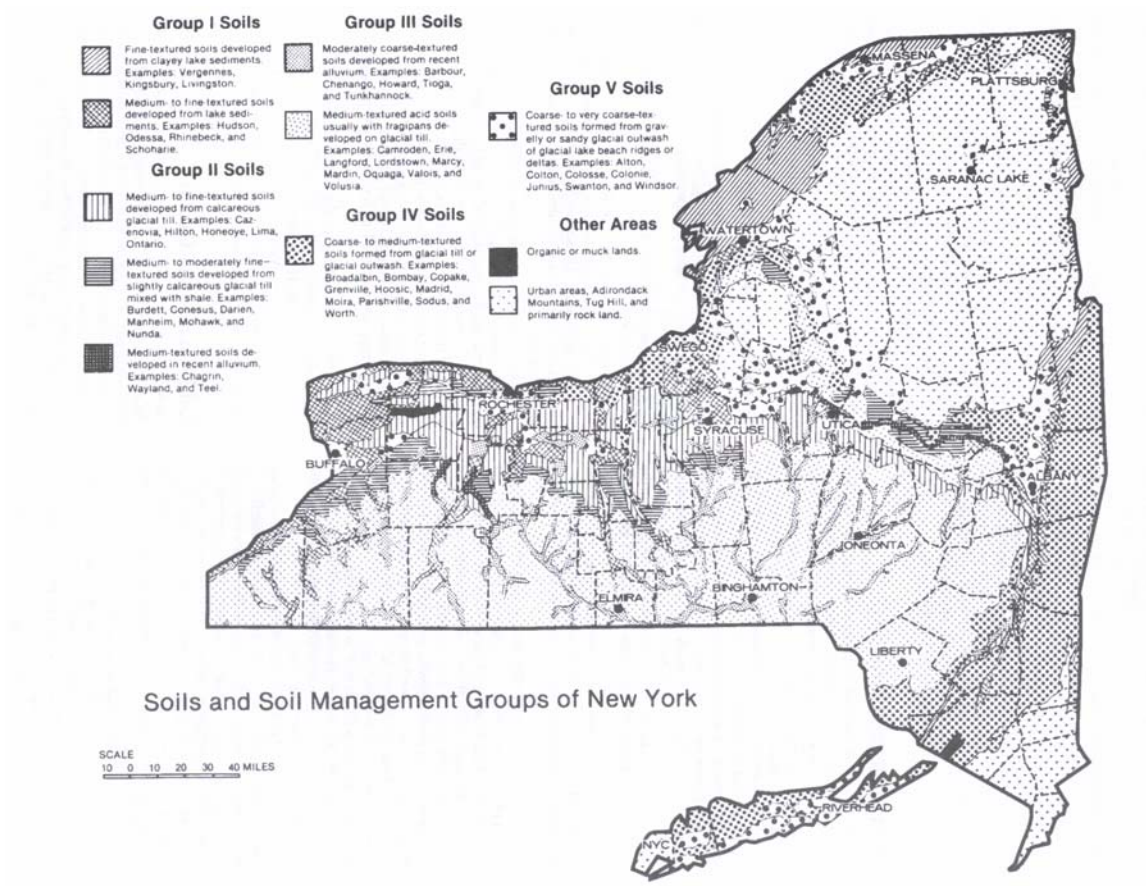

Figure 8.1: Soils and soil management groups of New York. Printed with permission from the Cornell Field Crops and Soils Handbook (1987). Cornell Cooperative Extension. Ithaca, NY.

Table 8.1: Soil management groups for New York State agricultural soils (modified from: Cornell Field Crops and Soils Handbook, Cornell Cooperative Extension, 1987).

Soil Management Group	General Description
I (1)	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
II (2)	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
III (3)	Moderately coarse-textured soils developed from glacial outwash and recent alluvium and medium-textured acid soils with fragipans developed on glacial till.
IV (4)	Coarse- to medium-textured soils formed from glacial till or glacial outwash.
V (5)	Coarse-textured to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas.
VI (6)	Organic or muck soils with more than 80% organic matter.

Soil management group I

The soils in this management group are medium- to fine-textured soils developed from lake sediments. They are heavy, generally wet soils formed from lake or marine sediments deposited in glacial lakes. They are characterized by a very slowly permeable subsurface of silty clay to clay.

Subgroup IA

These are fine-textured soils developed from clayey lake sediments. These are the heavy, generally wet soils formed from lake or marine sediments with silty clay loam to clay surfaces over heavier silty clay to clay subsoils. They contain little or no sand or gravel. The slope is generally level or nearly level, and the topography is level to undulating. The very slowly permeable profile and nearly level slopes make soil drainage and water management difficult but very important. Land smoothing and open ditches with good outlets are recommended. Rotations containing sod crops, cultural practices such as fall plowing, the incorporation of organic residues, and timely fitting operations at proper moisture conditions should be used to maintain good soil tilth for optimum crop yields. The water-holding capacity of these soils is high; but because of limited rooting in the clayey subsoils, crops suffer from drought more frequently than when grown on group II or III soils.

The soil pH ranges from 5.4 to 7.0; thus lime may or may not be needed. If the pH is low, large quantities of lime are required. Magnesium on these soils is usually adequate to high. The organic matter content is generally high, but the release of nitrogen (N) is slow, especially in the spring because of the cold, wet nature of these soils. The nitrogen supplying power of these soils usually exceeds 80 pounds per acre per year. The efficiency of applied N is often low, especially if applied pre-plant. These heavy-textured soils are often waterlogged, and some N is lost by denitrification. Side-dressing N increases its efficiency.

Phosphorus (P) is usually low, and the placement of P in the band near the seed at planting is critical. The heavy soil texture and wet, cold spring conditions slow root growth. Thus, the roots cannot extract nutrients from a large volume of soil. This reduces P uptake and increases the probability of a response when placed in the fertilizer band. The K supplying power is high, but restricted root growth decreases the ability of the plant to extract K; therefore, some K containing fertilizers are needed.

The corn yields in this subgroup are generally below 100 bu/acre (17 tons per acre of silage), except for the moderately well drained Vergennes and Wilpoint soils. The yield potential for perennial forages ranges from 2.5 to 4.5 tons/acre (12% moisture). Birdsfoot trefoil and grass are usually the most appropriate species to grow. Examples from group IA clayey soils are the moderately well drained Vergennes, the somewhat poorly drained Kingsbury, and the poorly drained Livingston soils. Large acreages of group IA soils occur in northern New York with limited acres (not shown in Figure 8.1) in eastern New York and the Hudson Valley.

Subgroup IB

These are medium- to fine-textured soils developed from lake sediments. These soils are formed from glacial lake or marine deposits and have a permeable, very fine sandy loam, silt loam, or silty clay loam surface over a more slowly permeable, heavier silty clay loam to clay subsurface. They differ from subgroup IA because of the more sandy surface and usually a more permeable subsoil. They generally occur on nearly level to gently sloping or rolling landscapes of the lower elevations near the lakes and along the Hudson River. The more rolling landscape makes surface water control and drainage easier than on the nearly level areas, but it increases the erosion hazard. Water and erosion control are important in managing these soils for crop production.

The pH of these soils ranges from 5.2 to 7.4, but most often the pH is 5.8 or above. Most subgroup IB soils need some lime for alfalfa production. The magnesium (Mg) supply is usually adequate.

The organic matter content is generally medium, and the N release is good on the well-drained to moderately well drained soils. The N supplying power generally exceeds 80 lbs per acre per year, but nitrogen loss is a problem as with the subgroup IA soils.

Original P levels are low, but the addition of manure and fertilizer P to cultivated areas may have increased soil P to higher levels. Band placement of P is important for crop establishment where P application is recommended. The K supplying power is high, but continuous cropping without adequate fertilizer can reduce the K levels.

The yield potentials for these soils vary from 75 to 120 bushels of corn per acre (13 to 20 tons of silage) depending on the soil drainage. The potential yields of perennial forage range from 2.5 to 5.5 tons per acre (12% moisture), but only the well-drained and moderately well drained soils are suited for alfalfa production. The Hudson, Odessa, and Schoharie series are examples of the well-drained and moderately well drained soils of the subgroup IB. Other examples are the somewhat poorly and poorly drained Caneadea, Canadice, and Rhinebeck soils and the very poorly drained Lakemont soils.

Soil management group II

The soils of this group are medium-textured to moderately fine-textured soils developed from calcareous glacial till, calcareous glacial till mixed with shale, or recent alluvium. The soils in this management group belong to one of three subgroups depending on parent material. Yield potentials of these soils vary from 75 to 150 bushels of corn (13-26 tons per acre of corn silage) and from 2.5 to 6 tons per acre of forage, depending primarily on the soil drainage characteristics.

Subgroup IIA

Medium- to fine-textured soils developed from calcareous glacial till. These soils are found in areas of undulating to gently rolling topography in the central plains of New York. They are formed from strongly calcareous glacial till. The soil profile is slightly acid to slightly alkaline in the surface and slightly alkaline or strongly alkaline in the subsoil. The surface texture may be a very fine sandy loam, loam, or silt loam with silt loam to silty clay loam subsoils. The water-holding capacity of these soils is high. Lime is usually not required, but surface soil pH's are occasionally low. Additions of manure and fertilizer P have increased the P content to high levels in some soils.

Soil water management is a problem on most of these soils. Erosion control and adequate soil drainage are critical problems. Subsurface drainage is effective in removing excess soil water. Strip-cropping, diversion ditches, sod waterways, and subdrain outlet terraces have successfully provided both erosion control and drainage. Once the water management problems have been solved, these are among the most productive soils of New York State.

Some examples are the well-drained Cazenovia, Hilton, Honeoye, Lima and Ontario series; the somewhat poorly drained Appleton, Kendaia, and Ovid series; and the poorly drained Lyons and Romulus series.

Subgroup IIB

Medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale. These soils generally have a very fine sandy loam or silt loam surface over a heavy silt loam or silty clay loam subsurface. These soils occur on nearly level or slightly undulating to rolling landscapes. They are generally located in the transition zone to the higher lime soils. The sloping landscapes often show signs of erosion, and erosion control practices are generally necessary. On the more level or concave topography and finer-textured soils, drainage is a problem. The better-drained soils of this group are well suited for the production of almost all field crops and vegetables. Almost all soils of this group require lime for legumes, and many must be limed for optimum production of other field crops. In general, the organic matter levels and N supplying power of these soils are medium. The original P supply was low, but P additions have increased it to high levels in some soils. The K supply is high. Some examples are the well-drained to moderately well drained Conesus, Lansing, Mohawk, and Nunda series. The somewhat poorly to poorly drained members include the generally finer textured Burdett, Darien, Kendaia, and Manheim series.

Subgroup IIC

Medium-textured soils developed in recent alluvium. These soils have developed on nearly level, first bottomlands and are subject to spring floods. The better-drained soils are intensively used and highly productive for a wide variety of crops. They have a water-holding capacity of 5 to 9 inches of available water. These are among the most fertile soils in New York. Crops grown on these soils respond to practices that improve soil tilth and minimize soil compaction. Examples are the well-drained Hamlin or Genesee, moderately well drained Teel, and somewhat poorly drained Wayland.

Soil management group III

The soils in this management group are medium-textured silt loams in both the surface and the subsoil. They are medium in K supplying power. There are two subgroups in this category that are similar in most of their management requirements but can differ in parent material, slope, tillage, and erosion control practices.

Subgroup IIIA

Moderately coarse textured soil developed from recent alluvium. These soils generally have a sandy loam, gravelly loam, or gravelly silt loam surface and gravelly loam, loam, sand or gravel subsurfaces. They occur on gravel outwash plains in the valleys or on glacial kames or eskers. The majority of the soils in this subgroup is level to nearly level and well suited to a variety of crops. Erosion and soil structure are generally not problems. These soils contain about 4 to 7 inches of available water in the soil profile. Irrigation may be required for vegetable production or during dry years for field crops.

The soils located near the high lime glacial tills are usually higher in pH than the soils in the southern part of the state, but lime must be added to most of these soils for optimum crop production. Yield potentials for this group are high with corn yields generally between 110 and 130 bushels per acre on the well-drained and moderately well drained areas. Perennial forage yields range from 2.5 to 5.8 tons per acre (12% moisture) depending on soil drainage. Examples are the well-drained to moderately well drained Barbour, Braceville, Chenango, Howard, Kars, Palmyra, Phelps, and Tioga series. The somewhat poorly drained soils include the Fredon, Holly, and Red Hook series.

Subgroup IIIB

These are medium-textured acid soils with fragipans developed on glacial till. These soils contain shale, sandstone, slate, or schist-type rocks with little or no lime. They have a silt loam surface and a more dense or compacted silt loam subsoil with fragipan or hardpan at various depths below the surface. The depth to the fragipan determines the soil drainage characteristics – the deeper the pan, the better drained the soil. The entire profile contains few to many angular and (or) flat stones of various sizes. The well-drained and moderately well drained soils usually contain 4 to 7 inches of available water; the somewhat poorly drained soils contain 3 to 4 inches. Erosion is a problem on all soils within this group. These sloping soils must be protected to reduce erosion by using combinations of cover crops, strip-cropping, rotations, and diversion ditches.

The pattern of soils within a field is usually complex because of the variable slopes. Most fields will contain two or more soils with different drainage characteristics; that is, the majority of a field may be moderately well drained soil such as Mardin, but in the low places a poorly drained soil such as Chippewa will occur. This type of soil pattern requires diversion terraces to intercept runoff from higher elevations and random subdrainage to eliminate wet spots. Such practices permit more timely and efficient farm operations. Yield potentials for the subgroup IIIB soils are generally lower than for subgroup IIIA because water is often a problem.

The well-drained and moderately well drained soils generally occur on the convex slopes near the top of the hills, on the knolls, or on sloping areas where there is no water seepage. These include the Mardin, Valois, and Langford soils. The well-drained Lordstown and Oquaga soils occur on steeper slopes and are shallow to bedrock. The somewhat poorly and poorly drained soils such a Camroden, Ellery, Erie, Marcy, Morris, and Volusia occur on the longer slopes, and near the bases of hills where water tends to collect or seep from above.

Soil management group IV

These soils are low in K-supplying power and are coarse- to moderately coarse textured soils formed from glacial till or glacial outwash (Figure 8.2). There is no subdivision of the soil management IV. The soil texture is sandy loam or silt loam in the surface, with or without gravel. The subsurface ranges from gravelly loam to clay textured. The slopes vary from level to strongly undulating. The somewhat poorly to poorly drained soils of this group can usually be drained effectively with widely spaced tile lines.

Figure 8.2: Glacial influences set the stage for soil management groups.

These soil profiles usually have an available water capacity of 3 to 5 inches. Crops grown on these soils suffer from insufficient water during extended dry periods, especially if the water table is more than 2 to 3 feet in depth. The soil tilth is excellent, and the soils can be worked over a wide range of moisture conditions without injury. Erosion from wind and water may be a problem in some areas. Most of these soils require regular additions of lime for crop growth. Crops respond well to fertilizers when moisture is adequate. Examples of the well-drained to moderately well drained soils of this group are Bombay, Broadalbin, Copake, Empeyville, Gloucester, Grenville, Hogansburg, Hoosic, Ira, Madrid, Moira, Parishville, Sodus, and Worth. The somewhat poorly to poorly drained soils include Brayton, Fredon, Massena, Scriba, and Westbury.

Soil management group V

These are coarse- to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas. The parent material for these soils has been reworked by water either as glacial outwash or by wave action from the glacial lakes, removing almost all the fine materials (silt and clay) and leaving usually deep deposits of sand and/or gravel. The soils that form have similar textures, usually with little organic matter. The topography is nearly level to undulating. Most of these soils are excessively drained. The available water capacity is very low, 2 to 3 inches. Supplemental irrigation is essential for consistent crop production. The tilth of these soils is generally good to loose. They can be worked at almost any time following a rain and are commonly used for producing fresh market vegetable crops. They require small, but regular, additions of lime. The fertility needs are great. The soils usually supply less than

50 pounds per acre of available N or K. Leaching of fertilizer N and K is a problem, and additional N and K should be added to the irrigated soils. Without irrigation these soils have low yields, generally less than 90 bushels per acre of corn (15 tons of 35% moisture silage per acre) and 4.5 tons of alfalfa (12% moisture). Examples of the excessively drained to well-drained soils include Alton, Colosse, Colton, Hinckley, and Windsor. The somewhat poorly and poorly drained soils include Claverack, Colonie, Elmwood, Granby, Junius, and Swanton.

Soil management group VI

Soil management group VI contains the muck soils. Muck is formed by deposits of decaying organic matter in bogs. Muck lands must be drained before they can be used for agriculture. Water management is extremely important not only for drainage for crop production but also for irrigation and control of the rate of decay of the organic matter. Muck soils are usually high in N, but low in P, K, copper and magnesium. The deep mucks may have marl mixed with, or very close to, the surface. This complicates the fertility program, especially for zinc and manganese.

The muck soils are generally used for the production of vegetable crops, but field crops are sometimes grown. When used for field crops, they should be fertilized with phosphorus and potassium as indicated in the section for soil management group V but N application rates should be reduced one-third to one-half of the rates recommended for mineral soils.

8. 5 Soil Test Interpretation and Conversions

Cornell University’s potassium recommendations are based on decades of yield response trials in New York. The Morgan extraction is the basis for these recommendations. Cornell soil K tests can be interpreted using Table 8.2.

Table 8.2: Interpretations of Cornell soil test K data.

Soil Management Group	Soil test K				
	Very Low	Low	Medium	High	Very High
	---------------------lbs K/acre (CNAL Morgan extraction)--------------------				
I	<35	35-64	65-94	95-149	>149
II	<40	40-69	70-99	100-164	>164
III	<45	45-79	80-119	120-199	>199
IV	<55	55-99	100-149	150-239	>239
V/VI	<60	60-114	115-164	165-269	>269

Mehlich-III soil tests from Brookside Laboratories Inc. (New Knoxville, Ohio), Spectrum Analytic Inc. (Washington C.H., Ohio), and A&L Eastern Laboratories Inc. (Richmond, Virginia), and A&L Canada Laboratories can be used to derive Cornell Morgan equivalents using the following equations. Comparative studies are necessary to derive CNAL Morgan equivalents for Mehlich-III data from other laboratories.

Brookside Laboratories Inc. (n=235, r^2=0.94, range = 42 to 468 ppm K):

CNAL Morgan K (lbs/a) = 2.16 * Brookside M3 K (ppm) - 47 [1]

Spectrum Analytic Inc. (n=235, r^2=0.93, range = 38 to 1094 lbs/acre K):

CNAL Morgan K (lbs/a) = 0.92 * Spectrum M3 K (lbs/acre) – 10 [2]

A&L Eastern Laboratories Inc. (n=232, r^2=0.96, range = 33 to 504 ppm K):

CNAL Morgan K (lbs/a) = 1.77 * A&L E M3 K (ppm) – 15 [3]

A&L Canada Laboratories Inc. (n=228, r^2=0.95, range = 28 to 487 ppm K):

CNAL Morgan K (lbs/a) = 1.99 * A&L C M3 K (ppm) – 18 [4]

If Morgan data from Spectrum Analytic Inc. or modified Morgan data from the University of Vermont are used, the following conversions need to be done:

Spectrum Analytic Inc. (n=82, r^2=0.97, range = 30 to 1250 lbs/acre K):

CNAL Morgan K (lbs/ac) = 1.34 * Spectrum Morgan K (lbs/acre) – 29 [5]

University of Vermont (n=232, r^2=0.67, range = 0 to 658 ppm K):

CNAL Morgan K (lbs/a) = 1.20 * UVM Modified Morgan K (ppm) + 31

[6]

8.6 Calculating Potassium Recommendations for Specific Field Crops

Potassium requirements are expressed in lbs of K_2O. The K recommendations for sod crops depend on yield potential, soil test K level and constants associated with the soil type. Because the K supplying potential of the soil groups varies widely, the soil test K interpretation and recommendations vary for each group. Non-sod crop K requirements depend on soil test K level and constants associated with the soil type. Cornell Crop codes can be found in Cropware Table 17.4.

Corn, millet, sorghum, sorghum sudan hybrid, sudangrass and sunflowers

Potassium requirements for corn (COG, COS), millet (MIL) sorghum forage (SOF), sorghum grain (SOG), sorghum sudan hybrids (SSH), sudangrass (SUD) and sunflowers (SUN) are calculated using the following K requirement equations:

If SoilTestK $\geq$ 1.5 * A:
K recommendation = 0 lbs K_2O/acre

If SoilTestK $\geq$ A but < 1.5 * A:
K recommendation = 20 lbs K_2O/acre

If SoilTestK > (Max + 20) but <A:
K recommendation = (20 + A – SoilTestK) K_2O/acre

If SoilTestK $\leq$ (Max + 20):
K recommendation = (Max) lbs K_2O/acre

[7]

SoilTestK is the Cornell Morgan soil test in lbs K/acre. See Table 8.3 for the "A" parameter and maximum recommendations.

Table 8.3: Fitting parameters A and B and minimum and maximum K_2O recommendations for grain corn (COG), corn silage (COS), millet (MIL,) sorghum forage (SOF), sorghum grain (SOG), sorghum sudan hybrids (SSH), sudangrass (SUD) and sunflowers (SUN).

Soil Management Group	Fitting Parameter A	Maximum Recommendation (Max) (COG, COS)	(MIL, SOF, SOG, SSH, SUD, SUN)
I	100	50	50
II	110	60	60
III	130	80	70
IV	160	120	80
V/VI	180	120	100

This set of equations implies that if the soil test K level is higher than 150% of the "A" value of a specific soil management group, the potassium requirement becomes zero. If the soil test K level between 100 and 150% of the "A" value, the potassium requirement is 20 lbs per acre K_2O. At low soil K levels, a maximum K_2O recommendation rate is set (Table 8.3). For crop establishment and topdressing potassium, manure can be used to supply the entire requirement. Appendix Table 8.A shows the K recommendations for each of these crops by Cornell Morgan soil test K level. The recommendations in this Table 8.A are rounded to the nearest 5 lbs.

Soybeans

The K recommendations for soybeans are soil management group and soil test specific as outlined in Table 8.4.

Table 8.4: Potassium recommendations (lbs K_2O/acre) for soybeans.

CNAL Morgan extractable K	Soil Management Group		
lbs K/acre	I, II	III	IV, V, VI
<60	40	40	60
60-79	20	40	60
80-99	20	20	60
100-149	20	20	40
150-199	0	20	20
200-269	0	0	20
>269	0	0	0

Established stands of alfalfa, alfalfa grass, and alfalfa birdsfoot trefoil

The potassium recommendations for established stands of alfalfa (ALT), alfalfa grass (AGT) and alfalfa birdsfoot trefoil (ABT) are derived using the following equations:

Soil management group I:

K recommendation (lbs K_2O/acre) = [{(ypa * 40) – SoilTestK} / 0.6] – 120 [8]

Soil management group II:

K recommendation (lbs K_2O/acre) = [{(ypa * 40) – SoilTestK} / 0.6] – 100 [9]

Soil management group III:

K recommendation (lbs K_2O/acre) = [{(ypa * 40) – SoilTestK} / 0.6] – 80 [10]

Soil management group IV:

K recommendation (lbs K_2O/acre) = [{(ypa * 40) – SoilTestK} / 0.6] – 60 [11]

Soil management group V and VI:

K recommendation (lbs K_2O/acre) = [{(ypa * 40) – SoilTestK} / 0.6] – 40 [12]

In these equations, ypa is the soil specific alfalfa yield potential in tons/acre (12% moisture) and SoilTestK is the lbs CNAL Morgan extractable K/acre. Soil type specific yield potentials for alfalfa can be found in Table 17.1.

Established grasses, intensively managed grass, and native grass pasture

Potassium recommendations for established and intensively managed grass (GIT) and established grasses (GRT) and native grass pasture (PNT) are derived from those for topdressing alfalfa (ALT):

GIT K recommendation (lbs K_2O/acre) = 0.8 * ALT K recommendations
GRT/PNT K recommendation (lbs K_2O/acre) = 0.66 * ALT K recommendations [13]

Derivations for potassium recommendations for established alfalfa were discussed in the section "Established stands of alfalfa, alfalfa grass, and alfalfa birdsfoot trefoil" above.

Spring barley, winter barley, oats, and wheat

Potassium requirements for spring barley (BSP), winter barley (BWI), oats (OAT) and wheat (WHT) are calculated using the following general K requirement equation:

If SoilTestK > 165, K_2O recommendation = 0 K_2O/acre
If SoilTestK > 80 but ≤ 165, K_2O recommendation = 20 lbs K_2O/acre
If SoilTestK ≤ 80, K_2O recommendation = (110-STK) * 0.7 lbs K_2O/acre [14]

In this equation, SoilTestK is the amount of CNAL Morgan extractable K in lbs/acre. The recommendations for these crops do not depend on soil management group and become zero for soil with soil test K levels of 166 lbs/acre or higher. Appendix Table 8.B shows the K recommendations (rounded to the nearest 5 lbs of K_2O) for these crops as a function of soil test K level.

Buckwheat and rye cover crop

Because buckwheat (BUK) is well-adapted to poor soils and easily lodges on highly fertile soils, no K_2O is recommended for soil with soil test K levels of 10 lbs/acre (CNAL Morgan soil test) or higher. The K recommendation for a rye cover crop (RYC) is identical to that of buckwheat. The maximum K recommendation amounts to 50 lbs K_2O/acre on soils with virtually no extractable K. Recommendations decrease with 5 lbs K_2O/acre for each lb/acre increase in soil test K (SoilTestK in lbs K/acre):

K recommendation (lbs K_2O/acre) = 50 – (5 * SoilTestK) [15]

Appendix Table 8.C shows K recommendations for buckwheat and rye cover crops (rounded to the nearest 5 lbs K_2O) as a function of CNAL Morgan extractable soil test K level.

Triticale peas

Triticale peas recommendations are soil test but not soil management group specific. Recommendations follow the general equation:

K recommendation (lbs K_2O /acre) = (110 – SoilTestK) * 0.70 [16]

In this equation, SoilTestK is the CNAL Morgan test K in lbs/acre. The minimum requirement is 20 lbs K_2O/acre. Appendix Table 8.D lists K_2O recommendations as a function of Cornell Morgan soil test level.

Established waterways

Established Waterway (WPT) recommendations are dependent on soil test K_2O and the soil management group and use the following equations:

Soil management group I:
K recommendation (lbs K_2O /acre) = (100 - SoilTestK) * 0.88 [17]

Soil management group II:
K recommendation (lbs K_2O /acre) = (110 - SoilTestK) * 0.88 [18]

Soil management group III:
K recommendation (lbs K_2O /acre) = (130 - SoilTestK) * 1.0 [19]

Soil management group IV:
K recommendation (lbs K_2O /acre) = (160 - SoilTestK) * 1.13 [20]

Soil management groups V and VI:
K recommendation (lbs K_2O /acre) = (200 - SoilTestK)*0.88 [21]

Other crops

Table 8.5 lists other crops for which K recommendations are available. These crops use the general K recommendation equation: K recommendation (lbs K_2O/acre) = (A-SoilTestK) * B.

Table 8.5: Crops (with Cornell crop code) that utilize K recommendation equations generated using the general equation: K recommendation = (A-SoilTestK) * B.

Code	Description
ABE	Alfalfa trefoil grass, Establishment
AGE	Alfalfa grass, Establishment
ALE	Alfalfa, Establishment
BCE	Birdsfoot trefoil clover, Establishment
BCT	Birdsfoot trefoil clover, Established
BGE	Birdsfoot trefoil grass, Establishment
BGT	Birdsfoot trefoil grass, Established
BSE	Birdsfoot trefoil seed, Establishment
BST	Birdsfoot trefoil seed, Established
BTE	Birdsfoot trefoil, Establishment
BTT	Birdsfoot trefoil, Established
BSS	Spring barley with legumes
BWS	Winter barley with legumes
CGE	Clover grass, Establishment
CGT	Clover grass, Established
CLE	Clover, Establishment
CLT	Clover, Established

Code	Description
CST	Clover seed production, Established
CVE	Crownvetch, Establishment
CVT	Crownvetch
GIE	Grasses intensively managed, Establishment
GRE	Grasses, Establishment
OAS	Oats with legume
PGE	Pasture improved grasses, Establishment
PGT	Pasture improved grasses, Established
PIE	Pasture intensively grazed, Establishment
PIT	Pasture intensively grazed, Established
PLE	Pasture with legumes, Establishment
PLT	Pasture with legumes, Established
WPE	Waterways, Establishment
WHS	Wheat with legume

Potassium recommendations for these crops are calculated using the following equations:

Soil management group I:

K recommendation (lbs K_2O /acre) = (100 - SoilTestK) * 0.70 [22]

Soil management group II:

K recommendation (lbs K_2O /acre) = (110 - SoilTestK) * 0.70 [23]

Soil management group III:

K recommendation (lbs K_2O /acre) = (130 - SoilTestK) * 0.80 [24]

Soil management group IV:

K recommendation (lbs K_2O /acre) = (160 - SoilTestK) * 0.90 [25]

Soil management groups V and VI:

K recommendation (lbs K_2O /acre) = (200 - SoilTestK) * 0.70 [26]

Appendix Table 8.E shows K recommendations as a function of Cornell Morgan soil test K level for each of the soil management groups. These recommendations are rounded to the nearest 5 lbs K_2O per acre. A minimum application of 20 lbs K_2O is recommended for all crops except for established birdsfoot-trefoil (BTT), birdsfoot-trefoil/clover (BCT), birdsfoot-trefoil/grass (BGT), and birdsfoot-trefoil seed (BST). A maximum application applies for established pasture of improved grasses, and intensively grazed pasture. Maximum application rates for these crops amount to 50, 60, 70, 80 and 100 lbs K_2O/acre for soils in management groups I, II, III, IV, V/VI, respectively. Rye seed production (RYS) recommended K_2O/acre application rate is 10 lbs less than the calculated rate for crops listed in Table 8.5 (20 lbs per acre minimum application). Potassium addition is not necessary for establishment or maintenance of Christmas trees.

8.7 Sources of Potassium and Their Management

Potassium fertilizers (Table 8.6) contain readily available K. The K in manure is primarily in a soluble form and most if not all of it is readily available to plants. Manure K can be substituted for fertilizer K on a one-to-one basis. Potassium can, and often does, accumulate to very high levels in heavily manured fields. The accumulated K can be used by another crop later in the rotation. Crop monitoring may be important because an excessive amount of K in the feed ration can affect animal health for transition cows.

Potassium fertilizers are primarily mined from deposits of potassium chloride, potassium sulfate, and potassium and magnesium sulfates. Applications of fertilizer K are important on fields where soil test K levels are low to medium, especially when manure will not be applied. Always check the fertilizer label for its guaranteed composition (there may be slight deviation from the values listed in Table 8.6).

For crop establishment, if the fertilizer recommendation is less than 20 lbs K_2O per acre, the entire amount should be applied as fertilizer. For larger applications, apply 20 lbs of K_2O fertilizer and use the K_2O equivalents in manure to supply the rest. To prevent salt injury, N+K_2O applications should be limited to no more than 80-100 lbs in the fertilizer band at planting. Potassium fertilizer can be broadcast and incorporated separately. If more than 80 lbs of N+K_2O needs to be applied, it is recommended to reduce the band rate to contain no more than 80 lbs and to apply the remaining as a pre-plant or side-dress application.

Table 8.6: Common potassium containing fertilizers

Common name	Chemical formula	N	P_2O_5	K_2O	Mg
Muriate of potash	KCl	0	0	60	0
Monopotassium phosphate	KH_2PO_4	0	~50[1]	40	0
Sulfate of potash	K_2SO_4	0	0	50	0
Sulfate of potash-magnesia	$K_2SO_4MgSO_4$	0	0	22	11

[1] Variable analysis.

8.8 APPENDIX

Appendix Table 8.A: Potassium recommendations for corn silage (COS), grain corn (COG), millet (MIL) sorghum forage (SOF), sorghum grain (SOG), sorghum sudan hybrids (SSH), sudangrass (SUD) and sunflowers (SUN).

CNAL Morgan Soil Test K lbs K/acre	K recommendation (lbs K_2O/acre) COS and COG Soil Management Group I	II	III	IV	V/VI	MIL, SOF, SOG, SSH, SUD, SUN Soil Management Group I	II	III	IV	V/VI
≤62	50	60	80	120	120	50	60	70	80	100
63-67	50	60	80	115	120	50	60	70	80	100
68-72	50	60	80	110	120	50	60	70	80	100
73-77	45	55	75	105	120	45	55	70	80	100
78-82	40	50	70	100	120	40	50	70	80	100
83-87	35	45	65	95	115	35	45	65	80	100
88-92	30	40	60	90	110	30	40	60	80	100
93-97	25	35	55	85	105	25	35	55	80	100
98-102	20	30	50	80	100	20	30	50	80	100
103-107	20	25	45	75	95	20	25	45	75	95
108-112	20	20	40	70	90	20	20	40	70	90
113-117	20	20	35	65	85	20	20	35	65	85
118-122	20	20	30	60	80	20	20	30	60	80
123-127	20	20	25	55	75	20	20	25	55	75
128-132	20	20	20	50	70	20	20	20	50	70
133-137	20	20	20	45	65	20	20	20	45	65
138-142	20	20	20	40	60	20	20	20	40	60
143-147	20	20	20	35	55	20	20	20	35	55
148-150	20	20	20	30	50	20	20	20	30	50
151-152	0	20	20	30	50	0	20	20	30	50
153-157	0	20	20	25	45	0	20	20	25	45
158-162	0	20	20	20	40	0	20	20	20	40
163-165	0	20	20	20	35	0	20	20	20	35
166-167	0	0	20	20	35	0	0	20	20	35
168-172	0	0	20	20	30	0	0	20	20	30
173-177	0	0	20	20	25	0	0	20	20	25
178-195	0	0	20	20	20	0	0	20	20	20
196-240	0	0	0	20	20	0	0	0	20	20
241-270	0	0	0	0	20	0	0	0	0	20
>270	0	0	0	0	0	0	0	0	0	0

Appendix Table 8.B: Potassium recommendations for spring barley (BSP), winter barley (BWI), oats (OAT) and wheat (WHT).

CNAL Morgan Soil Test lbs K/acre	K recommendation lbs K_2O/acre
≤6	75
7-13	70
14-20	65
21-27	60
28-35	55
36-42	50
43-49	45
50-56	40
57-63	35
64-70	30
71-77	25
78-165	20

Appendix Table 8.C: Potassium recommendations for buckwheat (BUK) and rye cover crop (RYC).

CNAL Morgan Soil Test lbs K/acre	K recommendation lbs K_2O/acre
<1	50
1	45
2	40
3	35
4	30
5	25
6	20
7	15
8	10
9	5
≥10	0

Appendix Table 8.D: Potassium recommendations for triticale peas (TRP).

CNAL Morgan Soil Test lbs K/acre	K recommendation lbs K_2O/acre
≤6	75
7-13	70
14-20	65
21-27	60
28-35	55
36-42	50
43-49	45
50-56	40
57-63	35
64-70	30
71-77	25
>77	20

Appendix Table 8.E: Potassium Recommendation for alfalfa (ABE, AGE, ALE), birdsfoot trefoil (BCE, BCT, BGE, BGT, BSE, BSS, BST, BTE, BTT, BWS), clover (CGE, CGT, CLE, CLT), pasture (PGT, PIT), and rye seed (RYS)[1]. See Table 17.4 for a description of crop codes.

CNAL Morgan Soil test K	K recommendation				
	Soil Management Group				
	I	II	III	IV	V/VI
lbs K/acre	lbs K_2O/acre				
≤1	70	75	105	145	140
2-3	70	75	100	140	140
4-6	65	75	100	140	135
7	65	70	100	140	135
8	65	70	100	135	135
9-10	65	70	95	135	135
11-12	60	70	95	135	130
13	60	70	95	130	130
14	60	65	95	130	130
15-17	60	65	90	130	130
18	55	65	90	130	125
19-20	55	65	90	125	125
21-23	55	60	85	125	125
24-25	55	60	85	120	125
26	50	60	85	120	120
27	50	60	80	120	120
28-29	50	55	80	120	120
30-32	50	55	80	115	120
33	45	55	80	115	115
34-35	45	55	75	115	115
36-39	45	50	75	110	115
40	40	50	70	110	110
41-42	40	50	70	105	110
43-45	40	45	70	105	110
46	40	45	65	105	110
47-49	35	45	65	100	105
50-51	35	40	65	100	105
52-53	35	40	60	95	105

[1] Minimum recommendations are 20 lbs K_2O/acre for the above-mentioned crops except BCT, BGT, BST and BTT. Maximum recommendations for PGT, PIT and RYS are 50, 60, 70, 80 and 100 lbs K_2O/acre for SMG I, II, III, IV, and V/VI, respectively.

Appendix Table 8.E (continued)

CNAL Morgan Soil test K	K recommendation				
	Soil Management Group				
	I	II	III	IV	V/VI
lbs K/acre	--------lbs K_2O/acre--------				
54-56	30	40	60	95	100
57	30	35	60	95	100
58	30	35	60	90	100
59-60	30	35	55	90	100
61-62	25	35	55	90	95
63	25	35	55	85	95
64	25	30	55	85	95
65-67	25	30	50	85	95
68	20	30	50	85	90
69-70	20	30	50	80	90
71-73	20	25	45	80	90
74-75	20	25	45	75	90
76	15	25	45	75	85
77	15	25	40	75	85
78-79	15	20	40	75	85
80-82	15	20	40	70	85
83	10	20	40	70	80
84-85	10	20	35	70	80
86-89	10	15	35	65	80
90	5	15	30	65	75
91-92	5	15	30	60	75
93-95	5	10	30	60	75
96	5	10	25	60	75
97	0	10	25	60	70
98-99	0	10	25	55	70
100-101	0	5	25	55	70
102-103	0	5	20	50	70
104-106	0	5	20	50	65
107	0	0	20	50	65
108	0	0	20	45	65
109-110	0	0	15	45	65
111-112	0	0	15	45	60
113-114	0	0	15	40	60
115-118	0	0	10	40	60
119-120	0	0	10	35	60
121-123	0	0	5	35	55
124-125	0	0	5	30	55

Appendix Table 8.E (Continued)

CNAL Morgan Soil test K	K recommendation				
	Soil Management Group				
	I	II	III	IV	V/VI
lbs K/acre	lbs K_2O/acre				
126	0	0	5	30	50
127-129	0	0	0	30	50
130-132	0	0	0	25	50
133-135	0	0	0	25	45
136-139	0	0	0	20	45
140	0	0	0	20	40
141-143	0	0	0	15	40
144-146	0	0	0	15	40
147-151	0	0	0	10	35
152-153	0	0	0	5	35
154-157	0	0	0	5	30
158-160	0	0	0	0	30
161-167	0	0	0	0	25
168-175	0	0	0	0	20
176-182	0	0	0	0	15
183-189	0	0	0	0	10
190-196	0	0	0	0	5
>196	0	0	0	0	0

9. Nutrient Guidelines: Vegetables

9.1 Acknowledgments

There was a strong message from producers and planners that Cropware 2.0 needed to incorporate N, P and K guidelines for vegetable crops. The vegetable nitrogen, phosphorus and potassium recommendations contained in Cropware 2.0 were provided by Dr. Steve Reiners (Department of Horticulture at the Geneva campus), and Dr. Donald Halseth and Dr. Roy Ellerbrock (Department of Horticulture at the Ithaca campus). In addition, lime guidelines are calculated for all vegetables except potatoes. The recommendations are further documented in The Vegetable Production Handbook (1994)[1] and The Handbook of Soil Testing for Vegetables (1983)[2].

9.2 Introduction

Three letter crop codes are used in Cropware to identify vegetables crops in the crop rotation (Table 9.1).

Table 9.1. Vegetable Crops and their Cornell Cropware Crop Codes

Crop Code	Description	Crop Code	Description
ASP	Asparagus	MML	Muskmelon
BDR	Beans - Dry	MUS	Mustard
BNL	Beans - Lima	ONS	Onion-Seeded
BNS	Beans - Snap	ONP	Onion-Transplant
BET	Beet	PSL	Parsley
BRS	Broccoli-Seeded	PSN	Parsnips
BRP	Broccoli-Transplanted	PEA	Pea
BUS	Brussels Sprouts	PEP	Peppers
CBS	Cabbage - Seeded	POP	Popcorn
CBP	Cabbage-Trans	POT	Potato
CAR	Carrots	PUM	Pumpkins
CFS	Cauliflower - Seeded	RAD	Radishes
CFP	Cauliflower - Transplanted	RHU	Rhubarb
CEL	Celery	RUT	Rutabagas
CRD	Chard	SPF	Spinach-Fall
CHC	Chinese Cabbage	SPS	Spinach-Spring

[1] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl.

[2] Kelly, W.C., S.D. Klausner, W.S. Reid, and J.B. Sieczka. 1983. The Handbook of Soil Testing for Vegetables. Vegetable Crops Mimeo # 274. Cornell University.

Table 9.1. Vegetable Crops and their Cornell Cropware Crop Codes (continued)

Crop Code	Description	Crop Code	Description
CKS	Cucumber - Seeded	SQS	Squash-Summer
CRD	Chard	SPF	Spinach-Fall
CHC	Chinese Cabbage	SPS	Spinach-Spring
CKS	Cucumber - Seeded	SQS	Squash-Summer
CKP	Cucumber - Transplanted	SQW	Squash-Winter
EGG	Eggplant	SWC	Sweet Corn
END	Endive	TOM	Tomato
GAR	Garlic	TUR	Turnips
LET	Lettuce	WAT	Watermelon
MIX	Mixed Vegetables		

9.3 Nitrogen Guidelines for Vegetables

Nitrogen recommendations for the 45 vegetables available in Cropware are defined in this section. The suggested N application is shown in pounds per acre. The allocation screen displays four columns pertinent to meeting plant nitrogen needs: “Gross N Required”, “Residual Manure N”, “Total N Required”; and “N Balance”. The Gross N requirement is shown in Table 9.2. Celery, onions, potatoes, and spinach have varying N recommendation rates depending on the sites soil management group designation. Muck type soils are classified as soil management group 6. Perennial vegetables such as asparagus and rhubarb have different nitrogen requirements in the planting (establishment) year and subsequent (established) years. Dry beans and potatoes are credited for residual N from sod decay if they follow a sod crop that contains at least 50% legume. For instance, if dry beans follow a stand of alfalfa hay, the Gross N required drops from 30 lbs per acre to 15 lbs per acre. Residual Manure N is the portion of the organic N from the past two years of manure applications available to the plants in the current plan year. The “Total N Required” is the difference between Gross N Required and Residual Manure N. Within the structure of the Cropware program, this N requirement can be met with organic, inorganic nitrogen or a combination of the two. However, a minimum inorganic N application is recommended for optimal economic yields. For vegetables, this minimum inorganic N recommendation is 25 lbs N/acre.

Popcorn nitrogen requirements are the same as field corn (COG, COS). See Nitrogen Guidelines for Field Crops.

Table 9.2. Cropware Nitrogen Recommendations for Vegetables

Crop Description	Crop Code	Gross N Recommendation (lbs/acre)	Minimum Gross N Rec. (lbs/acre)
Asparagus - Established	ASP	80	25
Asparagus - New Planting	ASP	100	25
Beans - Dry	BDR	30	25
Beans - Dry following 50%+ legume sod	BDR	15	25
Beans - Lima	BNL	40	25
Beans - Snap	BNS	40	25
Beet	BET	175	25
Broccoli-Transplanted	BRP	150	25
Broccoli-Seeded	BRS	150	25
Brussels Sprouts	BUS	150	25
Cabbage - Seeded	CBS	120	25
Cabbage-Transplanted	CBP	120	25
Carrots	CAR	150	25
Cauliflower - Transplanted	CFP	150	25
Cauliflower - Seeded	CFS	150	25
Celery, SMG = 1 to 5	CEL	180	25
Celery, SMG = 6	CEL	140	25
Chinese Cabbage	CHC	120	25
Chard	CRD	100	25
Cucumber - Transplanted	CKP	140	25
Cucumber - Seeded	CKS	140	25
Eggplant	EGG	130	25
Endive	END	100	25
Garlic	GAR	100	25
Lettuce	LET	100	25
Mixed Vegetables	MIX	140	25
Muskmelon	MML	140	25
Mustard	MUS	100	25
Onion-Transplant, SMG = 1 to 5	ONP	70	25
Onion-Transplant, SMG = 6	ONP	125	25
Onion-Seeded, SMG = 1 to 5	ONS	70	25
Onion-Seeded, SMG = 6	ONS	125	25
Parsley	PSL	100	25
Parsnips	PSN	150	25
Pea	PEA	50	25
Peppers	PEP	130	25
Popcorn	POP	*	25
Potato, SMG = 1 to 5	POT	150	25

Table 9.2. Cropware Nitrogen Recommendations for Vegetables (continued)

Crop Description	Crop Code	Gross N Recommendation (lbs/acre)	Minimum Gross N Rec. (lbs/acre)
Potato, SMG = 6	POT	100	25
Pumpkins	PUM	140	25
Rhubarb - Established	RHU	80	25
Rhubarb - New Planting	RHU	100	25
Radishes	RAD	60	25
Rutabagas	RUT	60	25
Spinach-Spring	SPS	130	25
Spinach-Spring	SPS	100	25
Spinach-Fall	SPF	130	25
Spinach-Fall	SPF	100	25
Squash-Summer	SQS	140	25
Squash-Winter	SQW	140	25
Sweet Corn	SWC	140	25
Tomato	TOM	130	25
Turnips	TUR	130	25
Watermelon	WAT	140	25

* Popcorn nitrogen requirements are the same as field corn (COG, COS). See Nitrogen Guidelines for Field Crops.

9.4 PHOSPHORUS GUIDELINES FOR VEGETABLES

The phosphorus recommendations for vegetables depend on the soil test phosphorus (STP) level as measured by the Morgan extraction method. Carrots, celery, endive, lettuce, onions, potatoes and spinach have different phosphorus recommendations when grown on mineral (soil management groups 1 to 5) and muck-type (soil management group 6) soils. Vegetable phosphorus recommendations in pounds per acre for mineral soils and muck soils are shown in tables 9.3.and 9.4, respectively. Popcorn phosphorus requirements are the same as field corn (COG, COS). See Phosphorus Guidelines for Field Crops. Potato phosphorus recommendation equations include production location (county), soil test P, aluminum, iron and pH.

Table 9.3. Phosphorus recommendations for selected vegetable crops grown on mineral soils (soil management groups 1-5) in pounds P_2O_5/acre[3]

Crop Description	Crop Code	-----Cornell Morgan Soil Test P, lbs/acre------- < 3	3-5	6-12	13-39	40+
Asparagus (new)	ASP	160	110	60	30	20
Asparagus (established)	ASP	100	75	60	25	0
Beans - Dry	BDR	100	80	60	40	20
Beans - Lima	BNL	100	80	60	40	20
Beans - Snap	BNS	100	80	60	40	20
Beet	BET	200	150	100	50	20
Broccoli-Transplanted	BRP	160	120	80	40	20
Broccoli-Seeded	BRS	160	120	80	40	20
Brussels Sprouts	BUS	160	120	80	40	20
Cabbage - Seeded	CBS	160	120	80	40	20
Cabbage-Transplanted	CBP	160	120	80	40	0
Carrots	CAR	160	120	80	40	20
Cauliflower - Transplanted	CFP	160	120	80	40	20
Cauliflower - Seeded	CFS	160	120	80	40	20
Celery	CEL	200	150	100	50	20
Chinese Cabbage	CHC	160	120	80	40	20
Chard	CRD	160	120	80	40	20
Cucumber - Transplanted	CKP	160	120	80	40	20
Cucumber - Seeded	CKS	160	120	80	40	20
Eggplant	EGG	200	150	100	50	20
Endive	END	160	120	80	40	20
Garlic	GAR	200	150	100	50	20
Lettuce	LET	160	120	80	40	20
Mixed Vegetables	MIX	160	120	80	40	20
Muskmelon	MML	160	120	80	40	20
Mustard	MUS	160	120	80	40	20
Onion-Transplant	ONP	200	150	100	50	20
Onion- Seeded	ONS	200	150	100	50	20
Parsley	PSL	160	120	80	40	20
Parsnips	PSN	160	120	80	40	20
Pea	PEA	120	100	75	50	20
Peppers	PEP	200	150	100	50	20
Pumpkins	PUM	160	120	80	40	20
Rhubarb - New Planting	RHU	160	110	60	30	20
Rhubarb - Established	RHU	100	75	50	25	0
Radishes	RAD	125	100	75	50	20
Rutabagas	RUT	125	100	75	50	20

[3] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 1, page 7.

Table 9.3. Phosphorus recommendations for selected vegetable crops grown on mineral soils (soil management groups 1-5) in pounds P_2O_5/acre[4] (continued)

Crop Description	Crop Code	-----Cornell Morgan Soil Test P, lbs/acre------- < 3	3-5	6-12	13-39	40+
Spinach-Spring	SPS	170	140	110	80	50
Spinach-Fall	SPF	170	140	110	80	50
Squash-Summer	SQS	160	120	80	40	20
Squash-Winter	SQW	160	120	80	40	20
Sweet Corn	SWC	160	120	80	40	20
Tomato	TOM	200	150	100	50	20
Turnips	TUR	125	100	75	50	20
Watermelon	WAT	160	120	80	40	20

Table 9.4. Phosphorus recommendations for selected vegetable crops grown on muck soils (soil management groups 6) in pounds P_2O_5/acre[5]

Crop Description	Crop Code	-----Cornell Morgan Soil Test P, lbs/acre------- <= 40	41-100	101-160	161-220	221+
Carrots	CAR	160	120	80	40	0
Celery	CEL	200	150	100	50	0
Endive	END	160	120	80	40	0
Garlic	GAR	200	150	100	50	0
Lettuce	LET	160	120	80	40	0
Onion-Transplant	ONP	200	150	100	50	0
Onion- Seeded	ONS	200	150	100	50	0
Spinach-Spring	SPS	170	140	110	80	0
Spinach-Fall	SPF	170	140	110	80	0

[4] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 1, page 7.

[5] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 3, page 9.

Potato phosphorus recommendations depend on county, soil test P (STP in lbs P/acre), soil iron (Fe), soil aluminum (Al) and pH. The following equations are used to calculate potato phosphorus recommendations:

For Potatoes (POT) grown in Suffolk County, New York:

If STP < 40, P recommendation = 240 lbs P_2O_5/acre
If STP ≥ 40, and (STAl + STFe) ≤ 200, P recommendation = 150 lbs P_2O_5/acre
If STP ≥ 40, and (STAl + STFe) > 200, P recommendation = 240 lbs P_2O_5/acre

For Potatoes (POT) grown in Upstate New York:

If STP < 20, P recommendation = 240 lbs P_2O_5/acre
If STP ≥ 20, and (STAl + STFe) < 100, P recommendation = 120 lbs P_2O_5/acre
If STP ≥ 20, and (STAl + STFe) ≥ 100 and ≤ 200, P recommendation = 150 lbs P_2O_5/acre
If STP ≥ 20, and (STAl + STFe) > 200, P recommendation = 240 lbs P_2O_5/acre

For Potatoes (POT) grown in Upstate New York where soil test aluminum and iron analyses are not available:

If STP < 20, P recommendation = 240 lbs P_2O_5/acre
If STP ≥ 20, and pH ≤ 5.2, P recommendation = 240 lbs P_2O_5/acre
If STP ≥ 20, and pH > 5.2 and ≤ 5.6, P recommendation = 150 lbs P_2O_5/acre
If STP ≥ 20, and pH > 5.6, P recommendation = 120 lbs P_2O_5/acre

Where:

STP is soil test phosphorus (lbs/acre Cornell Morgan extraction).
STAl is soil test aluminum (lbs/acre Cornell Morgan extraction).
STFe is soil test iron (lbs/acre Cornell Morgan extraction).

9.5 POTASSIUM GUIDELINES FOR VEGETABLES

The potassium recommendations for vegetables depend on the soil test potassium (STK) level as measured by the Morgan extraction method. Carrots, celery, endive, lettuce, onions, potatoes and spinach have different potassium recommendations when grown on mineral (soil management groups 1 to 5) and muck-type (soil management group 6) soils. Vegetable potassium recommendations in pounds per acre for mineral soils and muck soils are shown in tables 9.5.and 9.6, respectively. Popcorn potassium requirements are the same as field corn (COG, COS). See Potassium Guidelines for Field Crops. Recommendation potassium application rates for potatoes depend on the STK and the soil management group.

Table 9.5. Potassium recommendations for selected vegetable crops grown on mineral soils (soil management groups 1-5) in pounds K_2O/acre[6]

Crop Description	Crop Code	-----Cornell Morgan Soil Test K, lbs/acre-------				
		< 50	50-99	100-199	200-299	300+
Asparagus (new)	ASP	200	150	100	50	0
Asparagus (established)	ASP	100	80	60	40	0
Beans - Dry	BDR	80	60	40	20	0
Beans - Lima	BNL	80	60	40	20	0
Beans - Snap	BNS	80	60	40	20	0
Beet	BET	400	300	200	100	50
Broccoli-Transplanted	BRP	200	160	120	60	0
Broccoli-Seeded	BRS	200	160	120	60	0
Brussels Sprouts	BUS	200	160	120	60	0
Cabbage - Seeded	CBS	200	160	120	60	0
Cabbage-Transplanted	CBP	200	160	120	60	0
Carrots	CAR	200	160	120	60	0
Cauliflower - Transplanted	CFP	200	160	120	60	0
Cauliflower - Seeded	CFS	200	160	120	60	0
Celery	CEL	300	240	180	120	60
Chinese Cabbage	CHC	200	160	120	60	0
Chard	CRD	200	150	100	50	0
Cucumber - Transplanted	CKP	160	120	80	40	0
Cucumber - Seeded	CKS	160	120	80	40	0
Eggplant	EGG	200	150	100	50	0
Endive	END	200	150	100	50	0
Garlic	GAR	200	150	100	50	0
Lettuce	LET	200	150	100	50	0
Mixed Vegetables	MIX	160	120	80	40	0
Muskmelon	MML	160	120	80	40	0
Mustard	MUS	200	150	100	50	0
Onion-Transplant	ONP	200	150	100	50	0
Onion- Seeded	ONS	200	150	100	50	0
Parsley	PSL	200	150	100	50	0
Parsnips	PSN	200	160	120	60	0
Pea	PEA	160	120	80	40	0
Peppers	PEP	200	150	100	50	0
Pumpkins	PUM	160	120	80	40	0
Rhubarb - New Planting	RHU	200	150	100	50	0
Rhubarb - Established	RHU	100	80	60	40	0
Radishes	RAD	200	150	100	50	0
Rutabagas	RUT	200	150	100	50	0

[6] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 2, page 8.

Table 9.5. Potassium recommendations for selected vegetable crops grown on mineral soils (soil management groups 1-5) in pounds K_2O/acre[7] (continued)

Crop Description	Crop Code	----Cornell Morgan Soil Test K, lbs/acre------				
		< 50	50-99	100-199	200-299	300+
Spinach-Spring	SPS	200	150	100	50	0
Spinach-Fall	SPF	200	150	100	50	0
Squash-Summer	SQS	160	120	80	40	0
Squash-Winter	SQW	160	120	80	40	0
Sweet Corn	SWC	160	120	80	40	0
Tomato	TOM	240	180	120	60	0
Turnips	TUR	200	150	100	50	0
Watermelon	WAT	160	120	80	40	0

Table 9.6. Potassium recommendations for selected vegetable crops grown on muck soils (soil management groups 6) in pounds K_2O/acre[8]

Crop Description	Crop Code	----Cornell Morgan Soil Test K, lbs/acre-----				
		<= 220	220-370	371-520	521-670	> 670
Carrots	CAR	200	160	120	60	0
Celery	CEL	300	240	180	120	0
Endive	END	200	150	100	50	0
Garlic	GAR	200	150	100	50	0
Lettuce	LET	200	150	100	50	0
Onion-Transplant	ONP	200	150	100	50	0
Onion- Seeded	ONS	200	150	100	50	0
Spinach-Spring	SPS	200	150	100	50	0
Spinach-Fall	SPF	200	150	100	50	0

The K_2O recommendations for potatoes (POT) depend on soil test K level and constants associated with the soil type. The minimum recommended K_2O application is 50 lbs per acre. The maximum recommended rate is 300 lbs/acre for potatoes grown in soil management groups 1, 2, 3 and 4. The maximum recommended rate is 350 lbs/acre for production in soil management group 5 and 6 soils. Between the minimum and maximum rates, the following equation is used to calculate the K_2O recommendation:

$$K_2O \text{ recommendation (lbs/acre)} = (400-STK) * A - 50$$

See Table 9.7 for the "A" parameter.

[7] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 2, page 8.

[8] The Vegetable Production Handbook. 1994. Cornell Cooperative Extension. Edited by Susan Pohl. Table 3, page 9.

Table 9.7. Fitting parameter A for potatoes (POT).

Soil Management Group	Fitting Parameter A
I	0.75
II	0.75
III	0.85
IV	1.00
V,VI	1.15

9.6 LIME GUIDELINES FOR VEGETABLES

Table 11.1 indicates the minimum and desired soil pH levels for vegetables as used by Cropware lime recommendation equations. See Lime Recommendations. Due to the necessity for additional data inputs, Cropware does not make a potato lime recommendation but instead puts up a flag, "Consult CCE", if potatoes are part of the crop rotation. Table 9.8 provides a guideline for lime recommendations given the incidence of potato scab for the location and the resistance associated with the potato variety. In addition see the section below provided by Dr. Donald Halseth, Department of Horticulture, Cornell University.

Limitations on Rate and Sequence of Lime Applications

Continuous Potatoes:

1. Maximum recommended lime application of 0.5 ton/acre per year (even in rye year). The rye-potato rotation is considered to be the same as continuous potatoes.
2. If the total lime requirement cannot be met with 0.5 ton/acre per year, then apply the recommended amount and resample at end of the listed rotation.

Rotation:

1. Maximum recommended lime application of 0.5 ton/acre per year in the potato year.
2. Maximum recommended lime application of 4.0 tons/acre per year can be applied on the non-potato year, except for cole crops where the maximum is 1.0 ton/acre per year. If the total lime requirement can be met for a 3-year rotation by application on the non-potato year, all lime may be applied on the non-potato year.
3. If the lime recommendation is greater than 2.0 tons/acre per year, then split the lime rate by plowing in half and working in the rest in seed zone before planting.
4. If the lime recommendation is not satisfied for the previous rotation option, then apply the recommended amount and resample at end of listed rotation.

Specific Comments on Limestone and Magnesium

1. Use a limestone containing magnesium unless the soil test magnesium level is very high, in which case, use a low magnesium limestone.
2. Regardless of lime recommendation, if the Cornell Morgan soil test for magnesium is less than 100 lbs/acre or the pH is less than 5.0, apply 30 lbs of magnesium (50 pounds of magnesium oxide) per acre.

Table 9.8. Crop Rotation, Scab Incidence, Potato Cultivar Resistance to Scab and Soil pH Level Relationships to be Considered in Making Lime Recommendations.

Cropping System	Scab Incidence		Scab Resistant Variety?			pH		Comment	
	Not a Problem	Minor or Severe	Y		N	Min.	Desired	ID	Remark
Continuous Potatoes	X		X	or	X	5.3	5.5	1	If rye for grain is the only crop in rotation with potatoes, lime as if continuous potatoes.
Continuous Potatoes		X	X	or	X	5.0	5.2	2	Use of a scab resistant variety recommended.
Rotation Potatoes	X		X	or	X	5.3	5.6	3	Rotation with clover, grasses, wheat, barley, oats, buckwheat, corn, millet, sorghum and sudangrass (for Suffolk Co. only, include cabbage, Brussels sprouts, broccoli and cauliflower). Use of a scab resistant variety recommended.
Rotation Potatoes	X		X			5.8	6.0	4	Rotation with all other crops not listed in comment #3.
Rotation Potatoes	X				X	5.8	6.0	5	Rotation with all other crops not listed in comment #3. Use of a scab resistant variety recommended.
Rotation Potatoes		X	X	or	X	5.3	5.6	6	Same as comment #3.
Rotation Potatoes		X	X			5.8	6.0	7	Rotation with all other crops not listed in comment #3. CAUTION – Because of scab problem, rotation needs to be reviewed. Consult Cornell Cooperative Extension.
Rotation Potatoes	X				X	5.8	6.0	8	Rotation with all other crops not listed in comment #3. Use of a scab resistant variety is recommended. CAUTION – Because of scab problem, rotation needs to be reviewed. Consult Cornell Cooperative Extension.

10. Nutrient Guidelines: Micronutrients

Manure contains small quantities of micronutrients. As a result, micronutrient deficiencies on manured fields are not common. Because of their slow availability in manure, a micronutrient deficiency should be corrected with a commercial fertilizer source.

11. Nutrient Guidelines: Lime

11.1 Introduction

For optimal crop production and to obtain expected yield potential, soil pH must be adjusted with lime to fit crop needs. Lime requirements are based on effective neutralizing value. The effective neutralizing value is the quantity of the applied lime expected to react with the soil to increase the soil pH within the first year after application (Cornell Guide for Integrated Field Crop Management, 2003).

11.2 Calculating the Lime Recommendation

The soil test lime recommendation depends on the crop requiring the highest pH within the rotation. The lime recommendation is the greatest desired pH less the soil test pH, adjusted for tillage depth and ENV (effective neutralizing value) of the limestone. The lime recommendation equations use the following values:

- Cation Exchange Capacity for the specified soil management group (ECGrp).
- Exchange acidity.
- Original BaseSaturation.
- Desired BaseSaturation.
- Tillage depth in inches.

Two different lime requirement algorithms are used depending on the initial soil pH. If the initial soil pH is less than 6.1, the lime recommendation is based on the reported soil exchange acidity. When the initial soil pH is 6.1 or greater, lime recommendation is based on the soil group's cation exchange capacity.

Determine the desired pH

The first step in calculating the lime recommendation is to determine the crop in the rotation with the greatest lime requirement. The desired pH values and minimum pH values for each crop are shown in Desired and Minimum Crop pH Levels, Table 11.1. The highest pH value in this table for the current crop and the crops in the rotation over the future 5 years is set equal to the "Desired pH".

Table 11.1 Desired and Minimum Crop pH Levels

Crop Code	Crop Description	Desired pH	Minimum pH
ABE	Alfalfa trefoil grass, Establishment	7.0	6.7
ABT	Alfalfa trefoil grass, Established	7.0	6.7
AGE	Alfalfa grass, Establishment	7.0	6.7
AGT	Alfalfa grass, Established	7.0	6.7
ALE	Alfalfa, Establishment	7.0	6.7
ALT	Alfalfa, Established	7.0	6.7
ASP	Asparagus	7.0	6.8
BCE	Birdsfoot trefoil clover, Establishment	6.5	6.4
BCT	Birdsfoot trefoil clover, Established	6.5	6.4
BDR	Beans – Dry	6.4	6.0
BET	Beet	6.5	6.2
BGE	Birdsfoot treefoil grass, Establishment	6.5	6.4
BGT	Birdsfoot trefoil grass, Established	6.5	6.4
BNL	Beans – Lima	6.4	6.0
BNS	Beans – Snap	6.4	6.2
BRP	Broccoli-Transplanted	6.5	6.2
BRS	Broccoli-Seeded	6.5	6.2
BSE	Birdsfoot trefoil seed, Establishment	6.5	6.4
BSP	Spring barley	6.5	6.4
BSS	Spring barley with legumes	6.5	6.4
BST	Birdsfoot trefoil seed, Established	6.5	6.4
BTE	Birdsfoot treefoil, Establishment	6.5	6.4
BTT	Birdsfoot trefoil, Established	6.5	6.4
BUK	Buckwheat	6.2	6.0
BUS	Brussels Sprouts	6.5	6.2
BWI	Winter barley	6.5	6.4
BWS	Winter barley with legumes	6.5	6.4
CAR	Carrots (SMG=6)	5.5	5.5
CAR	Carrots	6.4	6.0
CBP	Cabbage-Trans	6.5	6.2
CBS	Cabbage – Seeded	6.5	6.2
CEL	Celery (SMG = 6)	5.5	5.5
CEL	Celery	6.4	6.0
CFP	Cauliflower – Transplanted	6.5	6.2
CFS	Cauliflower – Seeded	6.5	6.2
CGE	Clover grass, Establishment	6.2	6.0
CGT	Clover grass, Established	6.2	6.0
CHC	Chinese Cabbage	6.5	6.2
CKP	Cucumber – Transplanted	6.4	6.0
CKS	Cucumber – Seeded	6.4	6.0
CLE	Clover, Establishment	6.2	6.0
CLT	Clover, Established	6.2	6.0
COG	Corn grain	6.2	6.0

Table 11.1 Desired and Minimum Crop pH Levels (continued)

Crop Code	Crop Description	Desired pH	Minimum pH
COS	Corn silage	6.2	6.0
CRD	Chard	6.5	6.2
CSE	Clover seed production, Establishment	6.2	6.0
CST	Clover seed production, Established	6.2	6.0
CVE	Crownvetch, Establishment	6.2	6.0
CVT	Crownvetch	6.2	6.0
EGG	Eggplant	6.4	6.0
END	Endive (SMG=6)	5.6	5.6
END	Endive	6.5	6.2
GAR	Garlic	6.4	6.0
GIE	Grasses intensively managed, Establishment	6.2	6.0
GIT	Grasses intensively managed, Established	6.2	6.0
GRE	Grasses, Establishment	6.2	6.0
GRT	Grasses, Established	6.2	6.0
IDL	Idle Land	0.0	0.0
LET	Lettuce (SMG=6)	5.6	5.6
LET	Lettuce	6.5	6.2
MIL	Millet	6.2	6.0
MIX	Mixed Vegetables	6.4	6.0
MML	Muskmelon	6.4	6.0
MUS	Mustard	6.5	6.2
OAS	Oats with legume	6.2	6.0
OAT	Oats	6.2	6.0
ONP	Onion-Transplant (SMG=6)	5.2	5.2
ONP	Onion-Transplant	6.4	6.0
ONS	Onion-Seeded (SMG=6)	5.2	5.2
ONS	Onion-Seeded	6.4	6.0
PEA	Pea	6.5	6.2
PEP	Peppers	6.4	6.0
PGE	Pasture, Establishment	6.2	6.0
PGT	Pasture improved grasses, Established	6.2	6.0
PIE	Pasture intensively grazed, Establishment	6.2	6.0
PIT	Pasture intensively grazed, Established	6.2	6.0
PLE	Pasture with legumes, Establishment	6.2	6.0
PLT	Pasture with legumes, Established	6.2	6.0
PNT	Pasture native grasses	6.2	6.0
POP	Popcorn	6.2	6.0
POT	Potato (consult CCE)	-	-
PSL	Parsley	7.0	6.8
PSN	Parsnips	6.4	6.0
PUM	Pumpkins	6.4	6.0

Table 11.1 Desired and Minimum Crop pH Levels (continued)

Crop Code	Crop Description	Desired pH	Minimum pH
RAD	Radishes	6.4	6.0
RHU	Rhubarb	6.5	6.2
RUT	Rutabagas	6.4	6.0
RYC	Rye cover crop	6.2	6.0
RYS	Rye seed production	6.2	6.0
SOF	Sorghum forage	6.2	6.0
SOG	Sorghum grain	6.2	6.0
SOY	Soybeans	7.0	6.7
SPF	Spinach-Fall (SMG=6)	5.6	5.6
SPF	Spinach-Fall	6.7	6.5
SPS	Spinach-Spring (SMG=6)	5.6	5.6
SPS	Spinach-Spring	6.7	6.5
SQS	Squash-Summer	6.4	6.0
SQW	Squash-Winter	6.4	6.0
SSH	Sorghum sudan hybrid	6.2	6.0
SUD	Sudangrass	6.2	6.0
SUN	Sunflower	6.2	6.0
SWC	Sweet Corn	6.5	6.2
TOM	Tomato	6.4	6.0
TRE	Christmas trees, Establishment	6.0	5.9
TRP	Triticale peas	6.5	6.0
TRT	Christmas trees, Established	6.0	5.9
TUR	Turnips	6.4	6.0
WAT	Watermelon	6.4	6.0
WHS	Wheat with legume	6.5	6.4
WHT	Wheat	6.5	6.4
WPE	Waterways, Establishment	6.2	6.0
WPT	Waterways, Established	6.2	6.0

Determine base saturation

Determine base saturation for the soil test pH (base saturation original) and for the desired pH (base saturation desired) using the following values and formula. The base saturation is set equal to 0.00001 for a pH of less than 4.5 and equal to 1 for a pH greater than 7.8. Between these two values, the base saturation is calculated as:

BaseSaturation = bs * ((pH - 4.5) * 10, 0) + 1)

Where:

pH	bs	pH	bs
4.5	0.021	6.2	0.655
4.6	0.035	6.3	0.675
4.7	0.050	6.4	0.695
4.8	0.073	6.5	0.710
4.9	0.102	6.6	0.730
5.0	0.135	6.7	0.740
5.1	0.171	6.8	0.755
5.2	0.228	6.9	0.770
5.3	0.320	7.0	0.795
5.4	0.420	7.1	0.812
5.5	0.480	7.2	0.847
5.6	0.515	7.3	0.863
5.7	0.540	7.4	0.880
5.8	0.570	7.5	0.900
5.9	0.600	7.6	0.925
6.0	0.620	7.7	0.950
6.1	0.635	7.8	0.975

Calculate Lime Recommendation for soils with initial pH less than 6.1

Lime Recommended in tons ENV/acre =
Exchange_acidity * 0.5 * ((BaseSaturationDesired - BaseSaturationOriginal) / (1 - BaseSaturationOriginal)) * (Ttill_inch / 6)

Where:

Exchange_acidity is the soil test exchange acidity.
BaseSaturationDesired is the base saturation (above) associated with the crop in the roation with the greatest desired soil pH.
BaseSaturationOriginal is the base saturation (above) associated with the current soil test pH.
Till_inch is the tillage depth in inches.

Calculate Lime Recommendation for soils with initial pH of 6.1 or greater

If the Soil Test pH is 6.1 or greater, the lime recommendation is based on soil group's cation exchange capacity.

Lime Recommended in tons ENV/acre =
CECGrp(grp) * 0.5 * (BaseSaturationDesired - BaseSaturationOriginal) * (till_inch / 6)

Where:

CECGrp is the average cation exchange capacity associated with the soil in a specific soil management group (Table 11.2).
BaseSaturationDesired is the base saturation (above) associated with the crop in the roation with the greatest desired soil pH.
BaseSaturationOriginal is the base saturation (above) associated with the current soil test pH.
Till_inch is the tillage depth in inches.

Table 11.2 Cation exchange capacity (CECGrp) associated with soil management group (SMG).

Soil Group	CECGrp
1	25
2	20
3	18
4,6	16
5	12

For certain soils, it is not economically beneficial to add lime to adjust for a small pH deficit. Cropware ignores pH increment deficit of less than or equal to 0.4 (Desired pH rotation – Soil Test pH <=0.4) for soils which are considered to be "high" lime soils (lime index = H on Appendix Table 11.A).

Determining lime requirement if pH is less than 6.1 and soil exchange acidity is not available

If the soil analysis has a pH of <6.1, but is lacking exchange acidity data, use table 11.3 below, General Lime Guidelines (2003 Cornell Guide for Integrated Field Crop Management). Select the soil texture and initial pH, and find the correct lime requirement. The requirement is the amount of lime necessary to raise the soil pH to 7.0. This requirement can then be recorded in the "Comment" column of the Allocation Screen and later used in reports. Currently, if no exchange acidity is entered on the Fields-Crop Data screen, the default exchange acidity is 1 me/100g and this will result in an incorrect (low) Cropware calculated lime recommendation.

Table 11.3 General lime guidelines *from* 2003 Cornell Guide for Integrated Field Crop Management (Table 11).

Initial Soil pH	Sands	Sandy Loams	Loams and Silt Loams	Silty Clay Loams
-----------------Tons/acre of 100% ENV lime*---------------------------				
4.5	2.5	6.0	9.5	13.0
4.6-4.7	2.5	6.0	9.0	12.5
4.8-4.9	2.5	5.5	8.5	12.0
5.0-5.1	2.0	5.0	7.5	10.5
5.2-5.3	1.5	4.0	6.5	8.5
5.4-5.5	1.0	3.0	4.0	6.0
5.6-5.7	1.0	2.0	3.0	4.5
5.8-5.9	0.7	1.5	2.5	3.5
6.0-6.1	0.6	1.5	2.0	3.0
6.2-6.3	0.4	1.0	1.5	2.0
6.4-6.5	0.3	0.7	1.0	1.5
6.6-6.7	0.2	0.5	0.7	1.0

* Lime guidelines are in tons per acre and are based on a plow depth of 8 inches. If the plow depth is greater than 8 inches, increase the lime rate by 12 percent for each inch of depth greater than 8 inches. If the plow depth is less than 8 inches, decrease the rate given by 12 percent for each inch of depth less than 8 inches.

Lime requirement on no-till crop production systems

The Cornell Guide for Integrated Field Crop Management 2003 suggests that because the soil is not periodically mixed in a no-tillage crop production system, additional attention must be given to the soil pH and liming program. Often under no-tillage, the soil surface (0-1 inch depth) becomes acid more rapidly than the 0-6 inch soil zone (original plow layer). When the soil surface becomes acidic under corn production, the effectiveness of triazine herbicides is reduced and weed control is reduced. For legumes, the pH of the seeding zone is reduced and establishment problems may result. In the no-tillage liming program, the pH of two soil zones (0-1 inch and 0-6 inches) must be considered. Generally there are three situations that can result in different lime guidelines for no-tillage crops relative to conventionally tilled crops:

1. Surface (0-1 inch depth) pH is low, but the pH of the 0-6 inch zone is adequate. Guideline: add 1 to 1 ½ tons of lime per acre to raise the pH of the soil surface.
2. Strongly acidic throughout both the 0-1 and 0-6 inch soil zones. Guideline: do not use no-tillage methods for the establishment of legumes until lime has time to react (6 to 9 months after application).
3. Surface (0-1 inch depth) pH is adequate, but the 0-6 inch soil zone has a low pH. In this case, the legumes might be no-till seeded with a slightly lower overall pH or without waiting as long for the lime to react as when both zones have a low soil pH.

Zero Lime Recommendation

If the soil test pH is greater than the minimum needed (table 11.1) or the base saturation is already greater than that desired in rotation then no additional lime is recommended.

Lime Guidelines for Vegetables

See Cropware Help Section 9.6 for lime guidelines for vegetables.

Appendix Table 11.A Lime Index (0, L, M, H) of soils

Soil	Lime Index	Soil	Lime Index	Soil	Lime Index
ACTON	L	BICE	L	CAYUGA	M
ADAMS	L	BIDDEFORD	M	CAZENOVIA	M
ADIRONDACK	L	BIRDSALL	L	CERESCO	M
ADJIDAUMO	M	BLASDELL	L	CHADAKOIN	L
ADRIAN	0	BOMBAY	M	CHAGRIN	M
AGAWAM	L	BOOTS	0	CHAMPLAIN	L
ALBIA	L	BOROSAPRISTS	L	CHARLES	L
ALBRIGHTS	L	BOYNTON	L	CHARLTON	L
ALDEN	L	BRACEVILLE	L	CHATFIELD	L
ALLAGASH	L	BRAYTON	L	CHAUMONT	M
ALLARD	L	BRIDGEHAMPTON	L	CHAUTAUQUA	L
ALLENDALE	L	BRIDPORT	M	CHEEKTOWAGA	M
ALLIS	L	BRIGGS	L	CHENANGO	L
ALLUVIAL LAND	L	BRINKERTON	L	CHESHIRE	L
ALMOND	L	BROADALBIN	L	CHIPPENY	0
ALPS	L	BROCKPORT	M	CHIPPEWA	L
ALTMAR	L	BROOKFIELD	L	CHURCHVILLE	M
ALTON	L	BUCKLAND	L	CICERO	M
AMBOY	L	BUCKSPORT	L	CLARKSON	H
AMENIA	H	BUDD	L	CLAVERACK	L
ANGOLA	L	BURDETT	M	CLINBURG	L
APPLETON	M	BURNHAM	L	CLYMER	L
ARKPORT	L	BUSTI	L	COHOCTAH	L
ARMAGH	L	BUXTON	M	COLLAMER	M
ARNOT	L	CAMBRIA	M	COLONIE	L
ASHVILLE	L	CAMBRIDGE	L	COLOSSE	L
ATHERTON	L	CAMILLUS	H	COLRAIN	L
ATKINS	L	CAMRODEN	L	COLTON	L
ATSION	L	CANAAN	L	COLWOOD	L
AU GRES	L	CANAAN-ROCK	L	CONESUS	M
AURELIE	L	CANADICE	M	CONOTTON	L
AURORA	M	CANANDAIGUA	L	CONSTABLE	L
BARBOUR	L	CANASERAGA	L	COOK	M
BARCELONA	M	CANASTOTA	M	COPAKE	M
BARRE	L	CANEADEA	M	CORNISH	L
BASH	L	CANFIELD	L	COSAD	M
BASHER	L	CANTON	L	COSSAYUNA	L
BATH	L	CARBONDALE	0	COVERT	L
BECKET	L	CARLISLE	0	COVEYTOWN	L
BECRAFT	L	CARROLLTON	L	COVINGTON	M
BELGRADE	L	CARVER	L	CRARY	L
BENSON	H	CARVER-PLYMOUTH	L	CROGHAN	L
BERKSHIRE	L	CASTILE	M	CULVERS	L
BERNARDSTON	L	CATHRO	0	DALBO	L
BERRIEN	L	CATHRO-GREENWOOD	L	DALTON	L
BERRYLAND	M	CATTARAUGUS	L	DANLEY	M
BESEMAN	0	CAVODE	L	DANNEMORA	L

Appendix Table 11.A Lime Index (0, L, M, H) of soils (continued).

Soil	Lime Index	Soil	Lime Index	Soil	Lime Index
DAWSON	0	GENESEE	M	HOGBACK-RICKER	L
DEERFIELD	L	GEORGIA	M	HOLDERTON	L
DEFORD	L	GETZVILLE	L	HOLLIS	L
DEKALB	L	GILPEN	L	HOLLY	M
DEPEYSTER	M	GILPIN	L	HOLYOKE	L
DEPOSIT	L	GLEBE	L	HOLYOKE-ROCK	
DERB	L	GLEBE-SADDLEBACK	L	OUTCROP	L
DIXMONT	L	GLENDORA	L	HOMER	M
DORVAL	L	GLENFIELD	L	HONEOYE	H
DOVER	H	GLOUCESTER	L	HOOSIC	L
DUANE	L	GLOVER	L	HORNELL	L
DUNKIRK	M	GOUGEVILLE	L	HORNELLSVILLE	L
DUTCHESS	L	GRANBY	M	HOUGHTONVILLE	L
DUXBURY	L	GRATTAN	L	HOUGHTONVILLE-	
EDWARDS	0	GREENE	L	RAWSON	L
EEL	M	GREENWOOD	0	HOUSATONIC	L
EELWEIR	L	GRENVILLE	H	HOUSEVILLE	M
ELKA	L	GRETOR	L	HOWARD	M
ELLERY	L	GROTON	L	HUDSON	M
ELMRIDGE	L	GROVETON	L	HULBERTON	M
ELMWOOD	L	GUFF	L	HUNTER	L
ELNORA	L	GUFFIN	H	ILION	M
EMPEYVILLE	L	GULF	L	INSULA	L
ENFIELD	L	HADLEY	L	IPSWICH	0
ENSLEY	L	HAIGHTS	L	IRA	L
ERIE	L	HAIGHTS-GULF	L	ISCHUA	L
ERNEST	L	HAILESBORO	L	IVORY	L
ESSEX	L	HALCOTT	L	JEBAVY	L
FAHEY	L	HALSEY	L	JOLIET	M
FARMINGTON	H	HAMLIN	M	JUNIUS	L
FARNHAM	M	HAMPLAIN	L	KALURAH	M
FERNLAKE	L	HANNAWA	L	KANONA	L
FLACKVILLE	L	HARTLAND	L	KARS	M
FONDA	M	HAVEN	L	KEARSARGE	L
FRANKLINVILLE	L	HAWKSNEST	L	KENDAIA	M
FREDON	M	HEMPSTEAD	L	KIBBIE	L
FREETOWN	0	HENRIETTA	L	KINGSBURY	M
FREMONT	L	HERKIMER	M	KINZUA	L
FRENCHTOWN	L	HERMON	L	KNICKERBOCKER	L
FREWSBURG	L	HERO	M	LACKAWANA	L
FRYEBURG	H	HEUVELTON	M	LAGROSS	L
FULTON	M	HILTON	H	LAGROSS-HAIGHTS	L
GAGE	L	HINCKLEY	L	LAIRDSVILLE	M
GALEN	L	HINESBURG	L	LAKEMONT	M
GALESTOWN	L	HISTIC HUMAQUEPTS	L	LAKEWOOD	L
GALOO	L	HOGANSBURG	H	LAMSON	M
GALWAY	M	HOGBACK	L	LANESBORO	L

Appendix Table 11.A Lime Index (0, L, M, H) of soils (continued).

Soil	Lime Index	Soil	Lime Index	Soil	Lime Index
LANGFORD	L	MASSENA	M	NEVERSINK	L
LANSING	M	MATOON	L	NEWFANE	L
LECK KILL	L	MATUNUCK	0	NEWSTEAD	M
LEICESTER	L	MEDIHEMISTS	L	NEWTON	M
LEON	L	MEDIHMEISTS-HYDRAQUENTS	L	NIAGARA	L
LEWBATH	L	MEDINA	M	NICHOLVILLE	L
LEWBEACH	L	MEDOMAK	L	NINIGRET	L
LEYDEN	M	MELROSE	L	NORCHIP	L
LIMA	H	MENLO	L	NORWELL	L
LIMERICK	L	MENTOR	L	NORWICH	L
LINDEN	L	MERRIMAC	L	NUNDA	M
LINLITHGO	L	MIDDLEBROOK	L	OAKVILLE	L
LIVINGSTON	M	MIDDLEBROOK-MONGAUP	L	OCCUM	L
LOBDELL	M	MIDDLEBURY	M	ODESSA	M
LOCKPORT	M	MILLIS	L	OGDENSBURG	M
LORAIN	L	MILLSITE	L	OLEAN	L
LORDSTOWN	L	MINEOLA	L	ONDAWA	L
LOVEWELL	L	MINER	M	ONEIDA	M
LOWVILLE	L	MINO	M	ONOVILLE	L
LOXLEY	0	MINOA	M	ONTARIO	M
LUCAS	M	MOHAWK	M	ONTEORA	L
LUDLOW	L	MOHICAN	L	ONTUSIA	L
LUPTON	L	MOIRA	L	OQUAGA	L
LYMAN	L	MONADNOCK	L	ORAMEL	L
LYMAN-BECKET-BERKSHIRE	L	MONARDA	L	ORGANIC	0
LYME	L	MONGAUP	L	ORPARK	L
LYONS	M	MONTAUK	L	ORWELL	M
MACHIAS	L	MOOERS	L	OTISVILLE	L
MACOMBER	L	MOROCCO	L	OTSEGO	L
MACOMBER-	L	MORRIS	L	OTTAWA	L
MADALIN	M	MOSHERVILLE	L	OVID	M
MADAWASKA	L	MUCK	0	PALATINE	H
MADRID	M	MUNDAL	L	PALMS	0
MALONE	M	MUNDALITE	L	PALMYRA	M
MANAHAWKIN	0	MUNDALITE-	L	PANTON	L
MANDY	L	MUNSON	M	PAPAKATING	M
MANHEIM	M	MUNUSCONG	L	PARISHVILLE	L
MANHONING	M	MUSKEGO	L	PARSIPPANY	M
MANLIUS	L	MUSKELLUNGE	L	PATCHIN	L
MANSFIELD	L	NAPOLEON	L	PAWCATUCK	0
MAPLECREST	L	NAPOLI	L	PAWLING	L
MARCY	L	NASSAU	L	PAXTON	L
MARDIN	L	NAUMBURG	L	PEACHAM	L
MARILLA	L	NEHASNE	M	PEAT	L
MARLOW	L			PERU	L
				PETOSKEY	L

Appendix Table 11.A Lime Index (0,L,M,H) of soils (continued).

Soil	Lime Index	Soil	Lime Inde	Soil	Lime Index
MARTISCO	0	NELLIS	H	PHELPS	M
PHILO	L	ROMULUS	M	SWORMVILLE	L
PILLSBURY	L	ROSS	M	TACONIC	L
PINCKNEY	L	ROUNDABOUT	L	TACONIC-MACOMBER	L
PIPESTONE	L	RUMNEY	L	TAWAS	0
PITTSFIELD	L	RUNEBERG	L	TEEL	M
PITTSTOWN	L	RUSE	L	TIOGA	M
PLAINBO	L	RUSHFORD	L	TOLEDO	M
PLAINFIELD	L	SACO	M	TONAWANDA	M
PLESSIS	L	SALAMANCA	L	TOR	L
PLYMOUTH	L	SALMON	L	TORULL	L
PODUNK	L	SAUGATUCK	L	TOWERVILLE	M
POLAND	M	SCANTIC	M	TRESTLE	M
POMPTON	L	SCARBORO	M	TROUT RIVER	L
POOTATUCK	L	SCHOHARIE	M	TROY	L
POPE	L	SCHROON	L	TRUMBULL	M
POTSDAM	L	SCHUYLER	M	TUGHILL	L
POYGAN	L	SCIO	M	TULLER	L
PUNSIT	L	SCITUATE	M	TUNBRIDGE	L
PYRITIES	L	SCRIBA	L	TUNKHANNOCK	L
QUETICO	L	SEARSPORT	M	TURIN	M
RAQUETTE	M	SHAKER	M	TUSCARORA	L
RAWSONVILLE	L	SHOREHAM	M	UNADILLA	L
RAWSONVILLE-BESEMAN	L	SKERRY	L	VALOIS	L
		SLOAN	M	VARICK	M
RAYNE	L	SODUS	L	VARYSBURG	L
RAYNHAM	M	SOMERSET	M	VENANGO	L
RAYPOL	L	ST JOHNS	M	VERGENNES	M
RED HOOK	L	STAATSBURG	H	VLY	L
REDWATER	M	STAFFORD	L	VOLUSIA	L
REMSEN	M	STEAMBURG	L	WADDINGTON	L
RETSOF	L	STETSON	L	WAINOLA	L
REXFORD	L	STISSING	L	WAKELAND	L
RHINEBECK	M	STOCKBRIDGE	M	WAKEVILLE	L
RICKER	L	STOCKHOLM	L	WALLACE	L
RICKER-	L	STOWE	L	WALLINGTON	L
RIDGEBURY	L	SUDBURY	L	WALLKILL	M
RIFLE	0	SUFFIELD	M	WALPOLE	L
RIGA	M	SUMMERVILLE	H	WALTON	L
RIPPOWAM	L	SUN	M	WAMPSVILLE	M
RIVERHEAD	L	SUNAPEE	L	WAPPINGER	L
ROCKAWAY	M	SUNCOOK	L	WAREHAM	M
ROCK-RICKER-HOGBACK	L	SUNY	L	WARNERS	M
		SUTTON	L	WASSAIC	M
ROCK-RICKER-LYMAN	L	SWANTON	M	WATCHAUG	L
		SWARTSWOOD	L	WAUMBEK	L

Appendix Table 11.A Lime Index (0,L,M,H) of soils (continued).

Soil	Lime Index	Soil	Lime Index	Soil	Lime Index
WAYLAND	M	WILLDIN	L	WOOSTER	L
WEAVER	H	WILLETTE	0	WOOSTERN	L
WEGATCHIE	L	WILLIAMSON	L	WORDEN	L
WELLSBORO	L	WILLOWEMAC	L	WORTH	L
WENONAH	L	WILMINGTON	L	WURTSBORO	L
WESTBURY	L	WILPOINT	M	WYALUSING	L
WESTLAND	M	WINDSOR	L	YALESVILLE	L
WETHERSFIELD	L	WINOOSKI	L	YORKSHIRE	L
WHARTON	L	WOLCOTTSBURG	M		
WHATELY	M	WONSQUEAK	L		
WHIPPANY	M	WOODBRIDGE	L		
WHITELAW	M	WOODLAND	L		
WHITMAN	L	WOODLAWN	L		
WILBRAHAM	L	WOODSTOCK	L		

12. ENVIRONMENTAL RISK INDEX: NITRATE LEACHING INDEX

from

THE NEW YORK NITRATE LEACHING INDEX

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12.2 INTRODUCTION

The Nitrate Leaching Index (LI) is an indicator of the potential for nitrate to reach groundwater. Nitrate, because it is water soluble, moves downward as water percolates through the soil. The extent of percolation depends on permeability, pore-size distribution, soil depth to a restrictive layer, artificial drainage, and precipitation amount and distribution over the year. For a given precipitation pattern, excessively well drained soils such as Howard, Adams, Hoosic and Tunkhannock, or even well drained soils such as Madrid, Palmyra, Honeoye and Ontario have a significantly greater leaching potential than less well drained soils such as Vergennes, Swanton, Rhinebeck, Lordstown or Volusia. The current LI rates leaching potential based on soil hydrologic group (Table 12.1) and 10 year average precipitation data from weather stations around NY. Until recently, rainfall data were county-based. The latest version of the LI uses township-based precipitation data, which more accurately reflects precipitation patterns than the previously used county-based data. The effect of township-based data on LI score varies: some areas have significantly higher scores, some significantly lower, while other areas are essentially unchanged.

Table 12.1: Soil hydrologic groups. See Appendix Table 12.A for a complete list of hydrologic groups for New York soils.

Soil hydrologic group	Type	Infiltration capacity/ permeability	Leaching potential	Runoff potential
A	Deep, well-drained sands and gravels.	High	High	Low
B	Moderately drained, moderately fine to moderately coarse texture.	Moderate	Moderate	Moderate
C	Impeding layer, or moderately fine to fine texture.	Low	Low	High
D	Clay soils, soils with high water table.	Very low	Very low	Very high

12.3 HOW TO CALCULATE?

The Nitrate Leaching Index is the product of the Percolation Index and the Seasonal Index (Williams and Kissel, 1991): **LI = Percolation Index * Seasonal Index**. The Percolation Index (PI) is a function of the annual average precipitation (PA) and soil hydrologic group. The hydrologic group for each New York soil series can be found in Appendix Table 12.A. Under identical precipitation levels, soils with a hydrologic group "A" have the greatest percolation potential while soils of hydrologic group "D" have the least percolation and therefore are least conducive to leaching. Equations are shown below for users who wish to build these into their own software applications:

Hydrologic Group A: $PI = (P_A - 10.28)^2 / (P_A + 15.43)$
Hydrologic Group B: $PI = (P_A - 15.05)^2 / (P_A + 22.57)$
Hydrologic Group C: $PI = (P_A - 19.53)^2 / (P_A + 29.29)$
Hydrologic Group D: $PI = (P_A - 22.67)^2 / (P_A + 34.00)$

These equations were derived from Williams and Kissel (1991) and reported by Pierce et al. (1991 - Table 12-1). Precipitation data can be found in Appendix Table 12.B. For soils with a hydrologic group that consists of more than one letter (e.g. "A/D", "A/C", "C/D"), its hydrologic group is determined by the presence or absence of adequate artificial drainage. If the field is artificially drained ("adequate" or "excellent") the hydrologic group moves to the first of the two classes. If the field is inadequately drained or not drained at all, ("none" or "inadequate"), the second of the two classes is assigned. For example, a Halcott soil has a hydrologic class of "C/D". If this soil has adequate or excellent artificial drainage, the hydrologic group used is "C". If the soil is not or inadequately artificially drained, the hydrologic group "D" is assigned. For soils with a single hydrologic group, artificial drainage does not influence the hydrologic group used.

Box 1: What is the leaching index for a corn field near Auburn NY that is classified as a Lima soil type?

- Step 1:
  - Task: Look up the hydrologic group in Appendix Table 12.A.
  - Answer: Lima has a hydrologic group B.
- Step 2:
  - Task: Look up the annual precipitation (P_A) for Auburn in Cayuga County (Appendix Table 12.B).
  - Answer: P_A = 36.4 inches.
- Step 3:
  - Task: Look up the formula for the Percolation Index (PI) for a hydrologic group B soil.
  - Answer: $PI = (P_A - 15.05)^2 / (P_A + 22.57)$
- Step 4:
  - Task: Calculate the PI.
  - Answer: $PI = (36.4-15.05)^2 / (36.4 + 22.57) = 7.73$.
- Step 5:
  - Task: Look up the winter precipitation (P_W) for Auburn.
  - Answer: P_W = 16.0 inches.
- Step 6:
  - Task: Calculate the seasonal index (SI).
  - Answer: $SI = (2 * P_W/P_A)^{1/3}=(2 * 16.0/36.4)^{1/3}= 0.96$
- Step 7:
  - Task: Multiply the PI and the SI to obtain the LI.
  - Answer: $LI = PI * SI = 7.73 * 0.96 = 7.4$.

The Seasonal Index (SI) is determined by the annual precipitation (P_A in inches) and the sum of the fall and winter precipitation (PW, from October through March in inches): $SI = (2 * P_W / P_A)^{1/3}$. Average township-based precipitation as well as the N Leaching Index values for soils with hydrologic groups A, B, C, or D can be found in Appendix Table 12.B. An example of an N Leaching Index calculation is given in Box 1. Fortunately, no calculations are necessary: LI scores for each hydrologic group in each NY township are reported in Appendix Table 12.B. Use Appendix Table 12.A to identify soil hydrologic group and Appendix Table 12.B to look up LI scores.

12.4 Management Implications

An LI below 2 indicates that the potential for nitrate leaching below the root zone is low. An LI greater than 10 inches indicates that the potential for soluble nutrient leaching below the root zone is large while LI's between 2 and 10 are considered intermediate. In order to meet the N leaching requirements of the NRCS nutrient management standard (590), producers are expected to *implement* best management practices if the LI score for a field is high (>10). Producers are expected to *consider* the same practices on a case-by-case basis if the LI score for a field is intermediate (2-10). Best management practices recommended for soils with medium to high N leaching indices include those listed below. These recommendations are based on research done, among others, by Sogbedji and coworkers (2000) and Van Es and coworkers (2002).

- Unless the New York Phosphorus Index identifies the need for P based fertility management, manure and fertilizer application rates should be based on Cornell guidelines for meeting crop N needs.
- For corn, pre-plant (other than starter fertilizer) and early post plant *broadcast* applications of commercial nitrogen without the use of nitrification inhibitors are not recommended.
- Sidedress applications should be made after the corn has at least four true leaves.
- If starter N must be broadcast (e.g., for small grains or new seedings of grass), apply fertilizer as close to expected planting date as possible (ideally within 3 days or less).
- For row and cereal crops, including corn, maintain starter fertilizer N rates below 50 lbs/acre actual N under normal conditions.
- Manure and fertilizer applications should be adjusted based on information provided in “Nitrogen Recommendations for Field Crops in New York”, Cornell University Department of Crop and Soil Sciences Extension Series E01-4 (Ketterings and coworkers, 2001).
- Evaluate the need for sidedress N applications based on PSNT or other soil nitrate-nitrogen tests.
- Sod crops should not be incorporated in the fall. Chemical sod killing may be carried out when the soil temperature at four-inch depth is approaching 45^{o}F. Depending on location, this will not likely take place until early October.
- Minimize fall and/or winter manure application on good grass and/or legume sod fields that are to be rotated the following spring.
- Appropriate ammonia conservation is encouraged. Losses can either be reduced by immediately incorporating manure or eliminated by directly injecting manure as a sidedress application to growing crops.
- Plant winter hardy cover crops whenever possible, regardless of, but especially when fall manure is applied (e.g., rye, winter wheat, or interseed ryegrass in summer).
- Manure may be applied in the fall where there is a growing crop. Judicious amounts of manure can be applied to or in conjunction with perennial crops or winter hardy cover crops. Applications should generally not exceed the greater of 50 lbs/ace of first year available N or 50% of the expected N requirement of next year’s crop.
- Frost incorporation/injection is acceptable when soil conditions are suitable but winter applications should be made in accordance with the New York Phosphorus Index.
- Manure N application on legumes is acceptable to satisfy agronomic requirements when legumes represent less than 50% of the stand. When legumes represent more than 50% of the stand, manure may be applied at a rate not exceeding 150 lbs of available N/acre.

12.5 APPENDIX

Appendix Table 12.A: Soil hydrologic groups (HG) for New York soil types. For soils with a hydrologic group that consists of more than one letter (e.g. "A/D", "A/C", "C/D"), the hydrologic group for the N Leaching Index is determined by the presence or absence of adequate artificial drainage. If the field is artificially drained the hydrologic group moves to the first of the two classes. If the field is inadequately drained or not drained at all, the second of the two classes is assigned.

Soil Type	HG
Acton	C
Adams	A
Adirondack	D
Adjidaumo	D
Adrian	A/D
Agawam	B
Albia	C
Albrights	C
Alden	D
Allagash	B
Allard	B
Allendale	D
Allis	D
Alluvial Land	C
Almond	C
Alps	C
Altmar	B
Alton	A
Amboy	C
Amenia	B
Angola	C
Appleton	C
Arkport	B
Armagh	D
Arnot	C/D
Ashville	D
Atherton	B
Atkins	D
Atsion	C
Au Gres	B
Aurelie	D
Aurora	C
Barbour	B
Barcelona	C

Soil Type	HG
Barre	D
Bash	C
Basher	B
Bath	C
Becket	C
Becraft	B
Belgrade	B
Benson	D
Berkshire	B
Bernardston	C
Berrien	C
Berryland	B
Beseman	A
Bice	B
Biddeford	D
Birdsall	D
Blasdell	A
Bombay	B
Bonaparte	A
Bono	D
Boots	A
Borosaprists	A/D
Boynton	D
Braceville	C
Brayton	C
Bridgehampton	B
Bridport	D
Briggs	A
Brinkerton	D
Broadalbin	C
Brockport	D
Brookfield	B
Buckland	C
Bucksport	D

Soil Type	HG
Budd	B
Burdett	C
Burnham	D
Busti	C
Buxton	C
Cambria	D
Cambridge	C
Camillus	B
Camroden	C
Canaan	C
Canaan-Rock Outcrop	C
Canadice	D
Canandaigua	D
Canaseraga	C
Canastota	C
Caneadea	D
Canfield	C
Canton	B
Carbondale	A
Carlisle	A/D
Carrollton	C
Carver	A
Carver-Plymouth	A
Castile	B
Cathro	A
Cathro-Greenwood	A
Cattaraugus	C
Cavode	C
Cayuga	C
Cazenovia	B
Ceresco	Na
Chadakoin	B
Chagrin	B
Champlain	A

Soil Type	HG
Charles	C
Charlton	B
Chatfield	B
Chaumont	D
Chautauqua	C
Cheektowaga	D
Chenango	A
Cheshire	B
Chippeny	D
Chippewa	D
Churchville	D
Cicero	C
Clarkson	B
Claverack	C
Clymer	B
Cohoctah	B
Collamer	C
Colonie	A
Colosse	A
Colrain	A
Colton	A
Colwood	D
Conesus	B
Conotton	A
Constable	A
Cook	D
Copake	B
Cornish	C
Cosad	C
Cossayuna	C
Covert	A
Coveytown	C
Covington	D
Crary	C
Croghan	B
Culvers	C
Dalbo	C
Dalton	C
Danley	C
Dannemora	D
Darien	C
Dawson	A

Soil Type	HG
Deerfield	B
Deford	A
Dekalb	A
Depeyster	C
Deposit	B
Derb	C
Dixmont	C
Dorval	A
Dover	B
Duane	B
Dunkirk	B
Dutchess	B
Duxbury	A
Edwards	B
Eel	B
Eelweir	C
Elka	C
Ellery	D
Elmridge	C
Elmwood	C
Elnora	B
Empeyville	C
Enfield	B
Ensley	B
Erie	C
Ernest	C
Essex	C
Fahey	B
Farmington	C
Farnham	C
Fernlake	A
Flackville	C
Fonda	D
Franklinville	B
Fredon	C
Freetown	D
Fremont	C
Frenchtown	D
Frewsburg	C
Fryeburg	B
Fulton	D
Gage	D

Soil Type	HG
Galen	B
Galestown	A
Galoo	C
Galoo-Rock Outcrop	C
Galway	B
Genesee	B
Georgia	C
Getzville	D
Gilpen	C
Gilpin	C
Glebe	C
Glebe-Saddleback	C
Glendora	A/D
Glenfield	B
Gloucester	A
Glover	D
Gougeville	A
Granby	A/D
Grattan	A
Greene	C
Greenwood	A
Grenville	B
Gretor	C
Groton	A
Groveton	A
Guff	D
Guffin	D
Gulf	B
Hadley	B
Haights	B
Haights-Gulf	B
Hailesboro	C
Halcott	C/D
Halsey	C/D
Hamlin	B
Hamplain	B
Hannawa	D
Hartland	B
Haven	B
Hawksnest	C/D
Hempstead	B

Soil Type	HG
Henrietta	B
Herkimer	B
Hermon	A
Hero	B
Heuvelton	C
Hilton	B
Hinckley	A
Hinesburg	C
Hogansburg	B
Hogback	C
Hogback-Ricker	C
Holderton	B
Hollis	C
Holly	C/D
Holyoke	C
Holyoke-Rock Outcr	C
Homer	B
Honeoye	B
Hoosic	A
Hornell	D
Hornellsville	D
Houghtonville	C
Houghtonville-Rawson	C
Houseville	C
Howard	A
Hudson	C
Hulberton	C
Ilion	D
Insula	B
Ipswich	D
Ira	C
Ischua	B
Ivory	C
Jebavy	A
Joliet	D
Junius	C
Kalurah	B
Kanona	D
Kars	A
Kearsarge	B

Soil Type	HG
Kendaia	C
Kibbie	B
Kingsbury	D
Kinzua	B
Knickerbocker	A
Lackawanna	C
Lagross	A
Lagross-Haights	A
Lairdsville	D
Lakemont	D
Lakewood	A
Lamson	B/D
Lanesboro	C
Langford	C
Lansing	B
Leck Kill	B
Leicester	C
Leon	C
Lewbath	C
Lewbeach	C
Leyden	C
Lima	B
Limerick	C
Linden	B
Linlithgo	B
Livingston	D
Lobdell	B
Lockport	D
Lorain	D
Lordstown	C
Lovewell	B
Lowville	B
Loxley	A
Lucas	C
Ludlow	C
Lupton	A
Lyman	C
Lyman-Becket-Berkshire	C
Lyme	C
Lyons	D
Machias	B

Soil Type	HG
Macomber	C
Macomber-Taconic	C
Madalin	D
Madawaska	B
Madrid	B
Malone	C
Manahawkin	D
Mandy	C
Manheim	C
Manhoning	D
Manlius	C
Mansfield	D
Maplecrest	B
Marcy	D
Mardin	C
Marilla	C
Markey	A/D
Marlow	C
Martisco	B
Massena	C
Matoon	D
Matunuck	D
Medihemists	A/D
Medina	B
Medomak	D
Melrose	C
Menlo	D
Mentor	B
Merrimac	A
Middlebrook	C
Middlebrook-Mongaup	C
Middlebury	B
Millis	C
Millsite	C
Mineola	A
Miner	D
Mino	C
Minoa	C
Mohawk	B
Moira	C
Monadnock	B

Soil Type	HG
Monarda	D
Mongaup	C
Montauk	C
Mooers	B
Morocco	C
Morris	C
Mosherville	C
Muck	D
Muck-Peat	D
Mundal	C
Mundalite	C
Mundalite-Rawsonvill	C
Munson	D
Munuscong	B
Muskego	A/C
Muskellunge	D
Napoleon	A
Napoli	C
Nassau	C
Naumburg	C
Nehasne	B
Nellis	B
Neversink	D
Newfane	B
Newstead	C
Newton	A/D
Niagara	C
Nicholville	C
Ninigret	B
Norchip	D
Norwell	C
Norwich	D
Nunda	C
Oakville	A
Occum	B
Odessa	D
Ogdensburg	C
Olean	B
Ondawa	B
Oneida	C
Onoville	C

Soil Type	HG
Ontario	B
Onteora	C
Ontusia	C
Oquaga	C
Oramel	C
Organic	A/D
Orpark	C
Orwell	D
Ossipee	D
Otego	B
Otisville	A
Ottawa	A
Ovid	C
Palatine	B
Palms	A/D
Palmyra	B
Panton	D
Papakating	D
Parishville	C
Parsippany	D
Patchin	D
Pawcatuck	D
Pawling	B
Paxton	C
Peacham	D
Peat	A/D
Peat-Muck	A/D
Peru	C
Petoskey	A
Phelps	B
Philo	B
Pillsbury	C
Pinckney	C
Pipestone	B
Pittsfield	B
Pittstown	C
Plainbo	A
Plainfield	A
Plessis	D
Plymouth	A
Podunk	B
Poland	B

Soil Type	HG
Pompton	B
Pootatuck	B
Pope	B
Potsdam	C
Poygan	D
Punsit	C
Pyrities	B
Quetico	D
Quetico-Rock Outcro	D
Raquette	B
Rawsonville	C
Rawsonville-Beseman-	C
Rayne	B
Raynham	C
Raypol	C
Red Hook	C
Redwater	B
Remsen	D
Retsof	C
Rexford	C
Rhinebeck	D
Ricker	A
Ricker-Lyman	A
Ridgebury	C
Rifle	A
Riga	D
Rippowam	C
Riverhead	B
Rockaway	C
Romulus	D
Ross	B
Roundabout	C
Rumney	C
Runeberg	C
Ruse	D
Rushford	B
Saco	D
Salamanca	B
Salmon	B
Saprists	A/D

Soil Type	HG
Saugatuck	C
Scantic	D
Scarboro	D
Schoharie	C
Schroon	B
Schuyler	B
Scio	B
Scituate	B
Scriba	C
Searsport	D
Shaker	C
Shoreham	D
Sisk	C
Skerry	C
Sloan	B
Sodus	C
Somerset	C
St Johns	D
Staatsburg	C
Stafford	C
Steamburg	B
Stetson	B
Stissing	C
Stockbridge	C
Stockholm	C
Stowe	B
Sudbury	B
Suffield	B
Summerville	D
Sun	D
Sunapee	B
Suncook	A
Suny	D
Surplus	C
Surplus-Sisk	C
Sutton	B
Swanton	C
Swartswood	C
Swormville	C
Taconic	C
Taconic-Macomber	C
Tawas	A

Soil Type	HG
Teel	B
Tioga	B
Toledo	D
Tonawanda	D
Tor	D
Torull	D
Towerville	B
Trestle	B
Trout River	A
Troy	C
Trumbull	D
Tughill	D
Tuller	D
Tunbridge	C
Tunbridge-Adirondack	C
Tunkhannock	A
Turin	C
Tuscarora	C
Unadilla	B
Valois	B
Varick	D
Varysburg	B
Venango	C
Vergennes	C
Vly	C
Volusia	C
Waddington	A
Wainola	B
Wakeland	C
Wakeville	B
Wallace	B
Wallington	C
Wallkill	C
Walpole	C
Walton	C
Wampsville	B
Wappinger	B
Wareham	C
Warners	C
Wassaic	B
Watchaug	B

Soil Type	HG
Waumbeck	B
Wayland	C/D
Weaver	C
Wegatchie	D
Wellsboro	C
Wenonah	C
Westbury	B
Westland	C
Wethersfield	C
Wharton	C
Whately	D
Whippany	C
Whitelaw	B
Whitman	D
Wilbraham	C
Willdin	C
Willette	A
Williamson	C
Willowemoc	C
Wilmington	D
Wilpoint	D
Windsor	A
Winooski	B
Wolcottsburg	D
Wonsqueak	D
Woodbridge	C
Woodlawn	B
Woodstock	D
Woodstock-Rock Outcrop	D
Wooster	C
Woostern	C
Woostern-Bath-Valois	C
Worden	C
Worth	C
Wurtsboro	C
Wyalusing	D
Yalesville	C
Yorkshire	C

Appendix Table 12.B: New York township-based nitrate leaching index for soils with hydrological groups A, B, C and D. See Appendix Table 12.A for hydrologic groups for New York soil types and the formula used to calculate the N Leaching Indices for the different soil types.

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Albany	Berne	39.4	18.1	15.0	9.3	5.6	3.7
Albany	Bethlehem	36.4	16.0	12.6	7.4	4.1	2.6
Albany	Coeymans	37.7	16.4	13.5	8.1	4.7	3.0
Albany	Colonie	36.8	15.9	12.9	7.6	4.3	2.7
Albany	Guilderland	37.5	16.5	13.4	8.0	4.6	3.0
Albany	Knox	40.6	18.5	15.9	10.0	6.2	4.2
Albany	New Scotland	37.8	16.5	13.6	8.2	4.8	3.1
Albany	Rensselaerville	38.2	17.0	14.0	8.5	5.0	3.2
Albany	Westerlo	39.0	17.4	14.6	9.0	5.3	3.5
Allegany	Alfred	37.0	16.3	13.1	7.8	4.4	2.8
Allegany	Allen	36.9	15.3	12.7	7.5	4.3	2.7
Allegany	Alma	38.8	16.5	14.2	8.7	5.2	3.4
Allegany	Almond	35.3	14.5	11.6	6.6	3.6	2.2
Allegany	Amity	35.5	14.3	11.6	6.7	3.7	2.2
Allegany	Andover	37.4	16.4	13.3	8.0	4.6	2.9
Allegany	Angelica	36.0	14.8	12.1	7.0	3.9	2.4
Allegany	Belfast	35.7	14.5	11.8	6.8	3.8	2.3
Allegany	Birdsall	36.9	15.6	12.8	7.6	4.3	2.7
Allegany	Bolivar	38.9	16.4	14.3	8.8	5.2	3.4
Allegany	Burns	34.2	13.8	10.7	6.0	3.2	1.8
Allegany	Caneadea	35.0	14.8	11.5	6.6	3.5	2.1
Allegany	Centerville	38.4	15.9	13.8	8.4	4.9	3.2
Allegany	Clarksville	39.0	16.5	14.3	8.8	5.3	3.5
Allegany	Cuba	38.4	16.2	13.9	8.5	5.0	3.2
Allegany	Friendship	36.9	15.1	12.7	7.5	4.3	2.7
Allegany	Genesee	39.0	16.5	14.3	8.8	5.2	3.5
Allegany	Granger	36.7	15.5	12.6	7.5	4.2	2.6
Allegany	Grove	36.4	15.3	12.4	7.3	4.1	2.5
Allegany	Hume	35.5	14.8	11.7	6.8	3.7	2.2
Allegany	Independence	37.0	15.6	12.9	7.7	4.4	2.7
Allegany	New Hudson	37.8	15.4	13.3	8.0	4.6	3.0
Allegany	Rushford	36.4	15.0	12.4	7.3	4.1	2.5
Allegany	Scio	36.9	15.1	12.7	7.5	4.3	2.7
Allegany	Ward	37.3	16.3	13.2	7.9	4.5	2.9
Allegany	Wellsville	36.2	14.8	12.2	7.1	4.0	2.4

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Allegany	West Almond	37.2	16.2	13.1	7.8	4.5	2.8
Allegany	Willing	36.7	15.2	12.6	7.4	4.2	2.6
Allegany	Wirt	38.9	16.5	14.2	8.7	5.2	3.4
Broome	Barker	37.0	16.1	13.0	7.7	4.4	2.7
Broome	Binghamton	38.8	17.5	14.5	8.9	5.3	3.4
Broome	Chenango	37.0	16.0	13.0	7.7	4.4	2.8
Broome	Colesville	40.0	18.0	15.4	9.6	5.9	3.9
Broome	Conklin	38.4	16.7	14.0	8.5	5.0	3.3
Broome	Dickinson	36.7	16.0	12.8	7.5	4.3	2.6
Broome	Fenton	37.8	16.6	13.6	8.2	4.8	3.1
Broome	Kirkwood	38.3	16.6	13.9	8.4	5.0	3.2
Broome	Lisle	37.2	16.6	13.3	7.9	4.5	2.9
Broome	Maine	36.3	16.0	12.5	7.3	4.1	2.5
Broome	Nanticoke	37.0	16.1	13.0	7.7	4.4	2.8
Broome	Sanford	44.2	20.5	18.8	12.4	8.1	5.8
Broome	Triangle	37.5	16.6	13.4	8.0	4.6	2.9
Broome	Union	35.4	15.9	12.0	6.9	3.8	2.3
Broome	Vestal	37.0	16.2	13.1	7.8	4.4	2.8
Broome	Windsor	40.9	18.6	16.1	10.2	6.3	4.3
Cattaraugus	Allegany	42.8	18.5	17.3	11.2	7.1	5.0
Cattaraugus	Ashford	43.6	19.8	18.2	11.9	7.7	5.5
Cattaraugus	Carrollton	43.0	18.6	17.5	11.4	7.3	5.1
Cattaraugus	Cold Spring	44.2	19.8	18.6	12.3	8.0	5.7
Cattaraugus	Conewango	43.5	19.7	18.1	11.9	7.6	5.4
Cattaraugus	Dayton	42.9	19.8	17.7	11.5	7.4	5.2
Cattaraugus	East Otto	43.9	20.1	18.5	12.2	7.9	5.6
Cattaraugus	Ellicottville	46.3	21.2	20.4	13.8	9.2	6.7
Cattaraugus	Farmersville	40.6	17.5	15.6	9.8	6.0	4.1
Cattaraugus	Franklinville	42.6	18.7	17.2	11.1	7.1	5.0
Cattaraugus	Freedom	42.0	18.3	16.7	10.7	6.7	4.7
Cattaraugus	Great Valley	45.1	20.2	19.3	12.9	8.5	6.1
Cattaraugus	Hinsdale	40.5	17.4	15.5	9.8	6.0	4.0
Cattaraugus	Humphrey	43.6	19.1	18.0	11.8	7.6	5.4
Cattaraugus	Ischua	41.0	17.7	15.9	10.1	6.3	4.3
Cattaraugus	Leon	43.6	19.8	18.2	11.9	7.7	5.4
Cattaraugus	Little Valley	48.5	22.9	22.4	15.4	10.6	7.9
Cattaraugus	Lyndon	40.1	17.5	15.3	9.6	5.9	3.9
Cattaraugus	Machias	42.9	18.8	17.5	11.3	7.2	5.1
Cattaraugus	Mansfield	47.1	22.0	21.2	14.4	9.8	7.2

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Cattaraugus	Napoli	47.3	22.0	21.3	14.5	9.8	7.3
Cattaraugus	New Albion	45.7	20.8	19.9	13.4	8.9	6.5
Cattaraugus	Olean	40.8	17.4	15.7	9.9	6.1	4.2
Cattaraugus	Otto	43.0	19.4	17.7	11.5	7.3	5.2
Cattaraugus	Perrysburg	40.1	18.3	15.5	9.7	5.9	4.0
Cattaraugus	Persia	42.3	19.2	17.2	11.1	7.0	4.9
Cattaraugus	Portville	39.6	16.9	14.8	9.2	5.6	3.7
Cattaraugus	Randolph	44.4	20.4	18.9	12.5	8.2	5.9
Cattaraugus	Red House	45.0	20.2	19.2	12.8	8.4	6.1
Cattaraugus	Salamanca	44.7	20.2	19.0	12.6	8.3	5.9
Cattaraugus	South Valley	44.3	20.1	18.8	12.4	8.1	5.8
Cattaraugus	Yorkshire	42.5	18.9	17.2	11.1	7.1	5.0
Cayuga	Auburn	36.4	16.0	12.6	7.4	4.2	2.6
Cayuga	Aurelius	34.9	15.1	11.4	6.5	3.5	2.1
Cayuga	Brutus	37.0	17.0	13.2	7.9	4.5	2.8
Cayuga	Cato	37.6	17.3	13.7	8.2	4.7	3.0
Cayuga	Conquest	36.8	16.9	13.1	7.8	4.4	2.8
Cayuga	Fleming	36.8	15.9	12.9	7.6	4.3	2.7
Cayuga	Genoa	35.9	14.9	12.0	7.0	3.9	2.3
Cayuga	Ira	39.0	18.0	14.7	9.1	5.4	3.5
Cayuga	Ledyard	34.0	14.3	10.8	6.0	3.1	1.8
Cayuga	Locke	37.9	16.2	13.6	8.2	4.8	3.0
Cayuga	Mentz	35.4	15.9	12.0	6.9	3.8	2.3
Cayuga	Montezuma	35.0	15.3	11.6	6.6	3.6	2.1
Cayuga	Moravia	37.8	15.9	13.5	8.1	4.7	3.0
Cayuga	Niles	38.6	17.3	14.3	8.7	5.2	3.4
Cayuga	Owasco	37.7	17.0	13.6	8.2	4.7	3.0
Cayuga	Scipio	37.0	15.5	12.8	7.6	4.3	2.7
Cayuga	Sempronius	40.1	18.0	15.4	9.6	5.9	3.9
Cayuga	Sennett	37.3	17.0	13.4	8.0	4.6	2.9
Cayuga	Springport	34.4	14.8	11.1	6.2	3.3	1.9
Cayuga	Sterling	39.5	19.5	15.4	9.6	5.8	3.8
Cayuga	Summerhill	40.4	17.9	15.6	9.8	6.0	4.1
Cayuga	Throop	35.0	15.5	11.7	6.7	3.6	2.1
Cayuga	Venice	37.3	15.3	13.0	7.7	4.4	2.8
Cayuga	Victory	37.9	17.2	13.9	8.4	4.9	3.1
Chautauqua	Arkwright	46.2	21.9	20.5	13.8	9.2	6.8
Chautauqua	Busti	45.2	20.8	19.5	13.0	8.6	6.2
Chautauqua	Carroll	44.6	20.3	19.0	12.6	8.2	5.9

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Chautauqua	Charlotte	47.5	22.9	21.7	14.8	10.1	7.5
Chautauqua	Chautauqua	46.8	21.9	21.0	14.2	9.6	7.1
Chautauqua	Cherry Creek	45.9	21.7	20.3	13.6	9.1	6.6
Chautauqua	Clymer	47.2	22.3	21.4	14.5	9.8	7.3
Chautauqua	Dunkirk	39.0	18.3	14.8	9.1	5.4	3.6
Chautauqua	Ellery	46.4	22.1	20.8	14.0	9.4	6.9
Chautauqua	Ellicott	45.5	21.4	19.9	13.3	8.8	6.4
Chautauqua	Ellington	45.9	21.6	20.3	13.6	9.1	6.6
Chautauqua	French Creek	47.1	21.9	21.1	14.4	9.7	7.2
Chautauqua	Gerry	46.8	22.3	21.1	14.3	9.6	7.1
Chautauqua	Hanover	41.3	19.0	16.5	10.5	6.5	4.5
Chautauqua	Harmony	47.0	21.7	21.0	14.3	9.6	7.1
Chautauqua	Kiantone	44.3	20.0	18.7	12.3	8.0	5.8
Chautauqua	Mina	47.0	21.9	21.1	14.3	9.7	7.1
Chautauqua	North Harmony	46.4	21.9	20.7	14.0	9.4	6.9
Chautauqua	Poland	44.2	20.3	18.8	12.4	8.1	5.8
Chautauqua	Pomfret	43.0	19.9	17.9	11.6	7.4	5.2
Chautauqua	Portland	43.2	19.6	17.9	11.7	7.5	5.3
Chautauqua	Ripley	45.6	20.7	19.8	13.2	8.8	6.4
Chautauqua	Sheridan	40.9	18.7	16.2	10.2	6.3	4.3
Chautauqua	Sherman	47.1	22.1	21.2	14.4	9.8	7.2
Chautauqua	Stockton	46.4	22.0	20.7	14.0	9.4	6.9
Chautauqua	Villenova	45.3	21.5	19.8	13.2	8.7	6.3
Chautauqua	Westfield	45.6	20.7	19.8	13.2	8.8	6.4
Chemung	Ashland	34.8	15.0	11.4	6.5	3.5	2.0
Chemung	Baldwin	35.5	15.4	11.9	6.9	3.8	2.3
Chemung	Big Flats	33.1	13.7	10.1	5.5	2.8	1.5
Chemung	Catlin	34.4	14.0	10.9	6.1	3.2	1.9
Chemung	Chemung	35.4	15.6	11.9	6.9	3.8	2.3
Chemung	Elmira	33.5	14.2	10.4	5.8	2.9	1.7
Chemung	Erin	36.4	16.1	12.6	7.4	4.1	2.6
Chemung	Horseheads	33.8	14.1	10.6	5.9	3.0	1.7
Chemung	Southport	34.0	14.4	10.8	6.0	3.1	1.8
Chemung	Van Etten	37.7	16.8	13.6	8.2	4.7	3.0
Chemung	Veteran	34.4	14.6	11.0	6.2	3.3	1.9
Chenango	Afton	40.7	18.1	15.9	10.0	6.2	4.2
Chenango	Bainbridge	40.8	17.5	15.8	10.0	6.2	4.2
Chenango	Columbus	39.0	17.5	14.6	9.0	5.4	3.5
Chenango	Coventry	40.3	17.5	15.4	9.7	5.9	4.0

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Chenango	German	42.3	19.0	17.2	11.1	7.0	4.9
Chenango	Greene	38.8	17.0	14.3	8.8	5.2	3.4
Chenango	Guilford	39.9	17.3	15.1	9.4	5.7	3.8
Chenango	Lincklaen	41.0	18.4	16.1	10.2	6.3	4.3
Chenango	Mcdonough	41.4	18.4	16.4	10.4	6.5	4.5
Chenango	New Berlin	39.2	17.5	14.7	9.1	5.4	3.6
Chenango	North Norwich	38.1	16.9	13.9	8.4	4.9	3.2
Chenango	Norwich	39.6	17.5	15.0	9.3	5.6	3.7
Chenango	Otselic	41.1	18.1	16.1	10.2	6.3	4.3
Chenango	Oxford	39.4	17.5	14.9	9.2	5.5	3.7
Chenango	Pharsalia	42.8	19.6	17.7	11.5	7.3	5.1
Chenango	Pitcher	41.9	18.6	16.8	10.8	6.8	4.7
Chenango	Plymouth	40.1	17.5	15.3	9.6	5.8	3.9
Chenango	Preston	40.2	17.6	15.4	9.7	5.9	4.0
Chenango	Sherburne	37.7	16.6	13.6	8.2	4.7	3.0
Chenango	Smithville	39.5	17.5	14.9	9.2	5.6	3.7
Chenango	Smyrna	39.3	17.3	14.8	9.1	5.5	3.6
Clinton	Altona	32.9	13.6	9.9	5.4	2.7	1.5
Clinton	Ausable	31.8	13.2	9.2	4.8	2.3	1.2
Clinton	Beekmantown	32.7	13.5	9.8	5.3	2.6	1.4
Clinton	Black Brook	35.8	15.2	12.0	7.0	3.8	2.3
Clinton	Champlain	32.6	13.0	9.6	5.2	2.5	1.4
Clinton	Chazy	32.4	13.0	9.5	5.1	2.5	1.3
Clinton	Clinton	34.9	14.7	11.4	6.5	3.5	2.1
Clinton	Dannemora	37.8	16.6	13.6	8.2	4.8	3.1
Clinton	Ellenburg	36.9	15.9	12.9	7.7	4.4	2.7
Clinton	Mooers	32.1	13.0	9.3	4.9	2.4	1.2
Clinton	Peru	32.2	13.5	9.5	5.1	2.5	1.3
Clinton	Plattsburgh	32.4	13.6	9.6	5.2	2.5	1.3
Clinton	Saranac	36.4	15.5	12.5	7.3	4.1	2.5
Clinton	Schuyler Falls	32.3	13.3	9.6	5.1	2.5	1.3
Columbia	Ancram	43.8	19.7	18.3	12.0	7.8	5.6
Columbia	Austerlitz	46.0	21.2	20.2	13.6	9.0	6.6
Columbia	Canaan	45.3	20.5	19.5	13.0	8.6	6.2
Columbia	Chatham	41.3	18.5	16.4	10.4	6.5	4.5
Columbia	Claverack	41.3	18.5	16.4	10.4	6.5	4.5
Columbia	Clermont	41.4	19.1	16.6	10.6	6.6	4.5
Columbia	Copake	44.4	20.1	18.8	12.5	8.1	5.8
Columbia	Gallatin	42.3	19.0	17.2	11.1	7.0	4.9

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Columbia	Germantown	41.0	18.8	16.2	10.3	6.4	4.4
Columbia	Ghent	41.0	18.4	16.1	10.2	6.3	4.3
Columbia	Greenport	39.5	17.5	14.9	9.2	5.6	3.7
Columbia	Hillsdale	45.2	20.8	19.6	13.1	8.6	6.3
Columbia	Kinderhook	39.2	17.5	14.7	9.1	5.4	3.6
Columbia	Livingston	41.0	18.5	16.2	10.2	6.3	4.3
Columbia	New Lebanon	42.3	18.9	17.1	11.0	7.0	4.9
Columbia	Stockport	39.0	17.5	14.6	9.0	5.4	3.5
Columbia	Stuyvesant	38.4	17.0	14.1	8.6	5.1	3.3
Columbia	Taghkanic	42.4	19.0	17.2	11.1	7.0	4.9
Cortland	Cincinnatus	42.1	18.8	16.9	10.9	6.9	4.8
Cortland	Cortlandville	39.5	18.5	15.2	9.4	5.7	3.8
Cortland	Cuyler	41.1	18.3	16.1	10.2	6.3	4.3
Cortland	Freetown	41.2	18.0	16.2	10.3	6.4	4.4
Cortland	Harford	39.0	17.4	14.6	9.0	5.3	3.5
Cortland	Homer	40.7	18.8	16.0	10.1	6.2	4.2
Cortland	Lapeer	39.0	17.5	14.6	9.0	5.4	3.5
Cortland	Marathon	39.1	17.3	14.7	9.0	5.4	3.6
Cortland	Preble	40.9	18.6	16.1	10.2	6.3	4.3
Cortland	Scott	41.0	18.8	16.3	10.3	6.4	4.4
Cortland	Solon	41.3	18.8	16.5	10.5	6.5	4.5
Cortland	Taylor	42.1	18.9	17.0	10.9	6.9	4.8
Cortland	Truxton	41.0	18.0	16.0	10.1	6.3	4.3
Cortland	Virgl	39.7	17.8	15.1	9.4	5.7	3.8
Cortland	Willet	40.4	17.7	15.6	9.8	6.0	4.1
Delaware	Andes	41.3	17.9	16.1	10.3	6.4	4.4
Delaware	Bovina	40.1	17.0	15.2	9.5	5.8	3.9
Delaware	Colchester	44.3	19.9	18.7	12.4	8.1	5.8
Delaware	Davenport	39.5	16.9	14.8	9.1	5.5	3.7
Delaware	Delhi	41.3	18.1	16.2	10.3	6.4	4.4
Delaware	Deposit	43.4	19.8	18.1	11.8	7.6	5.4
Delaware	Franklin	42.2	18.8	17.0	10.9	6.9	4.8
Delaware	Hamden	43.1	19.2	17.7	11.5	7.4	5.2
Delaware	Hancock	43.7	20.1	18.4	12.1	7.8	5.5
Delaware	Harpersfield	39.0	16.9	14.5	8.9	5.3	3.5
Delaware	Kortright	39.4	17.0	14.7	9.1	5.5	3.6
Delaware	Masonville	43.3	19.4	17.9	11.7	7.5	5.3
Delaware	Meredith	41.3	18.3	16.3	10.4	6.4	4.4
Delaware	Middletown	39.1	16.9	14.5	8.9	5.3	3.5

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Delaware	Roxbury	41.1	18.1	16.1	10.2	6.3	4.3
Delaware	Sidney	41.0	18.1	16.0	10.1	6.3	4.3
Delaware	Stamford	40.7	17.8	15.8	9.9	6.1	4.2
Delaware	Tompkins	43.7	20.1	18.3	12.0	7.8	5.5
Delaware	Walton	45.2	20.6	19.5	13.0	8.6	6.2
Dutchess	Amenia	42.0	18.7	16.9	10.8	6.8	4.7
Dutchess	Beekman	45.2	21.2	19.7	13.1	8.7	6.3
Dutchess	Clinton	43.1	19.4	17.8	11.6	7.4	5.2
Dutchess	Dover	44.7	21.0	19.3	12.8	8.4	6.0
Dutchess	East Fishkill	44.5	20.5	19.0	12.6	8.2	5.9
Dutchess	Fishkill	44.5	20.4	19.0	12.5	8.2	5.9
Dutchess	Hyde Park	43.7	20.1	18.4	12.0	7.8	5.5
Dutchess	La Grange	42.9	19.1	17.5	11.4	7.3	5.1
Dutchess	Milan	42.4	19.1	17.2	11.1	7.0	4.9
Dutchess	Northeast	43.9	19.8	18.4	12.1	7.8	5.6
Dutchess	Pawling	46.1	22.0	20.5	13.8	9.2	6.7
Dutchess	Pine Plains	41.8	18.9	16.8	10.8	6.8	4.7
Dutchess	Pleasant Val'y	43.0	19.0	17.6	11.4	7.3	5.1
Dutchess	Poughkeepsie	41.7	19.0	16.7	10.7	6.7	4.6
Dutchess	Red Hook	42.6	19.6	17.5	11.4	7.2	5.1
Dutchess	Rhinebeck	44.1	20.6	18.8	12.4	8.0	5.8
Dutchess	Stanford	41.0	18.2	16.1	10.2	6.3	4.3
Dutchess	Union Vale	44.2	19.7	18.6	12.2	8.0	5.7
Dutchess	Wappinger	41.9	19.0	16.9	10.8	6.8	4.7
Dutchess	Washington	41.9	18.7	16.8	10.8	6.8	4.7
Erie	Alden	37.9	17.5	14.0	8.4	4.9	3.2
Erie	Amherst	37.9	18.0	14.1	8.5	4.9	3.2
Erie	Aurora	42.8	20.5	17.9	11.6	7.4	5.2
Erie	Boston	45.1	21.9	19.8	13.2	8.7	6.3
Erie	Brant	38.2	17.1	14.0	8.5	5.0	3.2
Erie	Cheektowaga	39.0	18.5	14.9	9.2	5.5	3.6
Erie	Clarence	37.4	17.3	13.6	8.1	4.7	3.0
Erie	Colden	47.1	22.8	21.5	14.6	9.9	7.3
Erie	Collins	39.9	18.4	15.5	9.6	5.9	3.9
Erie	Concord	44.8	21.2	19.4	12.9	8.4	6.1
Erie	Eden	40.7	18.7	16.0	10.1	6.2	4.2
Erie	Elma	39.6	18.6	15.3	9.5	5.7	3.8
Erie	Evans	37.9	17.0	13.8	8.3	4.8	3.1
Erie	Hamburg	38.5	17.7	14.3	8.7	5.1	3.4

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Erie	Holland	43.7	20.4	18.5	12.1	7.8	5.6
Erie	Lackawana	37.1	17.6	13.5	8.0	4.6	2.9
Erie	Lancaster	39.0	18.5	14.9	9.2	5.5	3.6
Erie	Marilla	39.8	18.4	15.4	9.6	5.8	3.9
Erie	Newstead	36.4	15.9	12.6	7.4	4.1	2.6
Erie	North Collins	42.2	20.0	17.4	11.2	7.1	4.9
Erie	Orchard Park	41.3	19.5	16.7	10.6	6.6	4.5
Erie	Sardinia	43.9	20.1	18.5	12.2	7.9	5.6
Erie	Tonawanda	37.6	18.3	13.9	8.4	4.8	3.1
Erie	Wales	42.5	20.1	17.6	11.4	7.2	5.1
Erie	West Seneca	39.0	18.5	14.9	9.2	5.5	3.6
Essex	Chesterfield	34.7	14.6	11.2	6.4	3.4	2.0
Essex	Crown Point	37.6	16.5	13.5	8.1	4.7	3.0
Essex	Elizabethtown	37.6	16.6	13.5	8.1	4.7	3.0
Essex	Essex	34.4	14.3	11.0	6.2	3.3	1.9
Essex	Jay	35.8	15.5	12.1	7.0	3.9	2.3
Essex	Keene	42.2	18.1	16.8	10.8	6.8	4.7
Essex	Lewis	36.6	15.9	12.7	7.5	4.2	2.6
Essex	Minerva	42.5	19.2	17.3	11.2	7.1	5.0
Essex	Moriah	37.5	16.4	13.4	8.0	4.6	2.9
Essex	Newcomb	43.4	19.2	17.9	11.7	7.5	5.3
Essex	North Elba	41.4	18.1	16.3	10.3	6.4	4.4
Essex	North Hudson	41.3	18.3	16.3	10.4	6.5	4.4
Essex	Schroon	40.6	18.2	15.8	10.0	6.1	4.2
Essex	St. Armand	39.5	17.4	14.9	9.2	5.5	3.7
Essex	Ticonderoga	38.2	16.8	13.9	8.5	5.0	3.2
Essex	Westport	35.7	15.2	12.0	6.9	3.8	2.3
Essex	Willsboro	33.2	13.8	10.1	5.5	2.8	1.5
Essex	Wilmington	38.8	16.7	14.2	8.7	5.2	3.4
Franklin	Altamont	41.7	18.1	16.5	10.5	6.6	4.6
Franklin	Bangor	36.4	15.6	12.5	7.3	4.1	2.5
Franklin	Bellmont	43.0	18.7	17.5	11.4	7.3	5.1
Franklin	Bombay	35.0	14.8	11.5	6.5	3.5	2.1
Franklin	Brandon	40.9	17.7	15.9	10.0	6.2	4.2
Franklin	Brighton	40.0	17.5	15.2	9.5	5.8	3.9
Franklin	Burke	36.6	15.6	12.6	7.4	4.2	2.6
Franklin	Chateaugay	37.3	16.0	13.2	7.9	4.5	2.9
Franklin	Constable	35.1	14.9	11.5	6.6	3.6	2.1
Franklin	Dickinson	37.9	16.1	13.5	8.2	4.7	3.0

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Franklin	Duane	41.6	17.9	16.4	10.4	6.5	4.5
Franklin	Fort Covington	35.0	14.5	11.4	6.5	3.5	2.1
Franklin	Franklin	39.5	17.2	14.8	9.2	5.5	3.7
Franklin	Harrietstown	40.8	17.9	15.9	10.0	6.2	4.2
Franklin	Malone	40.3	17.5	15.5	9.7	5.9	4.0
Franklin	Moira	35.1	15.0	11.6	6.6	3.6	2.1
Franklin	Santa Clara	41.0	17.7	15.9	10.1	6.2	4.3
Franklin	Waverly	40.9	17.8	15.9	10.1	6.2	4.3
Franklin	Westville	35.0	14.7	11.4	6.5	3.5	2.1
Fulton	Bleeker	50.3	24.7	24.2	17.0	11.8	9.0
Fulton	Broadalbin	43.0	20.4	18.0	11.7	7.5	5.3
Fulton	Caroga	50.6	24.5	24.4	17.1	11.9	9.1
Fulton	Ephratah	45.0	20.7	19.4	12.9	8.5	6.1
Fulton	Johnstown	44.2	20.6	18.8	12.4	8.1	5.8
Fulton	Mayfield	45.6	21.7	20.1	13.5	8.9	6.5
Fulton	Northampton	43.6	20.6	18.5	12.1	7.8	5.5
Fulton	Oppenheim	44.6	20.3	19.0	12.6	8.2	5.9
Fulton	Perth	42.3	19.6	17.3	11.2	7.1	4.9
Fulton	Stratford	49.8	23.3	23.4	16.3	11.3	8.6
Genesee	Alabama	35.0	14.6	11.4	6.5	3.5	2.1
Genesee	Alexander	36.0	15.0	12.1	7.0	3.9	2.4
Genesee	Batavia	35.0	14.5	11.4	6.5	3.5	2.1
Genesee	Bergen	32.1	13.9	9.6	5.1	2.5	1.3
Genesee	Bethany	35.9	15.0	12.0	7.0	3.9	2.4
Genesee	Byron	33.0	14.4	10.2	5.5	2.8	1.5
Genesee	Darien	36.9	16.1	13.0	7.7	4.4	2.7
Genesee	Elba	33.5	14.5	10.5	5.8	3.0	1.7
Genesee	Le Roy	33.7	14.4	10.6	5.8	3.0	1.7
Genesee	Oakfield	34.7	14.5	11.2	6.3	3.4	2.0
Genesee	Pavilion	35.6	15.2	11.9	6.9	3.8	2.3
Genesee	Pembroke	35.4	14.7	11.6	6.7	3.6	2.2
Genesee	Stafford	34.8	14.5	11.3	6.4	3.4	2.0
Greene	Ashland	38.9	17.6	14.6	9.0	5.3	3.5
Greene	Athens	39.2	17.8	14.8	9.1	5.5	3.6
Greene	Cairo	38.6	17.6	14.4	8.8	5.2	3.4
Greene	Catskill	40.8	18.8	16.1	10.2	6.3	4.3
Greene	Coxsackie	38.8	16.9	14.3	8.8	5.2	3.4
Greene	Durham	37.9	17.1	13.8	8.3	4.9	3.1
Greene	Greenville	38.7	17.0	14.3	8.7	5.2	3.4

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Greene	Halcott	45.2	21.0	19.7	13.1	8.7	6.3
Greene	Hunter	45.9	21.4	20.2	13.6	9.0	6.6
Greene	Jewett	41.8	19.2	16.9	10.8	6.8	4.7
Greene	Lexington	46.0	21.9	20.4	13.7	9.2	6.7
Greene	New Baltimore	37.7	16.3	13.5	8.1	4.7	3.0
Greene	Prattsville	37.0	16.3	13.0	7.7	4.4	2.8
Greene	Windham	41.6	19.2	16.8	10.7	6.7	4.6
Hamilton	Arietta	55.3	27.4	28.5	20.7	15.0	11.9
Hamilton	Benson	51.6	25.7	25.5	18.0	12.7	9.8
Hamilton	Hope	47.2	22.9	21.5	14.7	9.9	7.3
Hamilton	Indian Lake	43.7	20.3	18.4	12.1	7.8	5.6
Hamilton	Inlet	50.1	24.1	23.9	16.7	11.6	8.9
Hamilton	Lake Pleasant	52.4	25.8	26.0	18.5	13.2	10.2
Hamilton	Long Lake	46.1	21.1	20.2	13.6	9.1	6.6
Hamilton	Morehouse	54.7	27.1	28.0	20.3	14.7	11.5
Hamilton	Wells	48.7	23.7	22.8	15.7	10.8	8.1
Herkimer	Columbia	42.9	18.7	17.5	11.3	7.2	5.1
Herkimer	Danube	41.3	18.7	16.4	10.5	6.5	4.5
Herkimer	Fairfield	44.0	19.7	18.4	12.1	7.9	5.6
Herkimer	Frankfort	43.0	18.8	17.5	11.4	7.3	5.1
Herkimer	German Flatts	42.5	19.0	17.2	11.1	7.1	4.9
Herkimer	Herkimer	42.4	19.1	17.2	11.1	7.0	4.9
Herkimer	Litchfield	42.8	18.9	17.4	11.3	7.2	5.0
Herkimer	Little Falls	42.0	19.0	17.0	10.9	6.9	4.8
Herkimer	Manheim	42.5	19.5	17.4	11.2	7.1	5.0
Herkimer	Newport	46.3	21.3	20.4	13.8	9.2	6.8
Herkimer	Norway	49.8	23.1	23.3	16.3	11.3	8.6
Herkimer	Ohio	53.0	25.9	26.5	18.9	13.5	10.5
Herkimer	Russia	51.5	24.5	24.9	17.6	12.4	9.5
Herkimer	Salisbury	49.5	22.9	23.1	16.1	11.1	8.4
Herkimer	Schuyler	44.7	20.1	19.0	12.6	8.2	5.9
Herkimer	Stark	42.6	19.0	17.3	11.2	7.1	5.0
Herkimer	Warren	43.0	19.0	17.6	11.4	7.3	5.1
Herkimer	Webb	48.4	22.9	22.3	15.4	10.5	7.9
Herkimer	Winfield	41.4	18.5	16.4	10.5	6.5	4.5
Jefferson	Adams	38.2	19.0	14.5	8.8	5.2	3.3
Jefferson	Alexandria	37.0	17.3	13.3	7.9	4.5	2.8
Jefferson	Antwerp	37.5	17.1	13.6	8.1	4.7	3.0
Jefferson	Brownville	33.3	16.3	10.8	5.9	3.0	1.7

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Jefferson	Cape Vincent	35.0	17.4	12.1	6.9	3.7	2.2
Jefferson	Champion	43.9	21.9	19.0	12.5	8.1	5.8
Jefferson	Clayton	35.3	17.3	12.3	7.1	3.8	2.3
Jefferson	Ellisburg	39.9	20.3	16.0	10.0	6.0	4.0
Jefferson	Henderson	36.3	17.9	13.0	7.6	4.2	2.6
Jefferson	Hounsfield	33.4	16.5	10.9	6.0	3.1	1.7
Jefferson	Le Ray	38.6	19.0	14.8	9.0	5.3	3.5
Jefferson	Lorraine	48.0	24.8	22.7	15.6	10.6	7.9
Jefferson	Lyme	34.1	16.9	11.4	6.4	3.3	1.9
Jefferson	Orleans	36.2	17.5	12.8	7.5	4.2	2.6
Jefferson	Pamelia	36.0	17.7	12.8	7.5	4.1	2.5
Jefferson	Philadelphia	38.8	18.4	14.7	9.0	5.4	3.5
Jefferson	Rodman	46.6	23.8	21.4	14.5	9.7	7.1
Jefferson	Rutland	45.4	23.0	20.4	13.6	9.0	6.6
Jefferson	Theresa	37.9	17.8	14.0	8.5	4.9	3.2
Jefferson	Watertown	40.7	20.3	16.5	10.4	6.4	4.4
Jefferson	Wilna	39.1	18.3	14.9	9.2	5.5	3.6
Jefferson	Worth	54.6	29.0	28.6	20.7	15.0	11.8
Lewis	Croghan	40.8	19.1	16.2	10.2	6.3	4.3
Lewis	Denmark	43.4	21.3	18.6	12.1	7.8	5.5
Lewis	Diana	39.7	18.4	15.3	9.5	5.8	3.8
Lewis	Greig	47.4	22.9	21.6	14.8	10.0	7.4
Lewis	Harrisburg	53.9	28.1	27.9	20.0	14.4	11.3
Lewis	Lewis	55.7	28.2	29.1	21.2	15.5	12.2
Lewis	Leyden	53.2	26.8	26.9	19.3	13.8	10.7
Lewis	Lowville	43.4	21.4	18.6	12.1	7.8	5.5
Lewis	Lyonsdale	49.4	24.2	23.5	16.3	11.3	8.5
Lewis	Martinsburg	53.9	27.6	27.7	19.9	14.3	11.2
Lewis	Montague	59.5	32.1	33.2	24.7	18.5	14.9
Lewis	New Bremen	40.4	19.1	15.9	10.0	6.1	4.1
Lewis	Osceola	55.7	28.7	29.3	21.3	15.5	12.3
Lewis	Pickney	53.8	28.3	27.8	20.0	14.4	11.2
Lewis	Turin	50.0	24.4	23.9	16.7	11.6	8.8
Lewis	Watson	44.7	21.3	19.4	12.9	8.4	6.1
Lewis	West Turin	55.2	27.0	28.4	20.6	15.0	11.8
Livingston	Avon	31.1	12.5	8.7	4.5	2.1	1.0
Livingston	Caledonia	31.6	13.2	9.1	4.8	2.3	1.1
Livingston	Conesus	34.2	13.8	10.7	6.0	3.2	1.8
Livingston	Geneseo	31.5	12.8	9.0	4.7	2.2	1.1

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Livingston	Groveland	31.4	12.6	8.8	4.6	2.2	1.1
Livingston	Leicester	30.4	12.3	8.3	4.2	1.9	0.9
Livingston	Lima	32.3	13.1	9.5	5.0	2.5	1.3
Livingston	Livonia	33.1	13.4	10.0	5.5	2.8	1.5
Livingston	Mount Morris	31.2	12.7	8.8	4.5	2.1	1.0
Livingston	N. Dansville	32.5	12.8	9.5	5.1	2.5	1.3
Livingston	Nunda	35.0	14.5	11.4	6.5	3.5	2.1
Livingston	Ossian	34.4	14.0	10.9	6.2	3.3	1.9
Livingston	Portage	34.7	14.5	11.2	6.4	3.4	2.0
Livingston	Sparta	33.3	13.3	10.1	5.5	2.8	1.5
Livingston	Springwater	34.9	13.6	11.1	6.3	3.4	2.0
Livingston	West Sparta	32.6	13.1	9.6	5.2	2.6	1.4
Livingston	York	32.2	13.5	9.5	5.1	2.5	1.3
Madison	Brookfield	40.6	17.8	15.7	9.9	6.1	4.1
Madison	Cazenovia	41.7	19.0	16.7	10.7	6.7	4.6
Madison	De Ruyter	41.0	17.8	15.9	10.1	6.3	4.3
Madison	Eaton	39.4	17.6	14.9	9.2	5.6	3.7
Madison	Fenner	43.2	19.6	17.9	11.6	7.5	5.3
Madison	Georgetown	41.0	18.1	16.0	10.2	6.3	4.3
Madison	Hamilton	39.1	17.4	14.6	9.0	5.4	3.5
Madison	Lebanon	39.6	17.5	15.0	9.3	5.6	3.7
Madison	Lenox	41.0	18.1	16.0	10.2	6.3	4.3
Madison	Lincoln	41.8	19.3	16.9	10.8	6.8	4.7
Madison	Madison	40.4	17.7	15.6	9.8	6.0	4.1
Madison	Nelson	41.4	18.6	16.4	10.5	6.5	4.5
Madison	Oneida	41.3	19.0	16.5	10.5	6.5	4.5
Madison	Smithfield	41.5	18.6	16.5	10.5	6.6	4.5
Madison	Stockbridge	40.7	18.2	15.9	10.0	6.2	4.2
Madison	Sullivan	41.0	18.4	16.1	10.2	6.3	4.3
Monroe	Brighton	32.9	15.0	10.3	5.6	2.8	1.5
Monroe	Chili	31.1	14.0	9.0	4.6	2.1	1.0
Monroe	Clarkson	30.2	12.4	8.2	4.1	1.8	0.8
Monroe	E.Rochester	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Gates	31.1	14.4	9.1	4.7	2.2	1.1
Monroe	Greece	32.0	14.5	9.6	5.1	2.5	1.3
Monroe	Hamlin	31.0	13.8	8.9	4.6	2.1	1.0
Monroe	Henrietta	32.1	14.1	9.6	5.1	2.5	1.3
Monroe	Irondequoit	33.0	15.5	10.4	5.7	2.9	1.6
Monroe	Mendon	31.7	13.7	9.3	4.9	2.3	1.2

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Monroe	Ogden	31.0	13.6	8.9	4.5	2.1	1.0
Monroe	Parma	31.1	13.8	8.9	4.6	2.1	1.0
Monroe	Penfield	33.3	15.1	10.5	5.8	2.9	1.6
Monroe	Perinton	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Pittsford	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Riga	31.3	13.6	9.0	4.7	2.2	1.1
Monroe	Rush	31.0	13.1	8.8	4.5	2.1	1.0
Monroe	Sweden	30.9	13.1	8.7	4.4	2.0	1.0
Monroe	Webster	34.5	16.1	11.5	6.5	3.4	2.0
Monroe	Wheatland	31.5	13.5	9.1	4.8	2.2	1.1
Montgomery	Amsterdam	40.0	18.7	15.6	9.7	5.9	4.0
Montgomery	Canajoharie	41.0	18.4	16.1	10.2	6.3	4.3
Montgomery	Charleston	43.1	19.7	17.8	11.6	7.4	5.2
Montgomery	Florida	40.1	18.7	15.7	9.8	6.0	4.0
Montgomery	Glen	40.0	18.6	15.5	9.7	5.9	4.0
Montgomery	Minden	41.1	18.5	16.2	10.3	6.4	4.4
Montgomery	Mohawk	39.8	18.5	15.4	9.6	5.8	3.9
Montgomery	Palatine	41.3	18.8	16.5	10.5	6.5	4.5
Montgomery	Root	40.9	18.7	16.1	10.2	6.3	4.3
Montgomery	St Johnsville	42.5	19.5	17.4	11.3	7.2	5.0
Nassau	Glen Cove	45.4	21.7	20.0	13.4	8.8	6.4
Nassau	Hempstead	44.2	21.3	19.0	12.5	8.2	5.8
Nassau	Long Beach	43.0	21.0	18.2	11.8	7.6	5.3
Nassau	N Hempstead	45.0	21.7	19.7	13.1	8.6	6.2
Nassau	Oyster Bay	45.1	21.8	19.8	13.2	8.7	6.3
Niagara	Cambria	35.4	16.1	12.0	6.9	3.8	2.3
Niagara	Hartland	34.8	15.8	11.6	6.6	3.5	2.1
Niagara	Lewiston	34.4	15.4	11.2	6.3	3.3	1.9
Niagara	Lockport	36.7	16.9	13.0	7.7	4.4	2.7
Niagara	Newfane	33.3	14.9	10.5	5.7	2.9	1.6
Niagara	Niagara	37.0	16.9	13.2	7.8	4.5	2.8
Niagara	Pendleton	37.0	17.0	13.2	7.9	4.5	2.8
Niagara	Porter	32.1	14.4	9.7	5.1	2.5	1.3
Niagara	Royalton	36.5	16.3	12.8	7.5	4.2	2.6
Niagara	Somerset	33.2	14.6	10.3	5.6	2.9	1.6
Niagara	Wheatfield	37.0	17.0	13.2	7.9	4.5	2.8
Niagara	Wilson	31.6	13.9	9.3	4.9	2.3	1.2
Oneida	Annsville	49.7	24.4	23.7	16.5	11.4	8.7
Oneida	Augusta	42.0	18.8	16.9	10.8	6.8	4.7

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Oneida	Ava	57.7	29.9	31.1	22.9	16.9	13.5
Oneida	Boonville	56.0	28.9	29.6	21.6	15.7	12.5
Oneida	Bridgewater	42.2	18.5	16.9	10.9	6.9	4.8
Oneida	Camden	48.7	24.0	22.9	15.8	10.9	8.2
Oneida	Deerfield	47.4	22.2	21.5	14.6	9.9	7.3
Oneida	Florence	52.9	27.2	26.8	19.2	13.7	10.6
Oneida	Floyd	46.8	22.4	21.1	14.3	9.6	7.1
Oneida	Forestport	53.8	26.9	27.3	19.6	14.1	11.0
Oneida	Kirkland	43.1	20.2	18.0	11.7	7.5	5.3
Oneida	Lee	49.0	23.9	23.1	16.0	11.0	8.3
Oneida	Marcy	45.3	21.2	19.7	13.2	8.7	6.3
Oneida	Marshall	42.7	19.3	17.5	11.3	7.2	5.1
Oneida	New Hartford	43.0	20.0	17.9	11.6	7.4	5.2
Oneida	Paris	43.0	19.5	17.7	11.5	7.4	5.2
Oneida	Remsen	52.9	25.6	26.3	18.8	13.4	10.4
Oneida	Rome	44.5	21.1	19.2	12.7	8.3	6.0
Oneida	Sangerfield	41.9	18.4	16.7	10.7	6.7	4.7
Oneida	Steuben	54.7	27.3	28.1	20.3	14.7	11.5
Oneida	Trenton	47.7	22.4	21.7	14.9	10.1	7.5
Oneida	Utica	43.0	19.4	17.7	11.5	7.4	5.2
Oneida	Vernon	43.1	20.2	18.0	11.7	7.5	5.3
Oneida	Verona	42.5	19.4	17.4	11.2	7.1	5.0
Oneida	Vienna	43.7	20.4	18.5	12.1	7.8	5.6
Oneida	Western	51.9	25.9	25.7	18.2	12.9	10.0
Oneida	Westmoreland	44.7	20.8	19.2	12.8	8.4	6.0
Oneida	Whitestown	43.8	20.7	18.6	12.2	7.9	5.6
Onondaga	Camillus	39.0	17.9	14.7	9.1	5.4	3.5
Onondaga	Cicero	40.9	18.5	16.1	10.2	6.3	4.3
Onondaga	Clay	41.2	19.5	16.6	10.5	6.5	4.5
Onondaga	Dewitt	40.4	17.8	15.6	9.8	6.0	4.1
Onondaga	Elbridge	38.4	17.4	14.2	8.6	5.1	3.3
Onondaga	Fabius	41.0	17.8	15.9	10.1	6.3	4.3
Onondaga	Geddes	39.3	18.1	15.0	9.2	5.5	3.7
Onondaga	Lafayette	40.0	17.6	15.3	9.5	5.8	3.9
Onondaga	Lysander	40.2	19.0	15.8	9.9	6.0	4.1
Onondaga	Manilus	41.0	18.3	16.1	10.2	6.3	4.3
Onondaga	Marcellus	39.0	17.9	14.7	9.0	5.4	3.5
Onondaga	Onondaga	39.6	17.7	15.1	9.4	5.6	3.8
Onondaga	Otisco	39.1	17.6	14.7	9.1	5.4	3.6

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Onondaga	Pompey	41.0	18.2	16.1	10.2	6.3	4.3
Onondaga	Salina	39.4	17.8	15.0	9.3	5.6	3.7
Onondaga	Skaneateles	39.0	17.8	14.7	9.0	5.4	3.5
Onondaga	Spafford	39.3	17.9	14.9	9.2	5.5	3.7
Onondaga	Tully	40.0	17.5	15.3	9.5	5.8	3.9
Onondaga	Van Buren	39.7	18.5	15.3	9.5	5.8	3.8
Ontario	Bristol	34.3	14.3	10.9	6.1	3.2	1.9
Ontario	Canadice	34.7	13.9	11.0	6.3	3.3	2.0
Ontario	Canandaigua	33.1	13.7	10.1	5.5	2.8	1.5
Ontario	E. Bloomfield	33.0	13.5	10.0	5.4	2.7	1.5
Ontario	Farmington	33.0	14.3	10.2	5.5	2.8	1.5
Ontario	Geneva	33.0	13.9	10.1	5.5	2.8	1.5
Ontario	Gorham	33.0	13.9	10.1	5.5	2.8	1.5
Ontario	Hopewell	33.0	14.1	10.1	5.5	2.8	1.5
Ontario	Manchester	33.3	14.8	10.5	5.7	2.9	1.6
Ontario	Naples	33.5	13.1	10.2	5.6	2.9	1.6
Ontario	Phelps	33.2	14.6	10.3	5.7	2.9	1.6
Ontario	Richmond	33.3	13.5	10.1	5.6	2.8	1.6
Ontario	Seneca	33.0	14.4	10.2	5.5	2.8	1.5
Ontario	South Bristol	34.5	14.0	11.0	6.2	3.3	1.9
Ontario	Victor	33.0	14.1	10.1	5.5	2.8	1.5
Ontario	W. Bloomfield	32.8	13.5	9.8	5.3	2.7	1.4
Orange	Blooming Grove	45.6	21.1	19.9	13.3	8.8	6.4
Orange	Chester	45.6	20.8	19.8	13.3	8.8	6.4
Orange	Cornwall	47.1	22.1	21.3	14.5	9.8	7.2
Orange	Crawford	43.3	19.6	18.0	11.7	7.5	5.3
Orange	Deerpark	44.4	20.1	18.8	12.5	8.1	5.8
Orange	Goshen	43.1	19.2	17.7	11.5	7.4	5.2
Orange	Greenville	43.5	19.6	18.1	11.8	7.6	5.4
Orange	Hamptonburgh	43.1	19.3	17.8	11.6	7.4	5.2
Orange	Highlands	48.6	22.7	22.4	15.5	10.6	8.0
Orange	Minisink	43.0	19.4	17.7	11.5	7.4	5.2
Orange	Monroe	47.9	22.2	21.8	15.0	10.2	7.6
Orange	Montgomery	43.1	19.7	17.9	11.7	7.5	5.3
Orange	Mount Hope	43.0	19.1	17.6	11.5	7.3	5.2
Orange	New Windsor	44.5	20.5	19.0	12.6	8.2	5.9
Orange	Newburgh	44.1	20.0	18.6	12.2	7.9	5.7
Orange	Tuxedo	49.6	23.3	23.3	16.2	11.2	8.5
Orange	Wallkill	43.0	19.0	17.6	11.4	7.3	5.2

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Orange	Warwick	46.8	21.6	20.9	14.2	9.5	7.0
Orange	Wawayanda	43.0	19.0	17.6	11.4	7.3	5.2
Orange	Woodbury	48.6	22.6	22.4	15.5	10.6	8.0
Orleans	Albion	32.8	14.5	10.1	5.5	2.7	1.5
Orleans	Barre	33.3	14.5	10.4	5.7	2.9	1.6
Orleans	Carlton	32.5	14.5	9.9	5.3	2.6	1.4
Orleans	Clarendon	31.5	13.7	9.2	4.8	2.3	1.1
Orleans	Gaines	32.3	14.5	9.8	5.2	2.6	1.3
Orleans	Kendall	31.0	14.2	9.0	4.6	2.1	1.0
Orleans	Murray	31.0	13.2	8.8	4.5	2.1	1.0
Orleans	Ridgeway	34.4	15.2	11.2	6.3	3.3	1.9
Orleans	Shelby	35.0	15.3	11.6	6.6	3.6	2.1
Orleans	Yates	33.1	14.6	10.3	5.6	2.8	1.6
Oswego	Albion	46.0	23.4	20.9	14.1	9.4	6.9
Oswego	Amboy	47.8	23.9	22.2	15.2	10.4	7.7
Oswego	Boylston	52.7	27.9	26.9	19.2	13.7	10.6
Oswego	Constantia	43.4	20.9	18.4	12.0	7.7	5.5
Oswego	Granby	40.7	19.8	16.4	10.3	6.4	4.3
Oswego	Hannibal	39.6	19.6	15.5	9.6	5.8	3.9
Oswego	Hastings	43.3	21.2	18.4	12.0	7.7	5.5
Oswego	Mexico	42.4	20.8	17.8	11.5	7.3	5.1
Oswego	Minetto	41.0	20.6	16.7	10.6	6.6	4.5
Oswego	New Haven	41.2	20.6	16.9	10.7	6.7	4.6
Oswego	Orwell	51.1	27.0	25.5	18.0	12.6	9.7
Oswego	Oswego	41.0	20.6	16.8	10.6	6.6	4.5
Oswego	Palermo	43.0	20.8	18.1	11.8	7.5	5.3
Oswego	Parish	45.7	22.9	20.5	13.8	9.1	6.7
Oswego	Redfield	53.2	27.9	27.3	19.5	14.0	10.8
Oswego	Richland	41.8	20.8	17.3	11.1	6.9	4.8
Oswego	Sandy Creek	41.8	21.2	17.5	11.2	7.0	4.9
Oswego	Schroeppel	42.2	20.4	17.5	11.2	7.1	4.9
Oswego	Scriba	41.0	20.9	16.8	10.7	6.6	4.5
Oswego	Volney	41.2	20.5	16.8	10.7	6.6	4.5
Oswego	West Monroe	43.6	21.3	18.6	12.2	7.9	5.6
Oswego	Williamstown	49.6	25.5	24.0	16.7	11.6	8.7
Otsego	Burlington	41.0	18.0	16.0	10.1	6.3	4.3
Otsego	Butternuts	39.5	17.4	14.9	9.2	5.5	3.7
Otsego	Cherry Valley	43.5	19.8	18.2	11.9	7.7	5.4
Otsego	Decatur	43.0	19.4	17.7	11.5	7.4	5.2

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Otsego	Edmeston	39.7	17.6	15.1	9.4	5.7	3.8
Otsego	Exeter	41.9	18.5	16.7	10.7	6.7	4.7
Otsego	Hartwick	40.0	17.8	15.3	9.6	5.8	3.9
Otsego	Laurens	39.8	17.5	15.1	9.4	5.7	3.8
Otsego	Maryland	39.6	17.2	14.9	9.2	5.6	3.7
Otsego	Middlefield	40.9	18.2	16.0	10.1	6.3	4.3
Otsego	Milford	39.2	17.3	14.7	9.1	5.4	3.6
Otsego	Morris	39.8	17.5	15.1	9.4	5.7	3.8
Otsego	New Lisbon	40.8	17.8	15.8	10.0	6.2	4.2
Otsego	Oneonta	39.3	17.3	14.8	9.1	5.5	3.6
Otsego	Otego	40.2	17.5	15.3	9.6	5.9	3.9
Otsego	Otsego	40.8	18.2	15.9	10.1	6.2	4.2
Otsego	Pittsield	40.2	17.7	15.4	9.6	5.9	4.0
Otsego	Plainfield	41.6	18.3	16.5	10.5	6.6	4.5
Otsego	Richfield	42.7	18.7	17.3	11.2	7.1	5.0
Otsego	Roseboom	43.5	19.6	18.1	11.8	7.6	5.4
Otsego	Springfield	42.5	18.7	17.2	11.1	7.0	4.9
Otsego	Unadilla	39.3	17.3	14.8	9.1	5.5	3.6
Otsego	Westford	41.7	18.5	16.6	10.6	6.6	4.6
Otsego	Worcester	40.2	17.6	15.4	9.6	5.9	4.0
Putnam	Carmel	48.8	23.3	22.8	15.7	10.8	8.1
Putnam	Kent	47.3	22.1	21.3	14.5	9.8	7.3
Putnam	Patterson	47.3	22.1	21.3	14.5	9.8	7.3
Putnam	Philipstown	47.8	22.1	21.7	14.9	10.1	7.5
Putnam	Putnam Valley	48.7	23.2	22.7	15.6	10.7	8.1
Putnam	Southeast	48.9	23.3	22.8	15.8	10.9	8.2
Rensselaer	Berlin	45.3	20.1	19.4	13.0	8.6	6.2
Rensselaer	Brunswick	38.8	16.6	14.2	8.7	5.2	3.4
Rensselaer	East Greenbush	37.3	16.2	13.2	7.9	4.5	2.9
Rensselaer	Grafton	45.0	19.3	19.0	12.6	8.3	6.0
Rensselaer	Hoosick	37.5	16.0	13.3	8.0	4.6	2.9
Rensselaer	Nassau	40.7	18.0	15.9	10.0	6.2	4.2
Rensselaer	No. Greenbush	37.5	16.2	13.3	8.0	4.6	2.9
Rensselaer	Petersburg	42.4	18.3	17.0	11.0	7.0	4.9
Rensselaer	Pittstown	37.1	15.9	13.0	7.7	4.4	2.8
Rensselaer	Poestenkill	42.5	18.3	17.0	11.0	7.0	4.9
Rensselaer	Sand Lake	41.2	18.0	16.2	10.3	6.4	4.4
Rensselaer	Schaghticoke	37.0	15.9	12.9	7.7	4.4	2.7
Rensselaer	Schodack	38.1	16.3	13.7	8.3	4.9	3.1

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Rensselaer	Stephentown	42.3	18.7	17.1	11.0	7.0	4.9
Rockland	Clarkstown	47.3	22.0	21.3	14.5	9.8	7.3
Rockland	Haverstraw	48.9	22.7	22.6	15.6	10.8	8.1
Rockland	Orangetown	47.8	22.5	21.9	15.0	10.2	7.6
Rockland	Ramapo	49.3	22.4	22.8	15.8	10.9	8.2
Rockland	Stoney Point	48.3	22.4	22.1	15.2	10.4	7.8
Saratoga	Ballston	39.6	18.4	15.2	9.4	5.7	3.8
Saratoga	Charlton	41.4	19.1	16.6	10.6	6.6	4.5
Saratoga	Clifton Park	36.8	16.2	12.9	7.6	4.3	2.7
Saratoga	Corinth	44.4	21.1	19.1	12.6	8.2	5.9
Saratoga	Day	46.3	22.6	20.8	14.1	9.4	6.9
Saratoga	Edinburg	46.1	22.5	20.7	13.9	9.3	6.8
Saratoga	Galway	43.1	20.3	18.0	11.7	7.5	5.3
Saratoga	Greenfield	43.1	20.1	18.0	11.7	7.5	5.3
Saratoga	Hadley	43.3	20.7	18.3	11.9	7.7	5.4
Saratoga	Halfmoon	37.0	16.0	12.9	7.7	4.4	2.7
Saratoga	Malta	39.5	18.4	15.2	9.4	5.6	3.8
Saratoga	Milton	41.3	19.0	16.5	10.5	6.5	4.5
Saratoga	Moreau	38.0	17.3	14.0	8.4	4.9	3.2
Saratoga	Northumberland	37.9	17.3	13.9	8.4	4.9	3.1
Saratoga	Providence	45.6	21.9	20.2	13.5	8.9	6.5
Saratoga	Saratoga	38.6	17.9	14.5	8.8	5.2	3.4
Saratoga	Saratoga Sprgs	40.6	18.7	16.0	10.1	6.2	4.2
Saratoga	Stillwater	38.4	17.5	14.3	8.7	5.1	3.3
Saratoga	Waterford	37.0	15.5	12.8	7.6	4.3	2.7
Saratoga	Wilton	39.6	18.5	15.3	9.5	5.7	3.8
Schenectady	Duanesburg	42.3	19.5	17.3	11.2	7.1	4.9
Schenectady	Glenville	39.5	18.2	15.1	9.4	5.6	3.8
Schenectady	Niskayuna	36.9	16.1	12.9	7.6	4.3	2.7
Schenectady	Princetown	41.7	19.4	16.9	10.8	6.8	4.7
Schenectady	Rotterdam	38.9	17.7	14.6	9.0	5.3	3.5
Schenectady	Schenectady	37.0	16.1	13.0	7.7	4.4	2.8
Schoharie	Blenheim	37.5	16.4	13.4	8.0	4.6	2.9
Schoharie	Broome	38.4	16.9	14.1	8.6	5.1	3.3
Schoharie	Carlisle	41.0	18.5	16.2	10.2	6.3	4.3
Schoharie	Cobleskill	40.7	18.4	15.9	10.0	6.2	4.2
Schoharie	Conesville	37.3	16.3	13.2	7.9	4.5	2.9
Schoharie	Esperance	40.4	18.5	15.8	9.9	6.1	4.1
Schoharie	Fulton	38.0	16.9	13.9	8.4	4.9	3.1

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Schoharie	Gilboa	37.2	16.2	13.1	7.8	4.5	2.8
Schoharie	Jefferson	39.0	17.1	14.5	8.9	5.3	3.5
Schoharie	Middleburg	38.8	17.5	14.5	8.9	5.3	3.5
Schoharie	Richmondville	39.9	18.0	15.3	9.5	5.8	3.9
Schoharie	Schoharie	39.5	18.1	15.1	9.3	5.6	3.7
Schoharie	Seward	41.6	18.5	16.6	10.6	6.6	4.6
Schoharie	Sharon	42.4	18.6	17.1	11.0	7.0	4.9
Schoharie	Summit	39.8	17.7	15.2	9.5	5.7	3.8
Schoharie	Wright	39.9	18.3	15.4	9.6	5.8	3.9
Schuyler	Catherine	37.2	16.4	13.2	7.8	4.5	2.8
Schuyler	Cayuta	37.3	16.6	13.3	7.9	4.6	2.9
Schuyler	Dix	33.9	13.8	10.6	5.9	3.1	1.7
Schuyler	Hector	35.9	15.1	12.1	7.0	3.9	2.4
Schuyler	Montour	33.5	13.9	10.4	5.7	2.9	1.6
Schuyler	Orange	33.8	13.8	10.5	5.8	3.0	1.7
Schuyler	Reading	33.9	13.6	10.5	5.9	3.0	1.7
Schuyler	Tyrone	33.6	13.7	10.4	5.7	2.9	1.7
Seneca	Covert	34.7	14.5	11.2	6.4	3.4	2.0
Seneca	Fayette	33.0	13.9	10.1	5.5	2.8	1.5
Seneca	Junius	33.9	14.8	10.8	6.0	3.1	1.8
Seneca	Lodi	34.4	14.2	11.0	6.2	3.3	1.9
Seneca	Ovid	33.9	14.3	10.7	6.0	3.1	1.8
Seneca	Romulus	33.1	14.0	10.1	5.5	2.8	1.5
Seneca	Seneca Falls	33.1	14.4	10.2	5.6	2.8	1.5
Seneca	Tyre	34.7	15.1	11.3	6.4	3.4	2.0
Seneca	Varick	33.0	14.0	10.1	5.5	2.8	1.5
Seneca	Waterloo	33.0	13.6	10.0	5.4	2.7	1.5
St lawrence	Brasher	35.0	15.1	11.5	6.6	3.5	2.1
St lawrence	Canton	35.8	15.2	12.1	7.0	3.9	2.4
St lawrence	Clare	40.6	17.9	15.7	9.9	6.1	4.1
St lawrence	Clifton	43.2	18.7	17.6	11.5	7.4	5.2
St lawrence	Colton	42.0	18.6	16.8	10.8	6.8	4.7
St lawrence	De Peyster	35.7	16.0	12.2	7.0	3.9	2.3
St lawrence	Dekalb	36.8	16.5	13.0	7.7	4.4	2.7
St lawrence	Edwards	39.0	17.1	14.5	8.9	5.3	3.5
St lawrence	Fine	42.5	19.1	17.3	11.2	7.1	5.0
St lawrence	Fowler	37.8	17.0	13.7	8.3	4.8	3.1
St lawrence	Gouverneur	37.0	17.0	13.2	7.9	4.5	2.8
St lawrence	Hammond	37.0	17.0	13.2	7.9	4.5	2.8

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
St lawrence	Hermon	37.2	17.0	13.3	8.0	4.5	2.9
St lawrence	Hopkinton	40.2	17.4	15.3	9.6	5.9	3.9
St lawrence	Lawrence	35.4	15.0	11.7	6.8	3.7	2.2
St lawrence	Lisbon	33.9	14.7	10.8	6.0	3.1	1.8
St lawrence	Louisville	35.0	15.2	11.6	6.6	3.6	2.1
St lawrence	Macomb	37.0	16.9	13.2	7.8	4.5	2.8
St lawrence	Madrid	35.3	15.0	11.7	6.7	3.6	2.2
St lawrence	Massena	35.0	15.6	11.7	6.7	3.6	2.1
St lawrence	Morristown	35.9	16.3	12.4	7.2	4.0	2.4
St lawrence	Norfolk	35.4	15.2	11.8	6.8	3.7	2.2
St lawrence	Ogdensburg	33.0	14.0	10.1	5.5	2.8	1.5
St lawrence	Oswegathcie	34.5	15.3	11.3	6.4	3.4	2.0
St lawrence	Parishville	40.2	17.7	15.5	9.7	5.9	4.0
St lawrence	Piercefield	41.9	18.2	16.6	10.7	6.7	4.6
St lawrence	Pierrepont	38.9	17.2	14.5	8.9	5.3	3.5
St lawrence	Pitcairn	39.5	18.0	15.1	9.3	5.6	3.7
St lawrence	Potsdam	37.0	15.8	12.9	7.7	4.4	2.7
St lawrence	Rossie	37.0	17.0	13.2	7.9	4.5	2.8
St lawrence	Russell	38.2	16.9	14.0	8.5	5.0	3.2
St lawrence	Stockholm	36.1	15.6	12.3	7.2	4.0	2.5
St lawrence	Waddington	35.0	15.0	11.5	6.6	3.5	2.1
Steuben	Addison	31.9	13.5	9.3	4.9	2.4	1.2
Steuben	Avoca	32.6	13.3	9.7	5.2	2.6	1.4
Steuben	Bath	31.2	13.3	8.9	4.6	2.1	1.1
Steuben	Bradford	32.8	13.4	9.8	5.3	2.6	1.4
Steuben	Cameron	32.3	13.5	9.5	5.1	2.5	1.3
Steuben	Campbell	31.6	13.5	9.2	4.8	2.3	1.2
Steuben	Canisteo	33.7	13.6	10.4	5.8	3.0	1.7
Steuben	Caton	32.9	13.6	9.9	5.4	2.7	1.5
Steuben	Cohocton	33.7	13.2	10.3	5.7	2.9	1.6
Steuben	Corning	32.5	13.5	9.7	5.2	2.6	1.4
Steuben	Dansville	33.7	13.5	10.4	5.8	3.0	1.7
Steuben	Erwin	31.0	13.5	8.8	4.5	2.1	1.0
Steuben	Fremont	34.1	13.7	10.6	6.0	3.1	1.8
Steuben	Greenwood	37.4	15.9	13.2	7.9	4.5	2.9
Steuben	Hartsville	36.1	15.2	12.2	7.2	4.0	2.4
Steuben	Hornby	33.3	13.8	10.2	5.6	2.8	1.6
Steuben	Hornellsville	33.3	13.6	10.2	5.6	2.8	1.6
Steuben	Howard	33.7	13.5	10.3	5.7	2.9	1.7

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Steuben	Jasper	34.0	14.1	10.7	5.9	3.1	1.8
Steuben	Lindley	31.3	13.5	9.0	4.7	2.2	1.1
Steuben	Prattsburg	34.7	13.5	10.9	6.2	3.3	1.9
Steuben	Pulteney	32.7	13.1	9.7	5.2	2.6	1.4
Steuben	Rathbone	31.0	13.5	8.9	4.6	2.1	1.0
Steuben	Thurston	31.9	13.5	9.3	4.9	2.4	1.2
Steuben	Troupsburg	33.4	14.0	10.3	5.7	2.9	1.6
Steuben	Tuscarora	32.5	13.5	9.7	5.2	2.6	1.4
Steuben	Urbana	31.3	13.0	8.9	4.6	2.2	1.1
Steuben	Wayland	34.0	13.6	10.6	5.9	3.1	1.8
Steuben	Wayne	32.0	13.0	9.3	4.9	2.4	1.2
Steuben	West Union	37.3	16.0	13.1	7.9	4.5	2.8
Steuben	Wheeler	33.0	13.2	9.9	5.4	2.7	1.5
Steuben	Woodhull	31.7	13.5	9.2	4.8	2.3	1.2
Suffolk	Babylon	45.0	22.0	19.8	13.2	8.7	6.3
Suffolk	Brookhaven	46.1	23.8	21.1	14.2	9.4	6.9
Suffolk	East Hampton	44.7	23.4	20.0	13.3	8.7	6.3
Suffolk	Huntington	45.2	22.7	20.2	13.5	8.9	6.4
Suffolk	Islip	46.2	23.4	21.1	14.2	9.5	7.0
Suffolk	Riverhead	45.0	23.5	20.2	13.5	8.9	6.4
Suffolk	Shelter Island	45.0	23.2	20.2	13.4	8.8	6.4
Suffolk	Smithtown	45.2	23.5	20.3	13.6	8.9	6.5
Suffolk	Southampton	45.0	23.6	20.3	13.5	8.9	6.4
Suffolk	Southold	45.2	23.5	20.3	13.6	8.9	6.5
Sullivan	Bethel	44.1	19.9	18.5	12.2	7.9	5.7
Sullivan	Callicoon	46.0	21.1	20.2	13.6	9.1	6.6
Sullivan	Cochecton	42.1	19.0	17.0	10.9	6.9	4.8
Sullivan	Delaware	42.6	19.0	17.3	11.2	7.1	5.0
Sullivan	Fallsburg	47.0	21.8	21.1	14.3	9.6	7.1
Sullivan	Forestburgh	46.1	21.2	20.3	13.7	9.1	6.7
Sullivan	Fremont	44.2	20.3	18.7	12.4	8.0	5.8
Sullivan	Highland	42.6	19.1	17.3	11.2	7.1	5.0
Sullivan	Liberty	47.9	22.0	21.7	14.9	10.1	7.5
Sullivan	Lumberland	43.8	19.7	18.3	12.0	7.8	5.5
Sullivan	Mamakating	45.2	20.8	19.6	13.0	8.6	6.2
Sullivan	Neversink	48.5	22.2	22.2	15.3	10.5	7.9
Sullivan	Rockland	46.3	21.0	20.3	13.7	9.2	6.7
Sullivan	Thompson	46.5	21.4	20.6	13.9	9.3	6.9
Sullivan	Tusten	41.4	19.0	16.6	10.6	6.6	4.5

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Tioga	Barton	36.3	16.1	12.6	7.4	4.1	2.5
Tioga	Berkshire	37.1	16.5	13.1	7.8	4.5	2.8
Tioga	Candor	37.1	16.5	13.2	7.9	4.5	2.8
Tioga	Newark Valley	37.0	16.4	13.1	7.8	4.4	2.8
Tioga	Nichols	35.0	15.0	11.5	6.6	3.5	2.1
Tioga	Owego	36.2	15.9	12.5	7.3	4.1	2.5
Tioga	Richford	38.8	17.3	14.4	8.8	5.2	3.4
Tioga	Spencer	37.2	16.5	13.2	7.9	4.5	2.8
Tioga	Tioga	36.0	15.9	12.3	7.2	4.0	2.4
Tompkins	Caroline	38.2	16.9	14.0	8.5	5.0	3.2
Tompkins	Danby	37.7	16.6	13.6	8.2	4.7	3.0
Tompkins	Dryden	37.6	16.0	13.3	8.0	4.6	2.9
Tompkins	Enfield	37.8	16.4	13.6	8.2	4.8	3.1
Tompkins	Groton	38.0	16.5	13.7	8.3	4.8	3.1
Tompkins	Ithaca	34.9	15.0	11.5	6.5	3.5	2.1
Tompkins	Lansing	34.8	14.7	11.3	6.4	3.4	2.0
Tompkins	Newfield	38.5	17.2	14.2	8.7	5.1	3.3
Tompkins	Ulysses	34.9	14.7	11.4	6.5	3.5	2.0
Ulster	Denning	53.1	25.3	26.3	18.8	13.4	10.4
Ulster	Esopus	45.4	21.6	19.9	13.3	8.8	6.4
Ulster	Gardiner	45.3	21.2	19.8	13.2	8.7	6.3
Ulster	Hardenburgh	46.9	21.6	20.9	14.2	9.6	7.0
Ulster	Hurley	47.0	22.1	21.1	14.4	9.7	7.1
Ulster	Kingston	46.1	21.9	20.5	13.8	9.2	6.7
Ulster	Lloyd	45.0	20.9	19.5	13.0	8.5	6.2
Ulster	Marbletown	46.7	21.9	20.9	14.2	9.5	7.0
Ulster	Marlborough	43.7	20.0	18.3	12.0	7.8	5.5
Ulster	New Paltz	45.5	21.5	20.0	13.4	8.9	6.4
Ulster	Olive	49.3	23.1	23.0	16.0	11.0	8.3
Ulster	Plattekill	45.8	21.3	20.2	13.5	9.0	6.6
Ulster	Rochester	46.9	21.8	21.0	14.2	9.6	7.1
Ulster	Rosendale	45.2	21.5	19.8	13.2	8.7	6.3
Ulster	Saugerties	43.6	20.3	18.3	12.0	7.7	5.5
Ulster	Shandaken	49.1	23.8	23.1	16.0	11.0	8.3
Ulster	Shawangunk	44.8	21.0	19.3	12.8	8.4	6.1
Ulster	Ulster	44.8	21.4	19.5	13.0	8.5	6.1
Ulster	Wawarsing	46.3	21.6	20.6	13.9	9.3	6.8
Ulster	Woodstock	48.4	22.5	22.2	15.3	10.5	7.9
Warren	Bolton	40.7	18.7	16.0	10.1	6.2	4.2

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Warren	Chester	41.1	19.0	16.4	10.4	6.5	4.4
Warren	Hague	40.6	18.5	15.9	10.0	6.2	4.2
Warren	Horicon	41.0	19.0	16.3	10.3	6.4	4.4
Warren	Johnsburg	44.1	20.5	18.7	12.3	8.0	5.7
Warren	Lake George	43.0	19.9	17.9	11.6	7.5	5.3
Warren	Lake Luzerne	42.9	20.0	17.8	11.6	7.4	5.2
Warren	Queensbury	39.9	18.3	15.4	9.6	5.8	3.9
Warren	Stony Creek	46.5	22.7	21.0	14.2	9.5	7.0
Warren	Thurman	45.4	21.5	19.9	13.3	8.8	6.4
Warren	Warrensburg	43.0	20.1	17.9	11.6	7.4	5.2
Washington	Argyle	38.5	17.0	14.2	8.6	5.1	3.3
Washington	Cambridge	37.3	16.0	13.2	7.9	4.5	2.9
Washington	Dresden	42.3	19.4	17.2	11.1	7.0	4.9
Washington	Easton	37.3	16.2	13.2	7.9	4.5	2.9
Washington	Fort Ann	40.8	18.6	16.1	10.2	6.3	4.3
Washington	Fort Edward	37.0	16.4	13.1	7.8	4.4	2.8
Washington	Granville	39.3	17.5	14.8	9.1	5.5	3.6
Washington	Greenwich	37.5	16.1	13.3	8.0	4.6	2.9
Washington	Hampton	39.2	17.2	14.6	9.0	5.4	3.6
Washington	Hartford	39.7	18.0	15.2	9.4	5.7	3.8
Washington	Hebron	38.9	17.0	14.4	8.9	5.3	3.5
Washington	Jackson	38.3	16.5	13.9	8.5	5.0	3.2
Washington	Kingsbury	38.0	17.3	13.9	8.4	4.9	3.1
Washington	Putnam	37.6	16.5	13.5	8.1	4.7	3.0
Washington	Salem	37.7	16.4	13.5	8.1	4.7	3.0
Washington	White Creek	39.6	17.3	14.9	9.2	5.6	3.7
Washington	Whitehall	38.0	17.0	13.8	8.4	4.9	3.1
Wayne	Arcadia	35.2	15.8	11.8	6.8	3.7	2.2
Wayne	Butler	37.3	17.1	13.5	8.0	4.6	2.9
Wayne	Galen	36.2	16.5	12.6	7.4	4.1	2.5
Wayne	Huron	38.8	18.2	14.7	9.0	5.3	3.5
Wayne	Lyons	35.6	16.0	12.1	7.0	3.8	2.3
Wayne	Macedon	33.7	15.0	10.8	6.0	3.1	1.7
Wayne	Marion	35.9	16.4	12.4	7.2	4.0	2.4
Wayne	Ontario	36.4	16.7	12.8	7.5	4.2	2.6
Wayne	Palmyra	35.0	15.6	11.7	6.6	3.6	2.1
Wayne	Rose	37.1	17.3	13.4	8.0	4.5	2.9
Wayne	Savannah	36.2	16.4	12.6	7.3	4.1	2.5
Wayne	Sodus	37.0	17.6	13.4	8.0	4.5	2.8

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Wayne	Walworth	35.1	16.2	11.9	6.8	3.7	2.2
Wayne	Williamson	37.0	17.3	13.3	7.9	4.5	2.8
Wayne	Wolcott	39.0	18.6	14.9	9.2	5.5	3.6
Westchester	Bedford	49.0	23.9	23.1	16.0	11.0	8.3
Westchester	Cortlandt	47.0	22.1	21.2	14.4	9.7	7.2
Westchester	Eastchester	47.0	22.1	21.2	14.4	9.7	7.2
Westchester	Greenburgh	48.8	23.5	22.8	15.7	10.8	8.1
Westchester	Harrison	47.8	23.2	22.0	15.1	10.2	7.6
Westchester	Lewisboro	49.4	24.2	23.4	16.3	11.2	8.5
Westchester	Mamaroneck	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	Mount Pleasant	48.6	23.4	22.6	15.6	10.7	8.0
Westchester	Mount Vernon	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	New Castle	48.9	23.9	23.0	15.9	10.9	8.2
Westchester	New Rochelle	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	North Castle	49.0	24.0	23.1	16.0	11.0	8.3
Westchester	North Salem	48.9	23.8	23.0	15.9	10.9	8.2
Westchester	Ossining	47.3	22.8	21.6	14.7	9.9	7.4
Westchester	Pelham	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	Pound Ridge	49.0	24.3	23.2	16.1	11.1	8.3
Westchester	Rye	47.6	23.2	21.9	14.9	10.1	7.5
Westchester	Scarsdale	47.0	22.4	21.2	14.4	9.7	7.2
Westchester	Somers	48.9	23.6	22.9	15.9	10.9	8.2
Westchester	White Plains	47.2	23.0	21.5	14.7	9.9	7.3
Westchester	Yonkers	47.3	22.4	21.4	14.6	9.9	7.3
Westchester	Yorktown	48.6	23.0	22.5	15.5	10.7	8.0
Wyoming	Arcade	42.2	18.4	16.9	10.9	6.9	4.8
Wyoming	Attica	38.4	17.0	14.1	8.6	5.0	3.3
Wyoming	Bennington	39.2	17.5	14.7	9.1	5.4	3.6
Wyoming	Castile	35.5	15.1	11.8	6.8	3.7	2.2
Wyoming	Covington	36.3	15.4	12.4	7.2	4.0	2.5
Wyoming	Eagle	40.6	17.9	15.7	9.9	6.1	4.1
Wyoming	Gainsville	39.4	17.5	14.9	9.2	5.5	3.7
Wyoming	Genesee Falls	35.3	14.9	11.7	6.7	3.7	2.2
Wyoming	Java	41.0	17.9	16.0	10.1	6.3	4.3
Wyoming	Middlebury	37.8	16.8	13.7	8.2	4.8	3.1
Wyoming	Orangeville	40.8	18.0	15.9	10.0	6.2	4.2
Wyoming	Perry	36.1	15.4	12.3	7.2	4.0	2.4
Wyoming	Pike	38.1	16.6	13.8	8.4	4.9	3.2
Wyoming	Sheldon	40.2	17.9	15.5	9.7	5.9	4.0

County	Township	Precipitation		N Leaching Index			
		P_A	P_W	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Wyoming	Warsaw	38.0	16.7	13.8	8.3	4.8	3.1
Wyoming	Wethersfield	41.6	18.6	16.5	10.6	6.6	4.5
Yates	Barrington	33.7	13.7	10.4	5.8	3.0	1.7
Yates	Benton	33.0	14.0	10.1	5.5	2.8	1.5
Yates	Italy	34.1	13.3	10.5	5.9	3.1	1.8
Yates	Jerusalem	33.1	13.2	10.0	5.4	2.7	1.5
Yates	Middlesex	33.0	13.2	9.9	5.4	2.7	1.5
Yates	Milo	33.0	13.7	10.0	5.5	2.7	1.5
Yates	Potter	33.0	13.7	10.0	5.4	2.7	1.5
Yates	Starkey	33.1	13.6	10.0	5.5	2.7	1.5
Yates	Torrey	33.0	14.0	10.1	5.5	2.8	1.5

13. ENVIRONMENTAL RISK INDEX: THE NEW YORK PHOSPHORUS RUNOFF INDEX

from

PHOSPHORUS GUIDELINES FOR FIELD CROPS IN NEW YORK

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Department of Crop and Soil Sciences Extension Series E03-15

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Past members of the NY P Index working group that were instrumental in developing the first draft of the NY P Index include Fred Gaffney, Agronomist (Retired), Natural Resources Conservation Service; Jim Perry (retired), Resource Conservationist, Natural Resources Conservation Service; Ray Bryant, Research Leader & Soil Scientist, USDA-ARS; Barbara Bellows, formerly Extension Associate, Department of Biological and Environmental Engineering; Paul Ray, Resource Conservationist, Natural Resources Conservation Service; and Dean Hively, Graduate Student, Department of Natural Resources.

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For copies of this document

The full document is downloadable from the Nutrient Management Spear Program (NMSP) at: http://nmsp.css.cornell.edu/. For bound hardcopies contact Pam Kline by e-mail (pak1@cornell.edu), phone (607-255-2177) or regular mail (234 Emerson Hall, Department of Crop and Soil Sciences, Cornell University, Ithaca NY 14853).

For more thorough documentation and users' instructions for the NY P Index, see the "New York Phosphorus Runoff Index – User's Manual and Documentation" by K.J. Czymmek, Q.M Ketterings, L.D. Geohring, and G.L. Albrecht (2003). This user's guide is downloadable from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). Hardcopies can be ordered from Pam Kline (see contact information above).

13.2 Calculating the Phosphorus Runoff Index

The NY P Index is designed to assist producers and planners in identifying fields or portions of fields that are at highest risk of contributing phosphorus (P) to lakes and streams. The NY P Index assigns two scores to each field based upon its characteristics and the producer's intended management practices. One of the two scores, the **Dissolved P Index**, addresses the risk of loss of water-soluble P from a field (flow across the field or through the soil profile), while the **Particulate P Index** estimates the risk of loss of P attached to soil particles and manure.

The NY P Index scores will rank a field to determine its susceptibility to P losses. Fields with high or very high site vulnerability should be managed with minimizing P losses in mind. A low or medium ranking implies management can be nitrogen based. The NY P Index score will also indicate whether other management changes such as winter spreading must be addressed. It is, however, important to note that the P Index is not a measure of actual P loss, but rather an indicator of potential loss. A high or very high P Index score is a warning to further examine the causes, and a low P Index score means the risk of phosphorus loss is reduced, but perhaps not eliminated.

The NY P Index is separated into two main parts: potential sources of P ("source score") and potential movement of P ("transport score"). The final score is the multiplication of the source score and the transport score:

Dissolved P Index = P Source score * Dissolved P Transport score [1]

Particulate P Index = P Source score * Particulate P Transport score [2]

Rankings and management implications for final field scores are listed in Table 13.1. Both P forms (dissolved and particulate) are a concern for water quality and hence should be managed jointly. Estimates of P concentrations in harvests of field crops are listed in Appendix Table 7.B.

Table 13.1: NY P Index scores and their rankings and management implications.

Ranking Values	Site Vulnerability	Management
< 50	Low	N based management
50 – 74	Medium	N based management with best management practices
75 – 99	High	P applications limited to crop removal
≥ 100	Very High	No P fertilizer or manure application

P Index Source Components

Contributing to the source component are soil test P level, as well as manure and fertilizer additions:

P Source Score = Soil Test P + Fertilizer P + Organic P [3]

This is most easily done in four steps. Each step will be explained briefly. For more thorough documentation and users' instructions, see the "New York Phosphorus Runoff Index – User's Manual and Documentation" by K.J. Czymmek, Q.M Ketterings, L.D. Geohring, and G.L. Albrecht (2003). This user's guide is downloadable from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). A hardcopy can be obtained from the Department of Crop and Soil Sciences Extension Office: contact Pam Kline by e-mail (pak1@cornell.edu), phone (607-255-2177) or mail (234 Emerson Hall, Department of Crop and Soil Sciences, Cornell University, Ithaca NY 14853). Available from the same website are a downloadable P Index calculator (MS Excel) and a web-based calculator.

Source Score

Step 1: Calculate the soil test contribution:

Soil Test P Contribution: Soil Test P = 1.25 x Morgan P (lbs/acre)[1]

[1]see section 7.4. for Mehlich-III soil test data discussion.

Step 2: Calculate the fertilizer P contribution:

<table>
<tr><td colspan="6">Fertilizer P Contribution: Fertilizer P = (P_{fa}) x (P_{ft}) x (P_{fm})</td></tr>
<tr><td>Fertilizer P application (P_{fa})</td><td colspan="5">lbs P_2O_5 / acre</td></tr>
<tr><td>Fertilizer P timing (P_{ft})</td><td>May – August
0.4</td><td colspan="2">September – October
0.7</td><td>November – January
0.9</td><td>February – April
1.0</td></tr>
<tr><td rowspan="2">Fertilizer P method (P_{fm})</td><td rowspan="2">Inject or subsurface band
0.2</td><td colspan="2">Broadcast and incorporate within</td><td rowspan="2">Surface apply or broadcast and incorporate >5 days after application
0.8</td><td rowspan="2">Surface apply on frozen, snow covered or saturated ground
1.0</td></tr>
<tr><td>1-2 days
0.4</td><td>3-5 days
0.6</td></tr>
</table>

Step 3: Calculate the organic (manure) P contribution:

Organic P Contribution: Organic P = (P_{oa}) x (P_{ot}) x (P_{om})					
Organic P application rate (P_{oa})	0.75 **x** lbs P_2O_5 (in the organic source) applied / acre				
Organic P timing (P_{ot})	May – August 0.4	September – October 0.7		November – January 0.9	February – April 1.0
Organic P method (P_{om})	Inject or subsurface band 0.2	Broadcast and incorporate within 1-2 days 0.4	3-5 days 0.6	Surface apply or broadcast and incorporate >5 days after application 0.8	Surface apply on frozen, snow covered or saturated ground 1.0

Step 4: Calculate the total P source factor:

P Source Factor: Soil Test P + Fertilizer P + Organic P

P Index Transport Components: Dissolved P Transport Score

To assess dissolved P transport, the NY P Index considers soil drainage class, flooding frequency and predominant water flow distance to a stream:

Dissolved P Transport Score =
Soil drainage + Flooding frequency + Flow distance to stream

(if Dissolved P Transport ≥ 1, then Dissolved P Transport = 1) [4]

The soil drainage classification is determined from a soil survey and should not be modified if drainage practices have been installed. The flooding frequency is also determined from the soil survey or sometimes this information may be available on flood hazard boundary maps. The flow distance is the edge of "field" drainage path that excess water takes as it leaves a field and finds it way downhill to a watercourse (blue line stream). This can be estimated by field observation or determined from topographic maps whereby the flow path is perpendicular to the contour lines. The four steps involved in calculating the dissolved P Index are described below.

Dissolved P Transport Score

Step 1: Determine the soil drainage contribution:

Soil Drainage	Well to excessively well drained	Moderately well drained	Somewhat poorly drained	Poorly or very poorly drained
	0.1	0.3	0.7	1.0

Step 2: Determine the flooding frequency contribution:

Flooding Frequency	Rare / Never > 100 years	Occasional 10 – 100 years	Frequent < 10 years
	0	0.2	1.0

Step 3: Determine the flow distance contribution:

Flow distance in feet to blue line stream (or equivalent) as depicted on a topographic map and confirmed based on field evaluation	Intermittent Stream >200 feet Perennial Stream >300 feet	Intermittent Stream 25 to 200 feet Perennial Stream 50 to 300 feet	Intermittent Stream <25 feet Perennial Stream < 50 feet
	0	Intermittent Stream 1 – (Distance–25)/175 Perennial Stream 1 – (Distance–50)/250	1.0

* Intermittent streams are generally depicted with a dashed blue line on topographic maps and perennial streams are shown with a solid blue line.

Step 4: Determine the dissolved P transport factor:

Dissolved P Transport Factor = Drainage + Flooding Frequency + Flow Distance[1]

[1] If the dissolved P transport factor exceeds 1, the value is set to 1.

P Index Transport Components: Particulate P Transport Score

The particulate P component of the NY P Index is similar to the dissolved P component in that flooding frequency and the predominant water flow distance to a stream are again considered. Additionally, particulate P loss potential is influenced by soil erosion and the presence of concentrated flow paths. Soil erosion rate is estimated using the Universal Soil Loss Equation (USLE) or the Revised Universal Soil Loss Equation (RUSLE). The determination of whether or not concentrated flow paths are present in the field is best done through field observation. The current resolution of contour lines on topographic maps may not be sufficient to indicate whether a concentrated flow path is present.

Particulate P Transport Score =
Soil erosion + Flooding frequency + Flow distance to stream + Concentrated flow

(if Particulate P Transport ≥ 1, then Particulate P Transport = 1) [5]

The five steps involved in calculating the particulate P Index are described below.

<u>Particulate P Transport Score</u>

Step 1: Determine the flooding frequency contribution.

Flooding Frequency	Rare / Never > 100 years 0	Occasional 10 – 100 years 0.2	Frequent < 10 years 1.0

Step 2: Determine the flow distance contribution.

Flow distance in feet to blue line stream (or equivalent) as depicted on a topographic map and confirmed based on field evaluation	Intermittent Stream >200 feet Perennial Stream >300 feet -------------------- 0	Intermittent Stream 25 to 200 feet Perennial Stream 50 to 300 feet ------------------------ Intermittent Stream 1 – (Distance–25)/175 Perennial Stream 1 – (Distance–50)/250	Intermittent Stream <25 feet Perennial Stream < 50 feet ------------------- 1.0

* Intermittent streams are generally depicted with a dashed blue line on topographic maps and perennial streams are shown with a solid blue line.

Step 3: Determine the soil erosion contribution.

Soil erosion (from RUSLE model)	0.1 x RUSLE Erosion rate (tons/acre)

Step 4: Determine the concentrated flow contribution.

Is a concentrated flow present in the field?	No 0	Yes 0.2

Step 5: Determine the particulate P transport factor.

Particulate P Transport Factor =
Flooding Frequency + Flow Distance + Soil Erosion + Concentrated Flow[1]

[1] If the particulate P transport factor exceeds 1, the value is set to 1.

One should note that both the dissolved and particulate P Transport Scores are set equivalent to 1.0 when the various transport components add to more than one. Thus, the dissolved and particulate P Transport Scores represent a percentage of the P source factor to arrive at the final NY P Index risk scores.

14. CROPWARE 2.0 DAILY SPREAD FARM TUTORIAL

14.1 CROPWARE 2.0 DAILY SPREAD FARM TUTORIAL INTRODUCTION

Developing a Plan for a Farm with Daily Spread Manure Systems

In this tutorial, you will learn how to develop a nutrient management plan for a farm without manure storage systems using Cropware 2.0. The tutorial will provide all the data and direction necessary to build the plan from scratch, but if you would prefer to progress through the tutorial with a completed plan for the Daily Spread Farm, the "Cropware 2.0 Daily Spread Tutorial.mdb" file can be loaded into Cropware from the Cropware CD or downloaded from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). As another alternative, if you'd like to create the nutrient management plan using only the farm data without any instruction, you can access the basic data in the "Daily Spread Farm Tutorial (Data only).xls" file from the Cropware CD or the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu).

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14.2 Basic Nutrient Management Planning Flow

Before launching into the nutrient management plan tutorial, it's helpful to look at the big picture. Figure 14.1 below outlines the basic steps involved in nutrient management planning, including characterizing sources of manure and information about the farm fields, using that information to develop agronomic and environmental nutrient guidelines (performed by Cropware), allocating manure and fertilizer to meet crop and environmental goals (this step is often iterative), and generating a plan for implementation and evaluation. It may be helpful to refer back to this flow as you progress through the nutrient management planning process with Cropware.

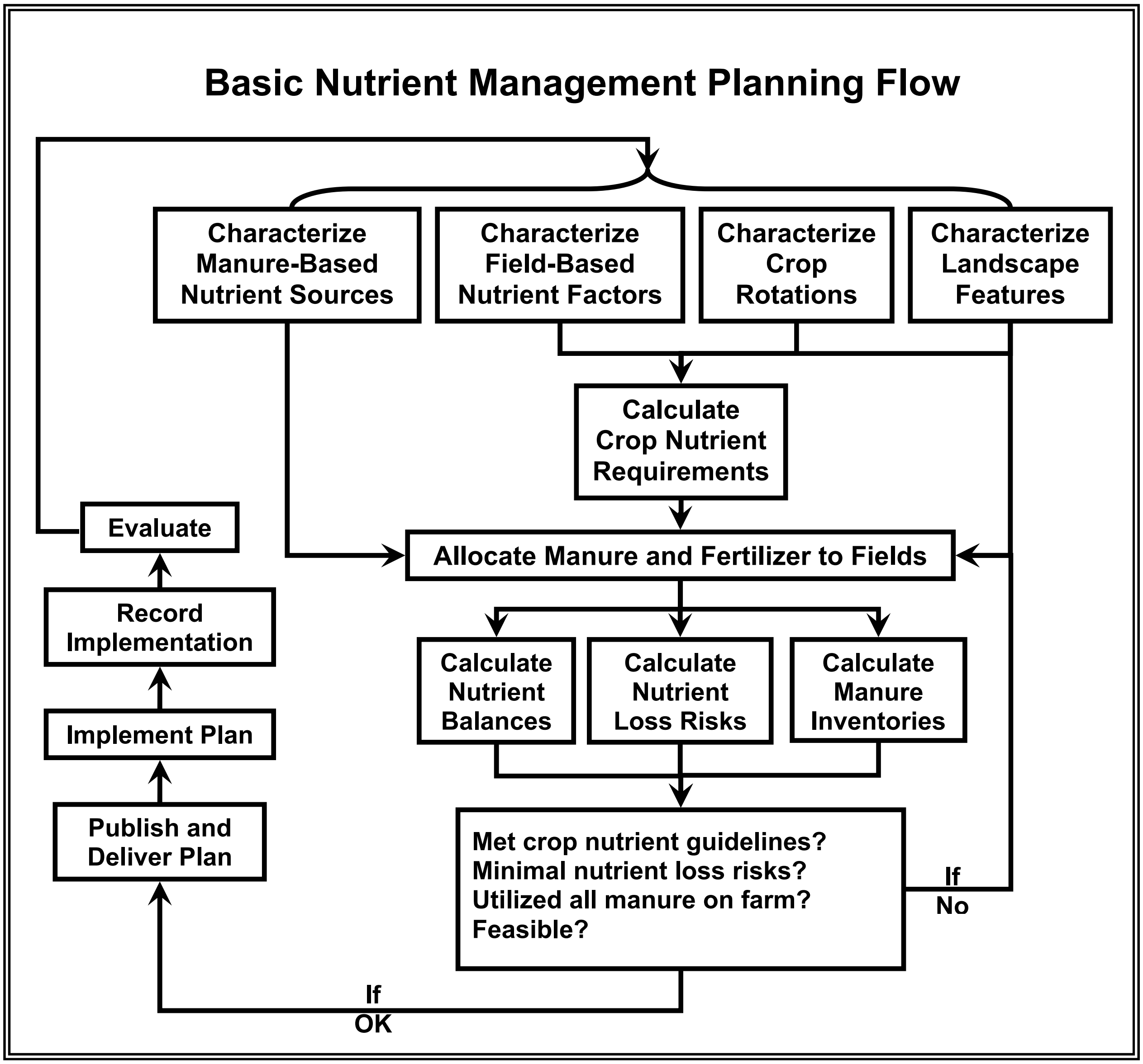


Figure 14.1

14.3 Getting Started

1. *Creating the Plan:* If this is the first time you have opened Cropware, a "No Plan in Memory" alert will be displayed. Click OK. Without a plan in memory, you must click on the File menu and select either New Plan or Load Plan. To create a new plan from scratch with the information provided in this tutorial, click on New Plan, name the plan Daily Spread Tutorial, and click on Save. Or, to load an existing plan, click on Load Plan, select "Cropware 2.0 Daily Spread Farm Tutorial.mdb" from the Cropware CD or the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu), and click on Open.

   As an alternative, if you've created the Daily Spread Farm Tutorial with Cropware 1.0, you may convert that file to the version 2.0 format according to the following instructions: click on Tools; select "Convert Version 1.0 Plan Files to Current Version"; select the "Daily Spread Tutorial Completed.cpw" file to convert and hit Open; next, name the converted file "Cropware 2.0 Daily Spread Farm Tutorial.mdb"; and click Save. The previous plan file has been converted to the Cropware 2.0 format and is ready for use.

2. *Saving the Plan:* You will want to save your plan as you populate it with the information provided in the tutorial. Click on the File menu and select Save to save the plan with its current name and folder or choose Save As to change the file name, folder, and/or drive. While in the File menu, you will also notice Auto-Save Plan on Exit option. This option can be selected and de-selected depending on whether you want the plan to be automatically saved when exiting Cropware.

3. *Exiting and Resuming a Cropware Session at a Later Time:* You may want to work through the tutorial during multiple sessions. For safety, save the plan before exiting, unless you've made changes since your last save that you would prefer not to be included in the plan. To exit the program, click on the File Menu, select Exit, and strike OK within the Confirm Exit box. Regardless your choice of Auto-Save options, upon exiting Cropware, a "Cropware Default Settings File.def" will be created in the Cropware folder on your hard drive. The default settings file will direct Cropware to bring up your last plan the next time you start the program, thereby eliminating the need to load the plan, as described in Step 1.

4. *Moving around the Program:* Take a minute to familiarize yourself with the flow of the program.

   Drop-Down Menus

   File: Allows the management of program files as described in Steps 1 through 3.

   Go To…: Provides an alternative method of moving to the various screens relative to clicking on one of the series of buttons below the drop-down menus.

Tools: Allows the management of future plan years, the importation of soil test data via electronic download, and the conversion of Cropware 1.0 plan files to the Cropware 2.0 format.

Reports: Provides an alternative method of moving directly to a chosen report relative to clicking on the Reports button.

Help: Provides a standard help system describing the use of Cropware, the nutrient management concepts driving the software, as well as a What's This? contact sensitive help system that allows you to click on a point of interest to display information about the item. The Help system is in .PDF format and requires Adobe Acrobat Reader (a free download from www.adobe.com) to be installed.

Planning Buttons: The Planning Buttons lead you from left to right through screens that assist you in characterizing the farm, developing the strategic nutrient management plan, and creating tactical work orders and summary reports. As a note, you must create a manure source on the Manure screen in order to have full use of the screens accessed by the buttons to the right of the Manure button.

Tree: Provides an alternative method of moving among the rotation, fertilizer, plan year, manure source, and field options within a given plan. The tree can be hidden to allow larger views of program screens.

Contacts: Input screen for basic farm and planner contact info and first plan year definition.

Options: Input screen for the plan-wide definition of the first month of the plan year and the default manure application field access per crop.

Rotations: Crop rotation library. Allows you to define the list of crop rotations that will be available for application to individual fields in the Fields screen.

Fertilizers: Fertilizer library. Allows you to define the list of fertilizers that will be available for application to individual fields in the Fields screen.

Manure: Input screen for 1) characterizing the total annual quantity and nutrient content of the manure from each manure source on a farm and 2) defining the manure storage capacity associated with each manure source.

Spreaders: Input screen for the defining the capacity of each manure spreader on a farm.

Fields: Input screen for characterizing each farm field in terms of, for example, soil type, soil nutrient analysis, crop rotation, past and future manure use, fertilizer use, and Phosphorus Index factors.

Allocation: Allows for the allocation of manures and fertilizers to meet agronomic and environmental goals on a field-by-field basis while fully utilizing the manure available for application from all manure sources across the landbase.

Calendar: Allows for the distribution of the manure selected for application on the Allocation screen for each field on a monthly basis within the plan year. Phosphorus Index timings may also be updated based on the monthly allocations of manure. Also, calculates end-of-month manure inventories for each manure source, so that storage capacities (if any) are not exceeded by manure supply.

Work Order: Input screen for the development of manure application work orders for a selected month, manure source, manure spreader, and application rate based on the temporal allocation of manure from the Calendar screen. Also allows for the recording and reporting of manure application activities on a monthly basis for each field.

Reports: Provides pre-designed reports and user-defined, custom reports for communication and documentation of the nutrient management plan.

14.4 CONTACTS SCREEN

5. *Defining Contacts*: **Enter the following information about the farm, planner, and first plan year.**

Table 14.1

Click in….	Enter the following
Producer Name	S.P. “Red” Daly
Farm Name	Daily Spread Farm
Address	2 Everyday Lane
City	Boxville
State	New York
Zip Code	33333
Phone	333-333-3333
FAX	333-333-3333
E-Mail	Daly@spread.com
Watershed	Susquehanna
County	Cortland
Township	Harford
Planner Name	Russell Low
Company	CNMP ASAP
Address	10 Recycling Way
City	Cleanville
State	New York
Zip Code	10000
Phone	777-777-7777
FAX	777-777-7777
E-Mail	cnmp@cnmpasap.com
First Plan Year	2002

The Watershed designation is purely a record and not utilized by Cropware. The County and Township designations link the farm-wide plan to a database of site-specific precipitation data for basic manure storage sizing (county precipitation data) and Nitrogen Leaching Index (township precipitation data) determinations. The county and township can be changed on a field-by-field basis in the Fields—Field Data screen for more accurate determination of the Nitrogen Leaching Index. The First Plan Year defines the starting plan year and sets a base for building future plan years. Once the First Plan Year is defined, you'll add subsequent plan years with the Create New Plan Year function within the Tools drop-down menu.

Save plan.

14.5 Options Screen

6. *Defining First Month of the Plan Year:* Click on the down arrow to view the list of months. **Select October.** By selecting October, you are defining the plan year as beginning October 1 and ending September 30. October will be the beginning month displayed on the manure application Calendar screen. You may want to change this definition for the plans that you will create depending on your growing season and plan communication style.

7. *Defining the Default Monthly Field Access as a Function of Current Crop:* This section defines which months a particular crop is open for the application of manure. For example, on many farms a corn field is only accessible for manure applications before planting and after harvest. **Click on the down arrow next to Crop and find COS, the crop code for corn silage (as a note, striking the "C" or "COS" until COS is highlighted may ease your search and is a function found in all of Cropware's drop-down menus).** Cropware's default settings define the period when manure can be physically applied to a COS field as from Oct-Apr. Therefore, this is the default accessibility period for COS for the entire plan. As you'll see later, the accessibility definition can be changed on a field-by-field basis in the Fields—Manure Use screen to accommodate soils with varying trafficability, different planting times, labor and machinery constraints, etc. The accessibility definition results in the shading of months closed to spreading in the Calendar screen, thereby assisting in the temporal allocation of manure.

   Now, select GIT, the code for intensively managed grass, from the crop drop-down menu. By clicking on the "Allow Manure Application All Months" button, the accessibility is changed accordingly from the default (all of the "Manure Application" buttons are selected).

   Next, by clicking on the "No Spreading Any Month" button you'll notice the crop is now closed to manure applications (all of the "No Spreading" buttons are selected).

   Finally, re-define the accessibility period for GIT by clicking on the months of May through October in the "Manure Application" row.

   Save plan.

14.6 Rotations Screen

8. *Reviewing Default List of Crop Rotations:* The list of default crop rotations may be modified by creating new rotations or deleting existing rotations. The list of rotations will be utilized in the Fields—Crop Data screen in order to couple a particular field with a specific crop rotation. **Click on the down arrow next to Rotation Name and scroll down the list of default rotations.** By clicking on a particular default rotation, you'll see the individual crops comprising the rotation within the Rotation Crops box.

9. *Creating a New Rotation:* You will likely want to add more rotations in the rotation library for later use in the Fields screen. **Click on the "Create New Rotation" button and name the new rotation, 4 Clover/Grass – 3 Corn Silage. Click OK. Now populate the rotation with individual crops. Click on CGE within the Perennial Crops – Establishment menu and notice CGE appears in the "Rotation Crops" box. Next click on CGT in the Perennial Crops – Established menu three times. Now you've described a rotation containing four years of Clover/Grass. Click on COS three times in the Annual Crops Menu. Now the rotation should look like the following.**

   Table 14.2

Yr 1: CGE
Yr 2: CGT
Yr 3: CGT
Yr 4: CGT
Yr 5: COS
Yr 6: COS
Yr 7: COS

   If you made a mistake in the order, you can change the order of the individual crops by highlighting a particular crop and moving it up or down within the rotation by clicking on the appropriate arrow to the right of the Rotation Crops box.

10. *Deleting a Rotation:* **If you made a mistake and inputted an incorrect crop code or an incorrect number of a certain crop code, you must delete the crop rotation and start over. You will not be using the 4 Clover/Grass – 3 Corn Silage rotation in the tutorial, so delete the rotation by highlighting it in the Rotation Name menu and clicking the "Delete Current Rotation" button. Click OK to confirm the deletion and voila!** As a note, you will not be allowed to delete a rotation from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the rotation is currently utilized upon the attempted deletion.

    Save plan.

14.7 Fertilizers Screen

11. *Reviewing Default List of Fertilizers:* The list of default crop fertilizers may be modified by creating new fertilizers or deleting existing fertilizers. The list of fertilizers will be utilized in the Fields—Fertilizers screen and the Allocation screen in order to couple a particular field with specific fertilizers. **Scroll down the list of default fertilizers in the Fertilizer menu.** By clicking on a particular default fertilizer, you'll see the following details about the fertilizer: cost (no costs have been entered for the default list of fertilizers), dry or liquid consistency, density (if liquid), and nutrient concentration (%).

12. *Creating a New Fertilizer:* You will likely want to add more fertilizers in the fertilizer library for later use in the Fields screen and the Allocation Screen. **Click on the "Add Fertilizer" button and name the fertilizer, Corn Starter #1. Click OK. With Corn Starter #1 highlighted in the Fertilizer Menu, characterize the fertilizer as follows:**

Table 14.3

Click in….	**Enter the following**
Solid or Liquid	Liquid
Density	11.0
Cost	$1.51/gal
N (%)	20
P_2O_5 (%)	10
K_2O (%)	0
B (%)	0
Fe (%)	0
Mg (%)	0
Mn (%)	0
Zn (%)	0
S (%)	0

Save plan.

13. *Deleting a Fertilizer:* **You will not be using the fertilizer named "Corn Starter #1" in the tutorial, so delete the fertilizer by highlighting it in the Fertilizer menu and clicking the "Remove Fertilizer" button. Click OK to confirm the deletion.** As a note, you will not be allowed to delete a fertilizer from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the fertilizer is currently utilized upon the attempted deletion.

14. *Reset to Default Fertilizers:* If you'd like to return the list of fertilizers in the Fertilizer menu to the original default list packaged with Cropware, **click on "Reset to Default Fertilizers", as the default list is used for the tutorial.**

Save plan.

14.8 MANURE SCREENS

Manure Screen – General Information

15. *Manure Screen:* To create a nutrient management plan, you will need to determine both the quantity and composition of manure to be allocated to crop land. To aid in this effort, the Manure screen is divided into three tabs: Manure Source Data, Manure Analyses, and Manure Storage.

    As a note, at least one waste source must be created before any field information can be entered in the Fields screens; otherwise, a message requesting the creation of a waste source will appear. The waste source is any manure or other waste handling system where the nutrients or waste are produced and must be accounted for. Examples of waste sources are "daily spread", "silage leachate", "bedded pack", "earthen storage system", "pasture", etc.

16. *Creating a Waste Source:* In this tutorial, you'll be working with two sources of waste on a dairy farm: waste from the Main Barn, containing lactating and dry cows and milking center waste, and manure from the Heifer Barn, containing young stock. **Click "Add Source", type Main Barn, and hit OK. Next, click "Add Source" again, type Heifer Barn, and hit OK.** You should be able to toggle between the two manure sources using the arrow buttons or the down arrow next to the Choose Waste Source drop-down menu. In order to enter or change data for a particular waste source, it must be selected in the Choose Waste Source menu. If you make a mistake and wish to delete a source, click the "Delete Source" button and confirm, but don't do this for the tutorial. As a note, you will not be allowed to delete a manure source from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the source is currently utilized upon the attempted deletion.

Manure Screen – Manure Source Data Tab

17. *Entering Information in the Manure Source Data Tab:* **Select Main Barn in the Choose Waste Source drop-down menu. Within the Manure Source Data tab, enter the following information about the Main Barn system.**

    Table 14.4

Click in….	**Enter the following**
Waste Source Units	Gallons
Manure Density	8.34 lbs/gal
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Select Heifer Barn in the Choose Waste Source menu. Within the Manure Source Data tab, enter the following information about the Heifer Barn system.

Table 14.5

Click in….	**Enter the following**
Waste Source Units	Tons
Manure Density	N/A
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Save plan.

18. *Estimate Waste Available for Application in the Plan Year:* The quantity of "Annual Waste Available for Application" is not a user entry but is calculated and displayed by the program, where:

"Amount at Start of Plan Year"
plus "Amount Added to System Annually"
less "Amount Exported from System Annually"
equals "Annual Waste Available for Application".

See Figure 14.2 below.

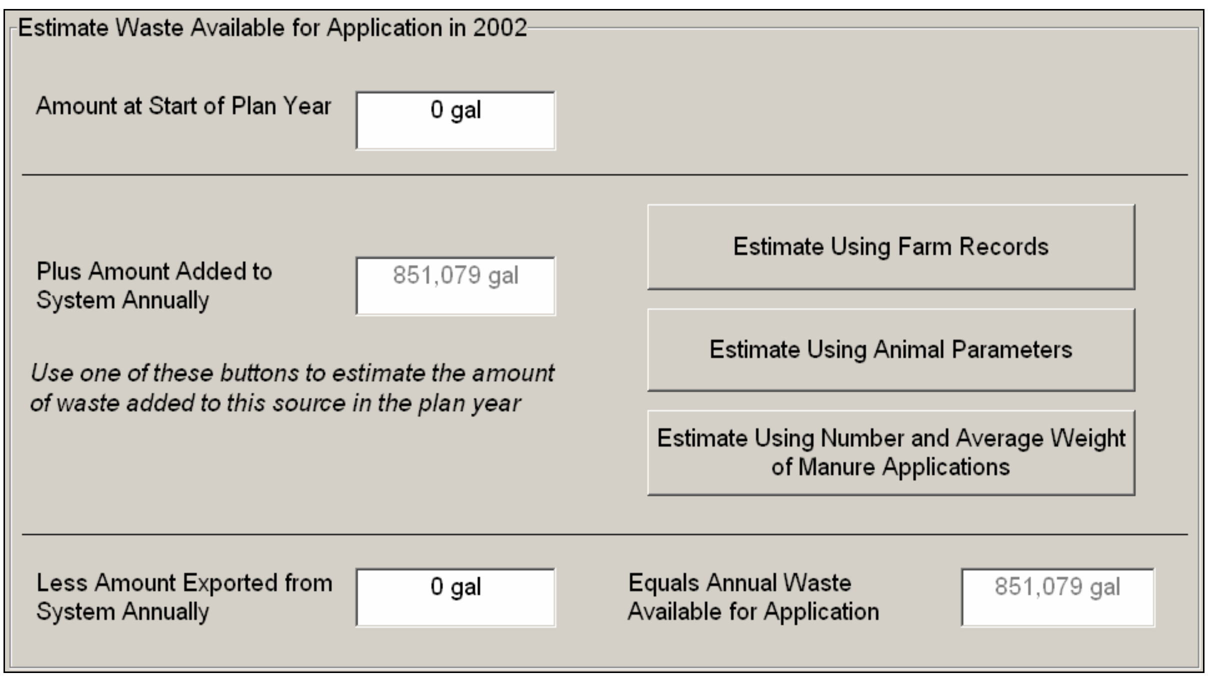


Figure 14.2

Amount at Start of Plan Year: **This tutorial focuses on a farm with no manure storage capacity. Therefore, enter the following data based on farm records.**

Table 14.6

Waste Source	Amount at Start of Plan Year
Main Barn	0 gallons
Heifer Barn	0 tons

As a note, when a new plan year is created the "Amount at start of plan year" is set as the manure available for application less the amount of manure allocated to crop land (i.e. last plan year's "Manure Balance" from the Allocation screen) or, in other words, it's the un-applied manure carried over from the previous plan year. However, if you use the manure spreading Calendar screen to plan the manure allocation through the year, the ending inventory amount in the last month may be a better estimate of the "Amount at start of plan year" than the program set value. In that case, you can manually enter the correct beginning inventory quantity here. Being that this is a farm without manure storage, no manure should be carried over to the next plan year. If this is not the case, then, among other reasons, manure storage should be considered in the future.

Amount Added to System Annually: In Cropware, you have the option of choosing one of three ways to estimate the amount of waste added to a waste system annually.

1. Estimate Amount Added Using Farm Records, or
2. Estimate Using Animal Parameters, or
3. Estimate Using Number and Average Weight of Manure Applications.

Again, refer to Figure 14.2 above.

Estimate Amount Added Using Farm Records: **Select Main Barn from the Choose Waste Source drop-down menu and click on the "Estimate Amount Using Farm Records" button. Enter 1,500,000 gallons and click OK. You have just directly defined the amount of waste produced annually for the Main Barn.**

Estimate Using Animal Parameters: **With Main Barn still selected, click on "Estimate Using Animal Parameters" to gain experience with another estimation method.** A data entry screen will displayed as in Figure 14.3 below.

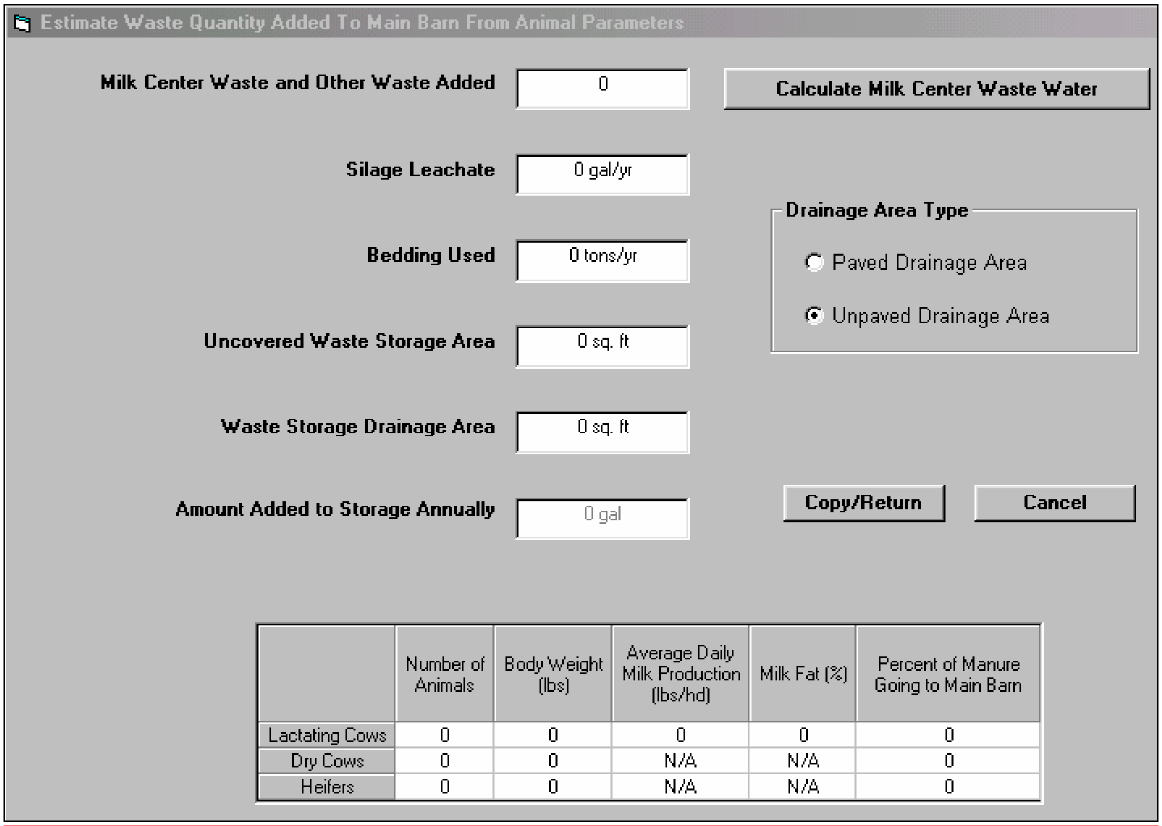


Figure 14.3

From Figure 14.3 you can see the factors considered in this estimation method. Starting from the top, to calculate milk center waste and other added wastes you can enter a value directly into the cell from records or, as for the tutorial, **click on "Calculate Milk Center Waste Water" to display a screen similar to Figure 14.4 below.**

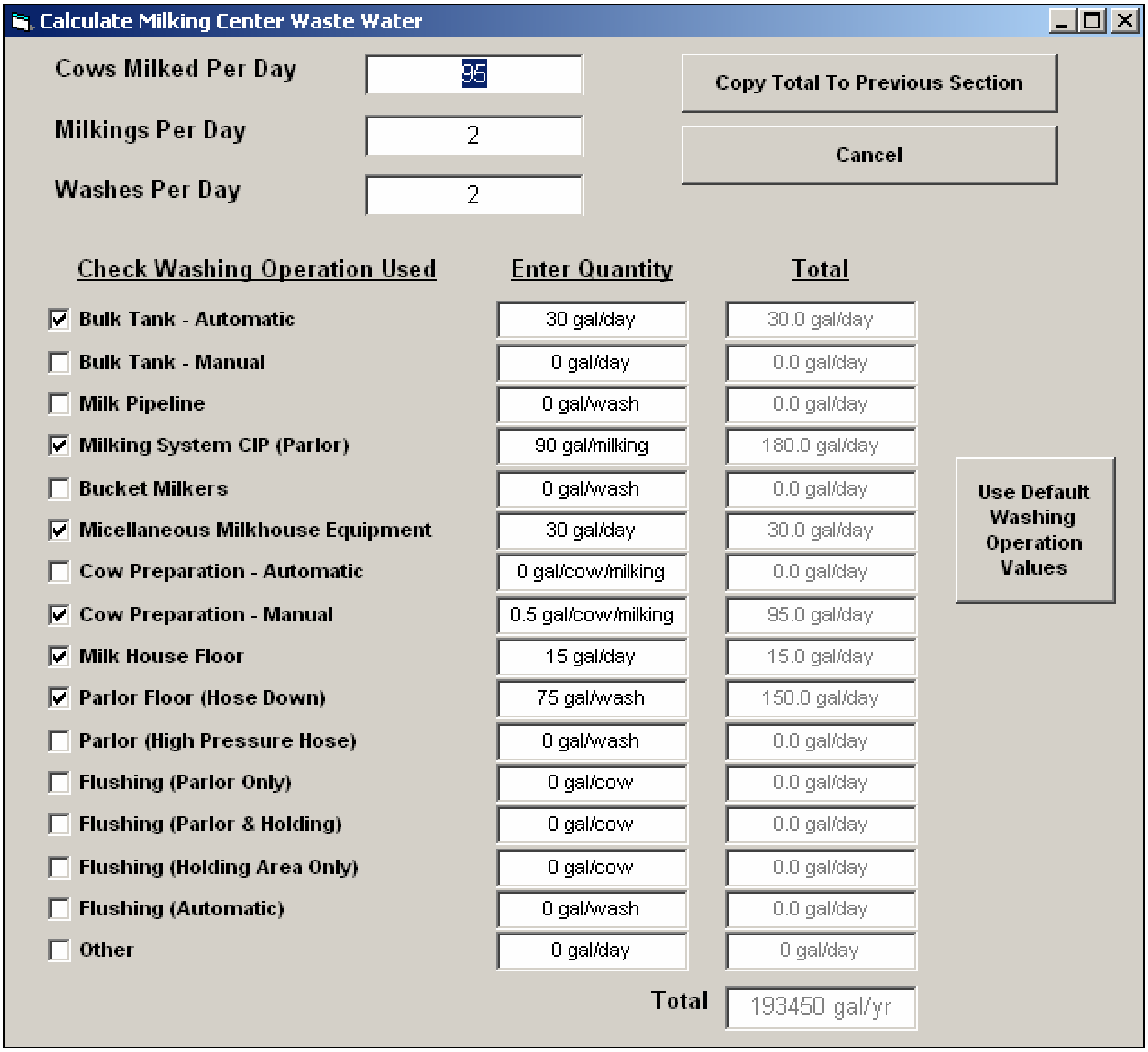


Figure 14.4

Enter the data contained in Figure 14.4 into the "Calculate Milking Center Waste Water" screen. In order for the volumes of wash water to be added to the total, the Washing Operation must be checked. To utilize a set of Default Washing Operation Values from NRAES-115, "Guideline for Milking Center Wastewater", you can click on the "Use Default Washing Operation Values" button, but do not take this step for the tutorial. **Click "Copy Total to Previous Screen". Now, enter the data for the remaining waste contributing sources from Figure 14.5 below.**

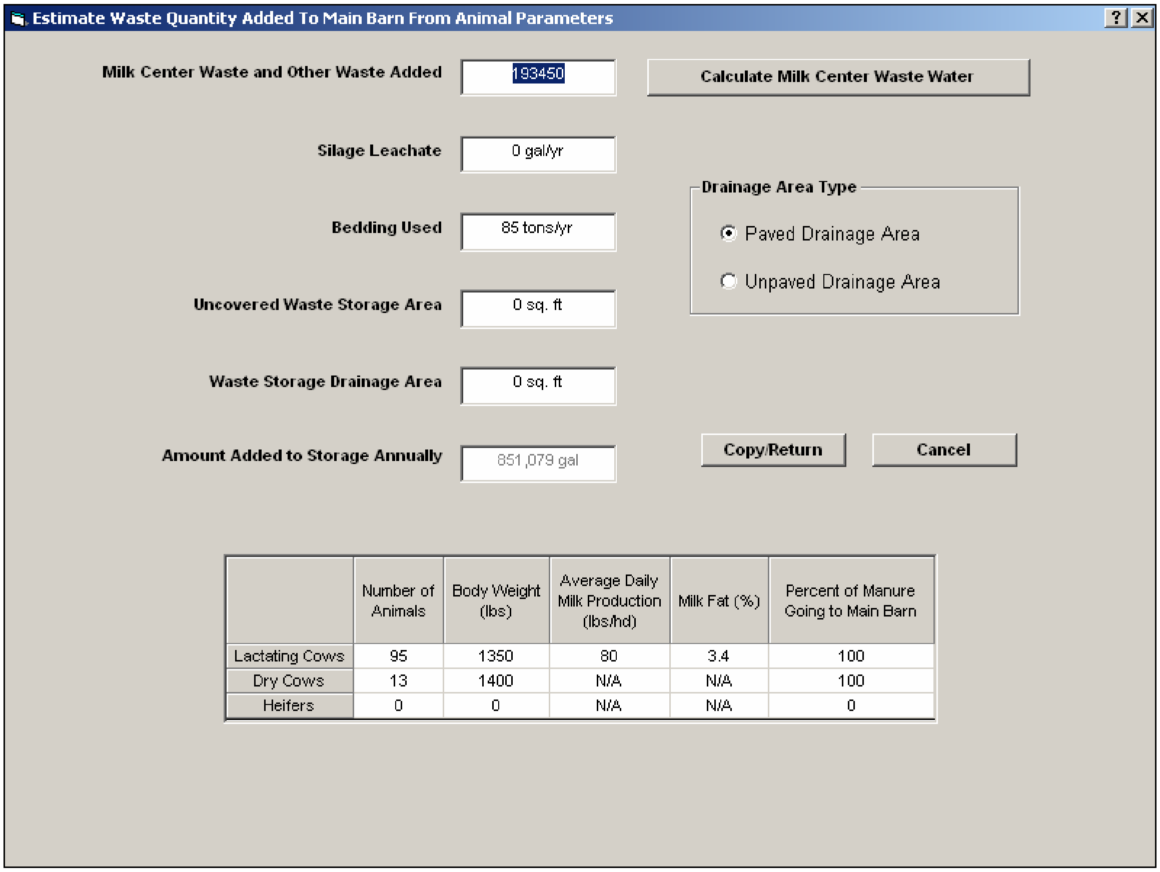


Figure 14.5

Silage Leachate: Estimated from farm records.
Bedding Used: Estimated from farm records or daily bedding use recommendations.
Uncovered Waste Storage Area: Measured from designs or in the field.
Waste Storage Drainage Area: Represents any area that drains into the waste system. Measured from plans, maps, or in the field.
Drainage Area Type: Paved drainage areas will contribute a greater volume of runoff than unpaved areas. Assess in the field.
Animal Parameters: Herd records. Note that 100% of the manure is collected in the Main Barn system. A farm utilizing pasture would contribute a portion of the manure to the Main Barn and the remainder to the Pasture System (see Grazing Farm Tutorial and/or Estimating manure on pasture).

Click on Copy/Return and notice that 851,079 gallons now populates the "Amount Added to System Annually" cell, replacing the 1,500,000 gallons that you directly entered using the initial "Estimate Amount Using Farm Records" method. The waste quantity estimation method utilized most recently will always populate the "Amount Added to System Annually" cell. Use the 851,079 gallon estimation for the Main Barn. Note the Animal Units cell has been populated with 146 as a result of entering the animal parameter information.

Save plan.

Estimate Using Number and Average Weight of Manure Applications: The final method offered in Cropware for waste quantity estimation is based on the number of loads removed from the system each day coupled with the average weight of each spreader load. **Select the Heifer Barn from the "Choose Waste Source" drop-down menu and click on the "Estimate Using Number and Average Weight of Manure Applications" button. If you haven't characterized any spreaders yet, you'll encounter a "No Spreaders Defined" pop-up box. Click Yes to define a spreader.** The Spreaders screen that appears is the same screen represented by the Spreaders button positioned across the top of the Cropware interface. **Click "Create Spreader", enter Box as the spreader name, click OK, and a screen similar to Figure 14.6 should appear.**

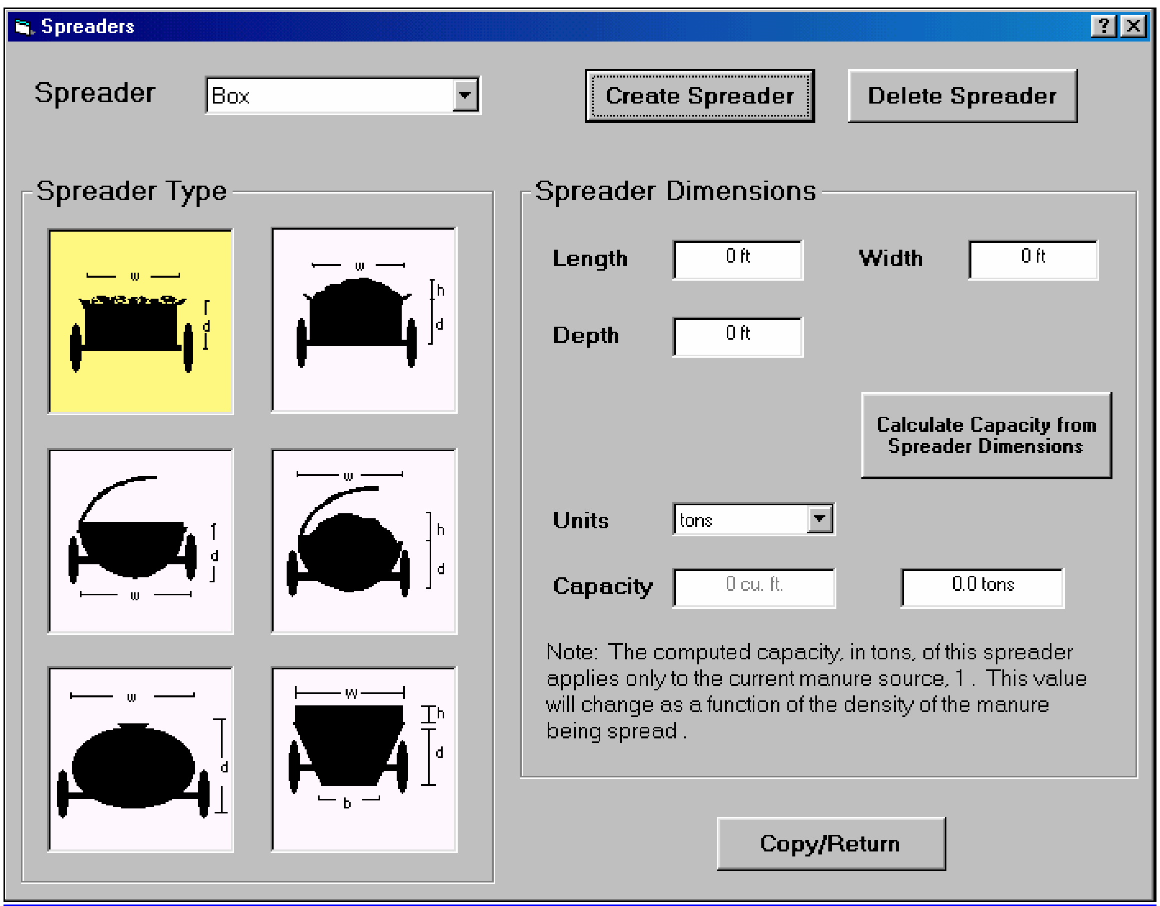


Figure 14.6

Choosing Spreader Type and Determining Spreader Capacity: Cropware allows you to define spreader capacity by entering the dimensions of the spreader

(Spreader Dimensions) or by entering the weight or volume of the spreader directly based on field measurements. Regardless of the method, Spreader Capacity is stored by Cropware in cubic feet and converted to gallons or tons depending on the units and density of the waste currently selected in the "Choose Waste Source" drop-down menu. **Toggle through the 6 spreader options in the "Spreader Type" menu and notice the change in Spreader Dimension options.** The "Calculate Capacity from Spreader Dimensions" button signals Cropware to compute the Spreader capacity from entered dimensions. **For the tutorial, highlight the symbol for the box-style spreader in the upper-left corner of Figure 14.6 above and enter the Capacity for the Box spreader directly into the rightmost "Capacity" cell based on Table 14.7 below.**

Table 14.7

Spreader ID	Capacity
Box	5 tons

Click on Copy/Return and you should return to the "Manure Source Data" screen. Click on the "Estimate Using Number and Average Weight of Manure Applications" button again and a screen similar to Figure 14.7 will appear.

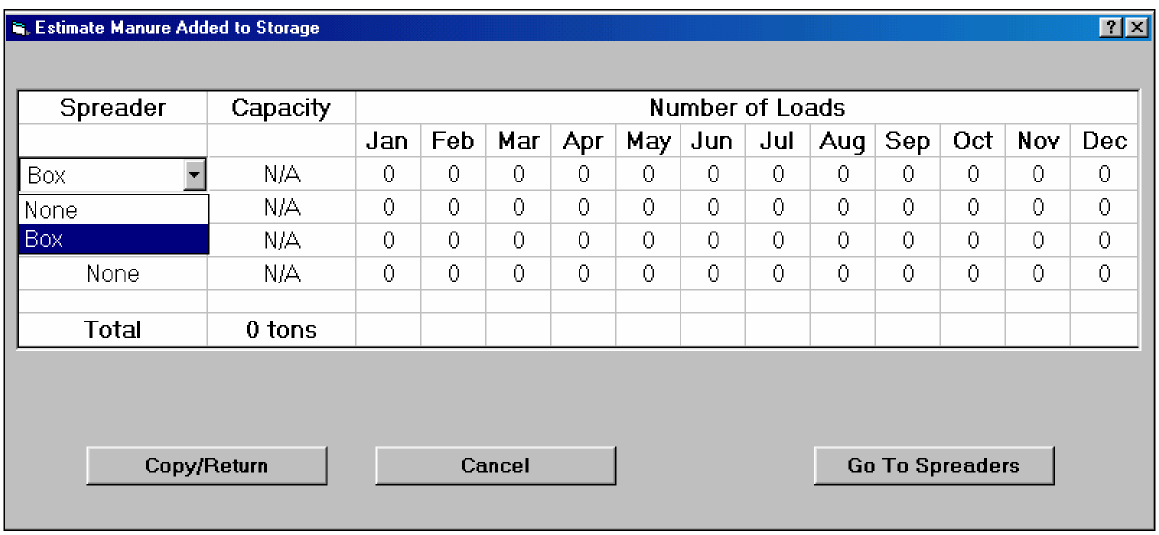


Figure 14.7

The "Estimate Manure Added to Storage" screen depicted in Figure 14.7 allows you to select the recently defined Box spreader, or up to four spreaders total, from the Spreader drop-down menus. **Click in the "Spreader" column, select the Box spreader, and click on another cell in the grid. The 5 ton capacity entered on the Spreaders screen will appear in the Capacity column.** At this point, you are set to enter the number of loads applied per month with the Box spreader over the course of a year from the Heifer Barn. The number of loads will be multiplied by the average weight of the spreader and recorded in the Total cell. **Enter the number of loads according to the manure application history in Table 14.8.**

Table 14.8

	Number of Loads											
Spreader	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Box	15	15	15	15	15	15	15	15	15	15	15	15

The Heifer Barn manure is applied approximately every other day (~180 loads based on farm records), resulting in a total manure quantity estimation of 900 tons. The records entered on this screen are also carried over to the "Manure Added" row of the Calendar screen, in order to define the amount of manure that is available for applications on a monthly basis during the current plan year. This feature is especially useful in honoring the fact that manure production can vary from month-to-month on a farm, unlike the basic example in Table 14.8, above. **Click on Copy/Return to record the 900 ton value in the "Amount Added to System Annually" cell on the Manure Source Data tab.**

As a note, it's possible to calculate the number of animal units contributing to a given waste system without using the "Estimate Using Animal Parameters" method of determining waste quantity. Select the Heifer Barn system in the Choose Waste Source menu and click on "Estimate Using Animal Parameters". Enter the animal parameters from Table 14.9 below into the grid.

Table 14.9

Animal Type	Number	Body Wt.	Milk Prod.	Milk Fat	% Going to Heifer Barn
Heifer	70	850	N/A	N/A	100

Click Copy/Return and you'll notice that 60 animal units now populate the Animal Units cell. Because "Estimate Using Animal Parameters" was the last manure quantity estimation method used, the Amount Added to System Annually cell now reads 888 tons! Have no fear, **click on the "Estimate Using Number and Average Weight of Manure Applications" button again and hit Copy/Return.** Now both the waste quantity based on number and weight of loads and the animal units are displayed for the Heifer Barn. A report of the animal units per acre exists in the "Crop, Livestock, and Nutrient Index Summary". In order to correctly account for the all animal units on the farm in this report, the animal units must be entered or calculated on the Manure screen.

Save plan.

Amount Exported from System Annually: You can enter the amount of manure exported from the farm and, therefore, not intended for application to the farm's land base. **No manure is exported from the farm for the tutorial.**

Manure Screen – Manure Analyses Tab

19. *Entering Information in the Manure Analyses Tab:* Once you've described the quantity of manure on the farm, you must characterize the nutrient content of the manure from each Waste Source. The quantity of manure will be paired with the nutrient content to calculate the total amount of nitrogen (ammonium-N and organic-N), phosphorus, and potassium available from manure for recycling back through the farm's crops, then animals, and so on. Manure analyses can be entered and deleted. The list of available manure analyses exists in the "Test Description" drop-down menu for each Waste Source and is accessible from Fields—Manure Use screen, Fields—Past Manure Use screen, and the Allocation screen once you begin allocating manure to the crop land. In addition, a listing of the all of the entered manure analysis details is created in the "Manure Analyses" report and the most recent manure analysis for each source is presented in the "Manure Analysis and Collection" report. **Click on the "Test Description" down arrow and notice that currently only the Default Dairy Cattle analysis populates the list.**

    Select Main Barn from the "Choose Waste Source" menu, click on the "Add Test" button, enter a Test Description name, hit OK, and repeat for the following list of manure Test Descriptions from Table 14.10.

    Table 14.10

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002

    Once the Test Description names are entered, click in the test attribute cells and enter the data from Table 14.11 for each of the Test Descriptions. As a note, entering Ammonia N and Organic N will automatically populate the Total N cell by addition.

    Table 14.11

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002
Ammonia N %	0.17	0.2	0.18
Organic N %	0.18	0.21	0.19
P_2O_5 Equivalent %	0.15	0.18	0.16
K_2O Equivalent %	0.26	0.23	0.3
Total Solids %	6.0	6.5	6.5
Manure Analysis Date	8-19-99	8-15-00	5-15-01

As a note, the nutrients are entered as percentages from your manure analysis report. Should you lack such data, to compute nutrient percentages from lbs of nutrient per ton:

4 lbs organic N/ton = 4 lbs/2000 lbs = 0.002 or 0.2%

or to compute nutrient percentages from lbs of nutrient per 1000 gallons:

12 lbs organic N/1000 gal = (12 lbs/1000 gal) / (8.34 lbs/gal) = 0.0014 or 0.14%

Save plan.

Next, repeat the preceding steps for the Heifer Barn with the data in Table 14.12.

Table 14.12

Test Description	Heifer Barn 2000	Heifer Barn 2001	Heifer Barn 2002
Ammonia N %	0.27	0.17	0.25
Organic N %	0.31	0.33	0.35
P_2O_5 Equivalent %	0.23	0.17	0.25
K_2O Equivalent %	0.44	0.43	0.40
Total Solids %	18.0	16.0	18.0
Manure Analysis Date	8-19-99	8-15-00	5-15-01

Save plan.

Manure Screen – Manure Storage Tab

20. *Entering Information in the Manure Storage Tab:* For each waste source, the storage capacity (if any) can be entered or calculated. This function is for planning, not design purposes. This is not a required input, but it is a necessary entry if you want to compare waste storage capacity to storage requirements and calculate months of storage duration in the "Manure Analysis, Collection, and Storage Report". In addition, if a waste storage is associated with a Waste Source, it's helpful to quantify its capacity for comparison with Ending Monthly manure Inventories in the Calendar screen. Are the end of the month manure inventories less than your storage capacity?…hope so!

For this tutorial, neither the barns are associated with waste storage systems, so storage capacities will remain zero. As a note, the Main Barn is a liquid system, so would likely have at least a few days of storage, but for simplicity, consider this facility to have no storage.

14.9 Spreaders Screen

21. *Spreaders:* Manure spreader capacity is entered on this screen. The capacity can be entered directly or calculated by the program from the size and shape of the spreader. The computed capacity applies only to the current manure source as the value computed will change as a function of the density of the manure being spread and the units selected.

22. *Create a new Spreader:* **Click on the "Spreaders" tab and hit the "Create Spreader" button. A tanker spreader has yet to be defined, so enter "Tank" as the name and click OK. Highlight the Tanker image in the lower left corner and enter the capacity according to Figure 14.8 below.**

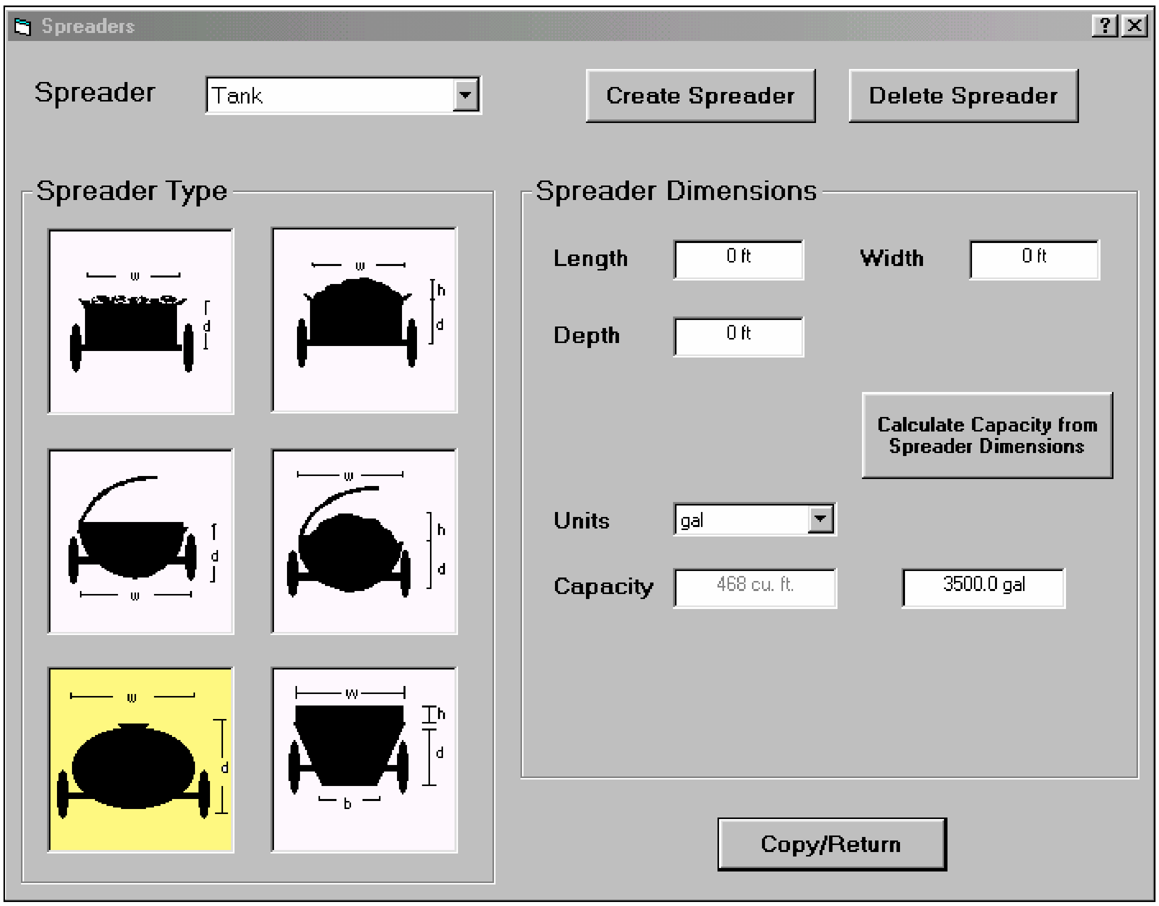


Figure 14.8

Click on Copy/Return. Now both the Box spreader and the Tank spreader have been defined and will be available for developing manure application work orders from the Work Order screen.

Save plan.

14.10 FIELDS SCREENS

Field Screens – General Information

23. *Create a Field:* The first step in characterizing a farm field is to create a field and name it. **Click on "Create Field", enter the Field ID, click OK, and repeat the process for the following list of fields.** As a note, the Field ID should be the Farm Service Agency tract and field number, according to the following example format: 3982.01A (where 3982 = Tract ID, 01 = Field ID, and A = Strip ID, if present).

Table 14.13

Field ID
3982.01
3982.02
3982.03
3982.04
3982.05
3982.06
3982.07
3982.08
3982.09
628.10

Once created, the list of Field ID's will populate the "Field ID" drop down menu. You can select a field by highlighting it in the drop-down menu or by using the left or right arrow. The newly created fields will also appear under the Fields limb of the Tree (if not currently displayed, activate the tree by clicking on the Tree button). You can navigate among different fields using either the Field ID menu or the Tree. **Save plan.**

24. *Copy Field:* If you have a group of similar fields, perhaps in terms of soil type, crop rotation, manure history, etc., you may wish to fully create and populate a representative field and copy it repeatedly depending on the number of similar fields. This can minimize data entry time by reducing the number of redundant keystrokes. The copy function will not be used in tutorial, but to get a feel for it, **select field 628.10 within the "Field ID" menu and click "Copy Field". Enter 628.10A as a field ID for the copy of 628.10 and hit OK. Repeat this process, but now enter 628.10B.** As a result, Field 628.10A and Field 628.10B have both been added to the list of fields in the Field ID menu. This could be a common change as fields are divided into smaller management units for production and/or environmental conservation purposes. On an actual plan, you would adjust the acreage of each "sub-field" to reflect the area of each management unit.

25. *Re-Order Fields:* Now let's re-order Field 628.10A and Field 628.10B above the original Field 628.10 in the list. **Click "Re-Order Fields", highlight 628.10A, and click the UP arrow once. Repeat this for 628.10B.** Both of the "sub-fields" should appear above the original 628.10. Hit OK when finished re-ordering the fields.

26. *Delete Field:* Field 628.10A and Field 628.10B will not be used in the tutorial, so **select field 628.10A within the "Field ID" menu, click on "Delete Field", and hit OK on the warning screen. Repeat for Field 628.10B.** Field 628.10A and Field 628.10B will no longer be listed in the Field ID menu.

Field Screens – Field Data Tab

27. *Field Data:* The Field Data screen is designed for characterizing the following field attributes.

Field Name	Soil Name	Artificial Drainage
Acres	Present or Past Sod	Corn Yield Potential
County	Tillage Depth	Highly Erodible Land
Township		

28. *Enter Field Data:* **Enter the following data into the Field Data screen.**

Table 14.14

Field ID	Field Name	Acres	County	Town-ship	Soil Name	Present or Past Sod	Tillage Depth	Artificial Drainage	Corn Yield Potential	HEL
3982.01	1	19.6	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.02	2	28.4	Cortland	Harford	Howard	50+% Leg	7-9 Inches	None	Use CU	N
3982.03	3	24.7	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.04	4	18.2	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	Adeq	Use CU	N
3982.05	5	17.9	Cortland	Harford	Bath	1-25% Leg	7-9 Inches	Adeq	Use CU	Y
3982.06	6	16.5	Cortland	Harford	Langford	1-25% Leg	7-9 Inches	None	Use CU	N
3982.07	7	25.6	Cortland	Harford	Langford	1-25% Leg	7-9 Inches	Adeq	Use CU	N
3982.08	8	7.0	Cortland	Harford	Valois	100% Grass	7-9 Inches	None	Use CU	Y
3982.09	9	26.9	Cortland	Harford	Erie	100% Grass	7-9 Inches	Adeq	Use CU	N
628.10	10	8.5	Cortland	Harford	Chagrin	26-50% Leg.	7-9 Inches	None	Use CU	N

Save Plan.

Fields Screens – Soil Test Tab

29. *Soil Test:* The Soil Test Data screen is designed for characterizing the following field attributes

Lab ID	P	Fe
Extraction Method	K	Mn
Sample Date	Al	Zn
pH	Ca	Organic Matter
Exchange Acidity	Mg	Pre Side-Dress N Test (PSNT)

30. *Enter Soil Test Data:* **Enter the following data into the Soil Test screen:**

Table 14.15

Field ID	Lab ID	Extraction Method	Sample Date	pH	Exch. Acidity	P	K	Al	Ca
3982.01	CNAL	Morgan	4/11/01	7.0		77	360	25	4210
3982.02	CNAL	Morgan	4/11/01	7.2		46	335	23	3470
3982.03	CNAL	Morgan	3/30/00	6.6		32	325	34	4470
3982.04	CNAL	Morgan	4/11/01	6.7		17	280	31	3950
3982.05	CNAL	Morgan	4/11/01	7.0		8	245	60	3400
3982.06	CNAL	Morgan	4/11/01	6.8		64	310	21	3790
3982.07	CNAL	Morgan	4/11/01	7.0		15	235	21	3350
3982.08	CNAL	Morgan	11/1/99	5.8	13	5	110	106	2190
3982.09	CNAL	Morgan	11/30/99	7.0		25	100	41	4230
628.10	CNAL	Morgan	4/11/01	6.0	14	7	215	52	2780

Table 14.16

Field ID	Mg	Fe	Mn	Zn	Organic Matter	PSNT
3982.01	620	3	19	2.6	4.1	
3982.02	450	1	9	2.3	4.4	
3982.03	635	3	18	3.3	3.9	
3982.04	705	3	21	2.9	4.6	
3982.05	520	6	19	1.8	4.3	
3982.06	610	1	11	2.5	4.0	
3982.07	640	1	9	1.5	4.6	
3982.08	250	21	32	1.8	5.4	
3982.09	620	4	22	2.7	4.8	
628.10	420	5	25	1.2	4.5	

Save plan.

Field Screens -- Crop Data Tab

31. *Crop Data:* The crop history and planned rotation for each field is entered on the Crop Data tab. The stock rotations that you defined in the Rotations screen are used to quickly setup the planned rotation for each field. Any changes made to a rotation in the Crop Data screen impact the rotation for the field only and do not change the stored, stock rotations defined on the Rotations Screen.

    The crop data from the past three crop years is used in the nutrient requirement equations. If a sod crop has been plowed down or killed during the past three years, the organic nitrogen will become available to the plants through mineralization. The amount of nitrogen available is a function of the amount of legume in the stand and the years since plow down, as defined by the user-selected cropping sequence on the Crop Data screen.

    In addition, for planning purposes, the Crop Data screen can be used in combination with the "Crop, Livestock, and Nutrient Index Summary" report and the "Crop Summary Report" to assess the acres of each crop across the entire farm for the plan year and over the course of the rotation, respectively.

32. *Selecting a Pre-Defined Crop Rotation:* **Click on the down arrow in the "Rotation" menu and select the desired rotation to fill the year fields with the rotation crop codes.**

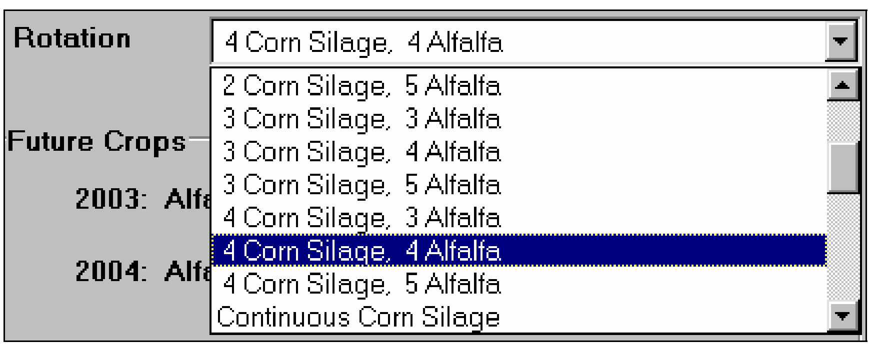


Figure 14.9

For field 3982.01, select the 4 Corn Silage, 4 Alfalfa rotation according to Table 14.17, below. Click OK to accept the rotation change. Repeat this progression for the remaining fields.

Table 14.17

Field ID	Rotation Goal
3982.01	4 Corn Silage, 4 Alfalfa
3982.02	4 Corn Silage, 4 Alfalfa
3982.03	4 Corn Silage, 4 Alfalfa
3982.04	4 Corn Silage, 4 Alfalfa
3982.05	3 Corn Silage, 4 Alfalfa-Grass Mix
3982.06	3 Corn Silage, 3 Alfalfa-Grass Mix
3982.07	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.08	Continuous Intensively Managed Grass
3982.09	Continuous Intensively Managed Grass
628.10	4 Corn Silage, 4 Alfalfa-Grass Mix

Save plan.

33. *Temporally Aligning a Crop Rotation:* Notice how the pre-defined rotation populated the rotation planning cells for field 3982.01 as shown in Figure 14.10.

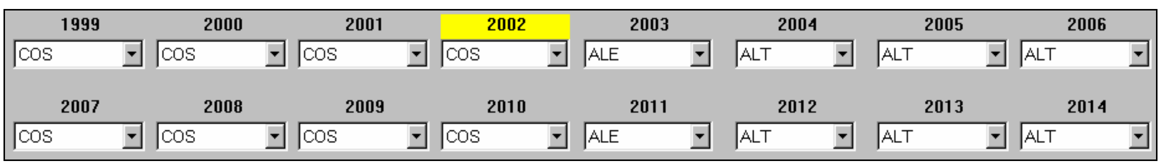


Figure 14.10

For field 3982.01, compare the sequence of crops within the rotation from Figure 14.10 to the true sequence of the rotation plan in Table 14.18.

Table 14.18

Field ID	1999	2000	2001	2002	2003	2004	2005	2006
3982.01	COS	ALE	ALT	ALT	ALT	COS	COS	COS

Notice that the initial crop sequence in the Cropware rotation displays COS for the current year (highlighted in Figure 14.10), but the true crop rotation plan (Table 14.18) specifies that 2002 should be in 3rd year alfalfa, that is ALT, preceded by ALT in 2001 and ALE in 2000. **In order to align the sequence of crops within a rotation correctly with the plan years, you can roll the entire rotation sequence forward or backward through the years. To do this, click on the year label above any rotation planning cell that matches the true crop's position in the rotation for the current plan year (i.e. any year with 3rd year alfalfa). The crop code for the year you click will become the crop for the yellow-highlighted, current plan year. So, considering Figure 14.10, clicking on 2005 or 2013 will roll the entire rotation around, resulting in correct**

alignment of the rotation with the past and future plan years, while maintaining the sequence of crops within the rotation. It's still a 4 Corn Silage, 4 Alfalfa rotation (Figure 14.11) over time!

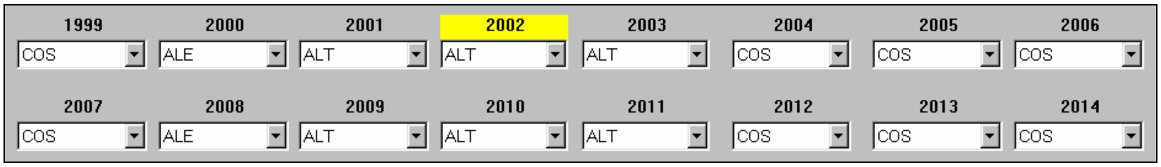


Figure 14.11

Now, correctly align the rotations for the remaining fields according to the rotation plan in Table 14.19.

Table 14.19

Field ID	1999	2000	2001	2002	2003	2004	2005	2006
3982.02	ALT	ALT	COS	COS	COS	COS	ALE	ALT
3982.03	ALE	ALT	ALT	ALT	COS	COS	COS	COS
3982.04	COS	COS	ALE	ALT	ALT	ALT	COS	COS
3982.05	AGT	AGT	COS	COS	COS	AGE	AGT	AGT
3982.06	COS	COS	COS	AGE	AGT	AGT	COS	COS
3982.07	COS	COS	COS	COS	AGE	AGT	AGT	AGT
3982.08	GIT	GIT	GIT	GIT	GIT	GIT	GIT	GIT
3982.09	GIT	GIT	GIT	GIT	GIT	GIT	GIT	GIT
628.10	AGT	COS	COS	COS	COS	AGE	AGT	AGT

Save plan.

34. *Changing Crops within a Rotation:* You can also edit the rotation for each field by clicking on the down arrow key next to the crop code in each year of the rotation and changing the crop code. In order to maintain the rotation sequence in future years, though, you'll need to change the crop code for each subsequent year in a similar manner.

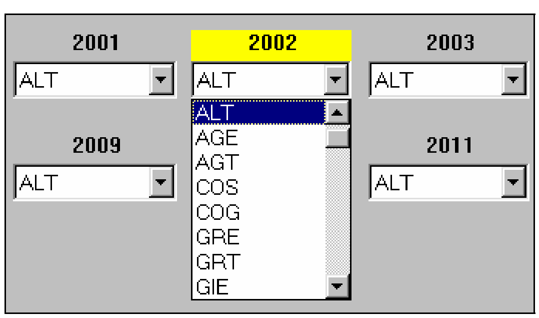


Figure 14.12

35. *Inserting or Removing Crops within a Rotation:* If the sequence of crops within a pre-defined rotation from the Rotation drop-down menu cannot be maintained precisely over time, you can choose to insert or remove a crop from the rotation without altering the crop sequence of the rotation in future plan years. **Select field 3982.06 in the Field ID menu.** After reviewing the crop rotation plan for 2002, you fear that not enough acres of corn silage were planned to meet the herd forage requirements. The pre-defined, long-term crop rotation plan for 2002 should be altered, such that field 3982.06 will be planted to a 4th year of COS instead of AGE. The farmer plans to resume the pre-defined crop sequence (i.e. 3 Corn Silage, 3 Alfalfa-Grass Mix) after 2002, so you must insert another COS crop into the rotation for 2002. **Click on the "Insert Crop" button, select 2002 from the "Year" drop-down menu, choose "COS" from the "Crop" drop-down menu, and hit OK. Compare the pre-defined rotation sequence in Figure 14.13 with the updated sequence in Figure 14.14.**

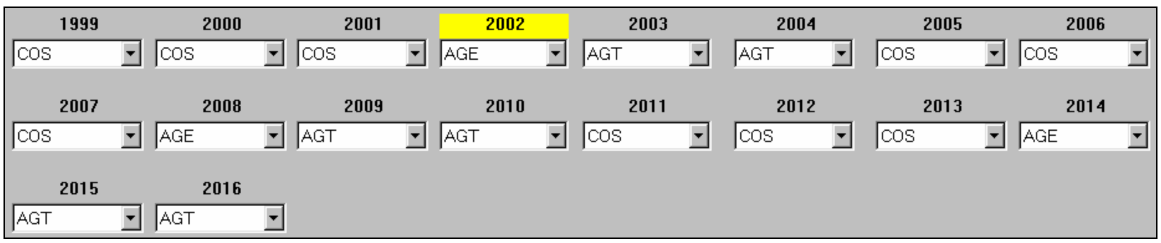


Figure 14.13

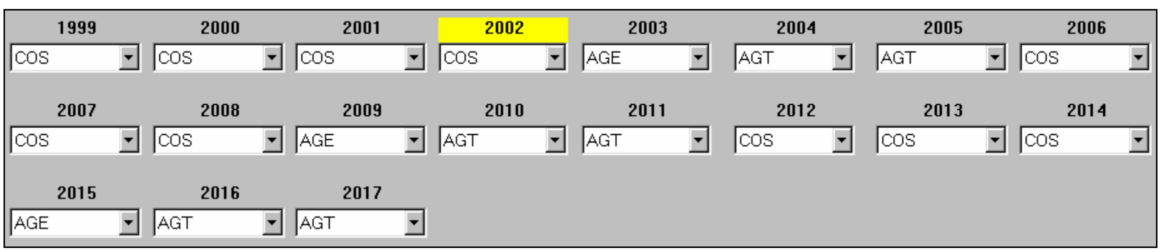


Figure 14.14

Now, after a talk with the herd nutritionist, you realize that plenty of corn silage will be produced relative to herd demand with the original crop plan for 2002, so **click on the "Remove Crop" button, select "2002" from the Year menu, and hit OK. The rotation for Field 3982.06 should mirror Figure 14.13 again.**

Save plan.

Field Screens – Manure Use Tab

36. *Manure Use:* In the Manure Use screen, you can enter information about the planned manure applications for the current plan year. **The screen is designed to accommodate two manure application events per field per plan year, as distinguished by Primary Application and Secondary Application.**

37. *Entering Current Year Data:* The following outlines the Manure Use screen for the Primary Application and the Secondary Application.

    Manure Source and Test Description: **Click on the drop-down menus to view the lists of manure Source Names and manure Test Descriptions, originally entered on the Manure Screen. These data can also be selected for a given field on the Allocation Screen.** So, unless you know that manure from a particular source will be applied to a particular field based on your knowledge of the field or the planned crop (see the Crop Summary portion of the Manure Use screen), it's often more efficient to **select this information on the Allocation screen. Use this method for the tutorial.** The Manure Source and Test are coupled with the rate of manure application from the Allocation screen in the Phosphorus Index calculation.

    Timing: The months of the year during which manure will be applied. The manure application timing is utilized in the Phosphorus Index calculation. In some cases, perhaps based on the planned crop, you'll know when manure will be applied to a field at this stage of the planning process. Otherwise, the Timing of application should be defined after the manure has been temporally allocated in the Calendar screen. As a default setting, manure application timings are set to "Feb-Apr" as this represents the highest risk timing in the Phosphorus Index. This default setting is a good starting point for allocating manure on the Allocation screen, because it represents a conservative approach. **Don't define the Timing for the tutorial at this point. Instead, return to the Manure Use screen to define the Timing of application after completion of the Calendar screen.**

    Application Method: The selection of an Application Method depends on the manure source chosen for a field, the amount of manure storage for the given source, the equipment and labor resources, the crop, the risk of runoff and/or leaching, etc. With experience on a given farm, you may be able to initially select the application method per field at this stage in the planning process, but you will likely find it necessary to then confirm the application method after planning manure applications across the land base in the Allocation screen and the Calendar screen. It's often helpful to toggle among the Fields—Manure Use, Allocation, and Calendar screens through the planning process. **For the tutorial, utilize the "Top Dress or Incorporated After 5 Days" option initially.** The method of manure application is utilized in the Phosphorus Index calculation and ammonia conservation determination.

    Hydrologic Sensitivity Description: Enter comments on hydrologically sensitive areas for a given field. This is only used as a comment space by Cropware. **Enter the following.**

Table 14.20

Field ID	Hydrologic Sensitivity Description (Primary Application)	Hydrologic Sensitivity Description (Secondary Application)
3982.01		
3982.02		
3982.03	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP
3982.04		
3982.05	AVOID APPLICATION IN WET POCKET--NE CORNER	AVOID APPLICATION IN WET POCKET--NE CORNER
3982.06		
3982.07	AVOID APPLICATION IN GRASSED WATERWAY	AVOID APPLICATION IN GRASSED WATERWAY
3982.08		
3982.09		
628.10	AVOID APPLICATION IN FILTER STRIP	AVOID APPLICATION IN FILTER STRIP

Priority Nutrient: **Use Nitrogen as the Priority Nutrient for all fields in the tutorial.**

Field Access: In the Options screen, you defined the time period available for manure applications based on crop. Having defined the crop for the plan year in the Crop Data screen, Cropware now displays the months available for spreading on the "Field Access" button. At this point, you can change the manure application access periods from the default settings on a field-by-field basis. **Select field 3982.07 in the "Field ID" menu and notice the default field accessibility, based on the definition for COS in the Options screen.**

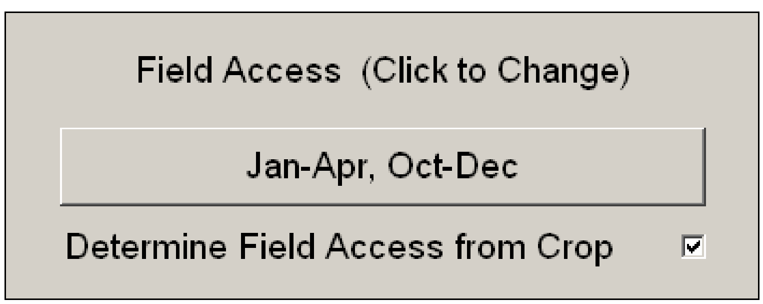


Figure 14.15

Click on the checkbox next to "Determine Field Access from Crop" to de-select this option. Click on the "Field Access" button to define the field accessibility for this field specifically. By clicking in Manure Application row, allow manure applications on this field from Oct-May and hit Return.

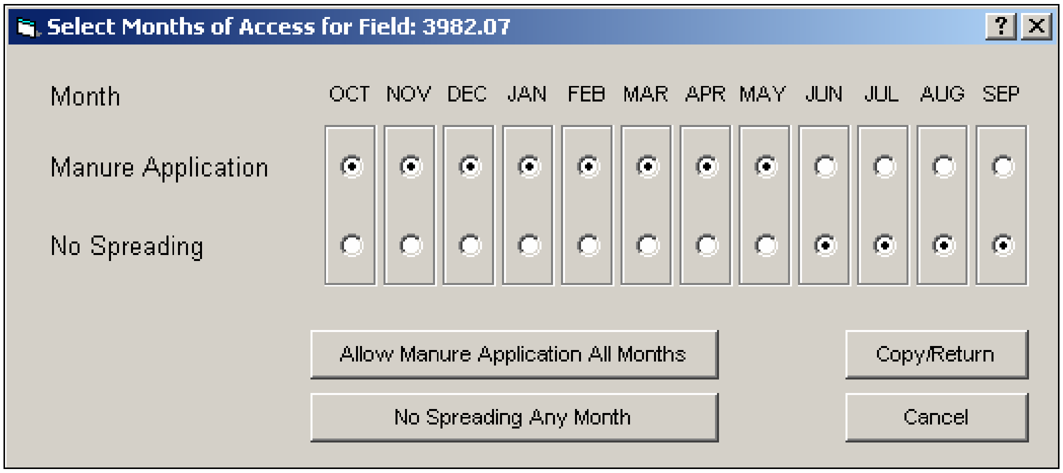


Figure 14.16

"Jan-May, Oct-Dec" will appear on the Field Access button now and the shaded, no-spreading period on the Calendar screen will reflect this change. **Select the "Determine Access from Crop" checkbox to return field 3982.07 to its original accessibility status, as in Figure 14.15 above.**

Save plan.

Field Screens – Past Manure Use Tab

38. *Enter Past Manure Use Data:* Past manure application data are used to determine the residual nitrogen available from the last two years of manure application activity for the plan year's crop nitrogen requirement. **Enter the Manure Source, associated historic Test Description, and the Quantity Applied per acre on a given field for both two years ago and last year according to the Table 14.21.**

Table 14.21

	Last Year				2 Years Ago			
Field ID	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)
3982.01	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary				Secondary			
3982.02	Primary	Heifer Barn	Heifer 2001	5	Primary	Main Barn	Main 2000	7500
	Secondary				Secondary			
3982.03	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary				Secondary			
3982.04	Primary	Main Barn	Main 2001	7500	Primary	Heifer Barn	Heifer 2000	20
	Secondary				Secondary			
3982.05	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	7500
	Secondary	Main Barn	Main 2001	5000	Secondary			
3982.06	Primary	Heifer Barn	Heifer 2001	20	Primary	Heifer Barn	Heifer 2000	10
	Secondary				Secondary			
3982.07	Primary	Heifer Barn	Heifer 2001	10	Primary	Heifer Barn	Heifer 2000	10
	Secondary				Secondary			
3982.08	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary	Heifer Barn	Heifer 2001	10	Secondary			
3982.09	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary	Main Barn	Main 2001	5000	Secondary	Heifer Barn	Heifer 2000	10
628.10	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary				Secondary	Heifer Barn	Heifer 2000	10

Save plan.

Manure applications planned in the previous two plan years on the Allocation screen will be carried forward to the Fields—Past Manure Use screen in the newly created plan year to save data entry effort. Please check these "planned" quantities with the actual records of manure application and update where necessary.

Field Screens – Fertilizers Tab

39. *Fertilizers:* On this tab, you can enter up to four fertilizers to be applied to this field in the plan year. You'll be selecting fertilizers from the list housed on the Fertilizers library screen.

40. *Entering Fertilizer Application Data:*

Fertilizer Name: As in the Manure Use screen, you'll be choosing soil fertility amendments for application in the Allocation screen. In some cases, perhaps depending on crop (notice the crop summary on the bottom of the Fertilizers screen), knowledge of past management, etc., you'll know what fertilizer material(s) a particular field should receive. **In most cases, though, fertilizer selection should be made on the Allocation Screen, where the crop nutrient requirement can be assessed.**

Planned Application Rate: **Wait to select the application rate on the Allocation screen while you're balancing the field's nutrient requirements.** The rate of fertilizer application is used in the Phosphorus Index calculation.

Timing: If a Fertilizer Name is not chosen, you won't be able to input a Timing. If fertilizer has been chosen, depending on the crop and your knowledge of the field, you may be able to assume a timing of application on the Fields—Fertilizers tab before consulting the Allocation screen. Regardless of whether a fertilizer material and rate are chosen on the Allocation screen or the Fields—Fertilizer tab, the timing of application will need to be selected from the Field—Fertilizer tab. The timing of fertilizer application is used in the Phosphorus Index calculation.

Application Method: If a Fertilizer Name is not chosen, you won't be able to input an Application Method. If fertilizer has been chosen, depending on the crop, your knowledge of field management, etc., you may be able to assume an application method at this point. Otherwise, you can toggle back to the Fields—Fertilizers tab from the Allocation screen. The method of fertilizer application is used in the Phosphorus Index calculation.

Save plan.

Field Screens – Phosphorus Index Factors Tab

41. *Phosphorus Index Factors:* This tab collects information used with other entered data to rank the fields according to their risk of P losses via the Phosphorus Index. The following remaining information is necessary to calculate the Phosphorus Index: Soil Erosion –RUSLE (tons/acre), Proximate Waterbody Type, Predominant Flow Distance to Blue Line Stream or Equivalent, Soil Drainage Class, Flooding Frequency, and presence of Concentrated Flows.

42. *Entering Phosphorus Index Factors:* **Enter the remaining information necessary to calculate the Phosphorus Index from Table 14.22:**

Table 14.22

Field ID	Soil Erosion RUSLE	Watercourse (Intermittent or Perennial)	Flow Distance to Watercourse (ft)	Soil Drainage Class	Flooding Frequency	Concentrated Flows (Y/N)
3982.01	1.1	I	1500	MWD	Rare	N
3982.02	1.5	I	1300	MWD	Rare	N
3982.03	1.5	I	65	MWD	Rare	N
3982.04	1.4	I	4500	MWD	Rare	Y
3982.05	1.0	I	110	WD	Rare	N
3982.06	1.7	P	1350	MWD	Rare	Y
3982.07	2.2	P	400	MWD	Rare	Y
3982.08	1.0	P	130	WD	Rare	N
3982.09	1.0	P	1300	SPD	Rare	N
628.10	2.2	P	850	MWD	Rare	Y

Save plan.

14.11 Allocation Screen

Allocation Screen – General Information

43. *Allocation:* The Allocation Screen is the step in the nutrient management plan where the farm's spatial nutrient balance is created. Considering the crop nutrient requirements, available manure, and risk indices (Phosphorus Runoff Index and Nitrate Leaching Index), you'll assign the source and rate of manure applications and rates of fertilizer applications for each field on this screen. The table at the top of the screen titled Manure Summary shows the quantity of manure available for application, the current quantity allocated to the fields and the difference between the two for each manure source and for the whole farm. The Field Nutrient Balance table is where you balance the crop nutrient requirements for each field with nutrients from manure and fertilizer. All cells allowing data entry are shaded yellow. **Your basic goals in the Allocation screen are to optimally:**

1. **Meet crop nutrient guidelines on a field-by-field basis by allocating manure and/or fertilizer at achievable rates on the farm.**

2. **Allocate all of the farm's manure across the land base (otherwise you may need to reconsider the Amount Exported from System Annually option on the Manure screen).**
3. **Minimize the risk of nutrient losses via runoff, erosion, and leaching, as indicated by the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index, respectively.**

Refer to the Nitrogen, Phosphorus, and Potassium management sections in the Help for a better understanding of the Nutrient Management concepts applied in Cropware.

Allocation Screen – Configuring the Allocation Screen

44. *Configuring the Allocation Screen:* You can change what information is displayed on the Allocation screen in order to best suit your nutrient balancing efforts. You'll likely develop your own preferences, but to get a feel for the screen, consider the following.

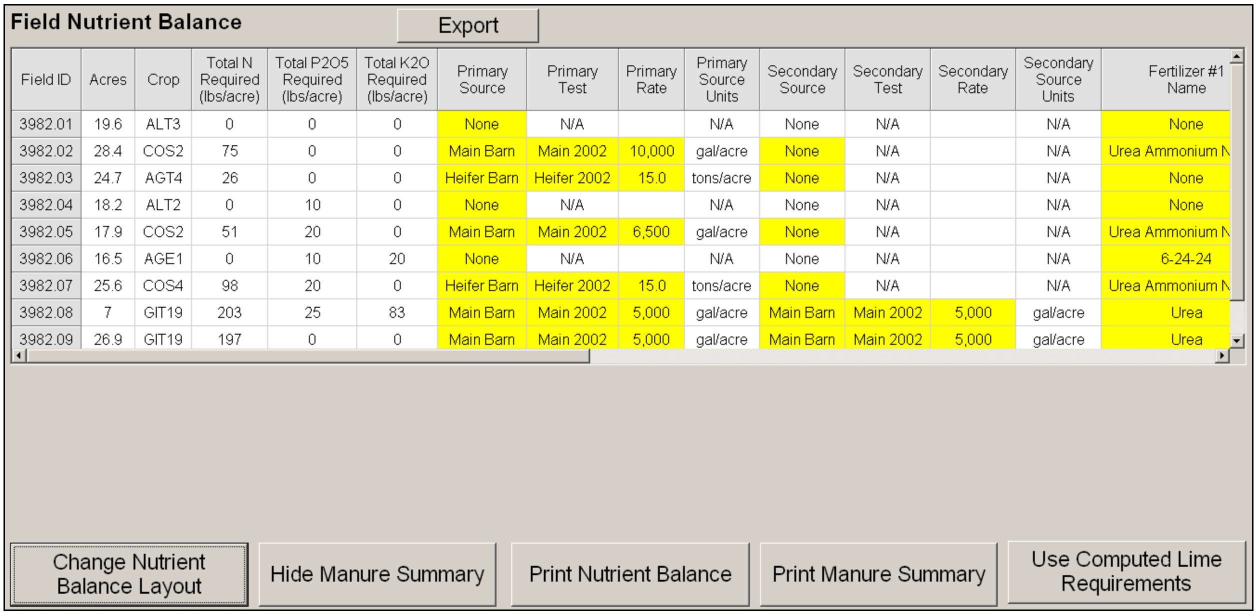
Manure Summary: The Manure Summary is helpful to consider while allocating manure in order to monitor manure inventories. The Manure Summary values will include changes made to the Field Nutrient Balance table when the **Update NMP** button is clicked. To have the Manure Summary updated after each entry, check the **Update NMP with Each Change** box. However, selecting this option will slow down the Allocation screen operation. **The Manure Summary can be hidden to expand the view of the Field Nutrient Balance table, by clicking on the "Hide Manure Summary" button. Try this. Then click on the "Show Manure Summary" button to re-display the Manure Summary, as in Figure 14.17 below.**

Manure Summary Export

	Total Tons	Total Gal	Main Barn	Heifer Barn
Manure Available For Application	900.00	851,079	851,079 gal	900.00 tons
Manure Allocated	882.00	824,350	824,350 gal	882.00 tons
Manure Balance	18.00	26,729	26,729 gal	18.00 tons

Figure 14.17

Field Nutrient Balance: On this screen you can decide the rate, source, and test of manure to be applied, the rate of up to four fertilizers to be applied, and whether any comments should be assigned to a given field (see yellow input columns). All inputs should be entered on a "per acre" basis. To assist such decisions, you can choose the columns of data to view on the Field Nutrient Balance Table.



Field Nutrient Balance

Export

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units	Secondary Source	Secondary Test	Secondary Rate	Secondary Source Units	Fertilizer #1 Name
3982.01	19.6	ALT3	0	0	0	None	N/A		N/A	None	N/A		N/A	None
3982.02	28.4	COS2	75	0	0	Main Barn	Main 2002	10,000	gal/acre	None	N/A		N/A	Urea Ammonium N
3982.03	24.7	AGT4	26	0	0	Heifer Barn	Heifer 2002	15.0	tons/acre	None	N/A		N/A	None
3982.04	18.2	ALT2	0	10	0	None	N/A		N/A	None	N/A		N/A	None
3982.05	17.9	COS2	51	20	0	Main Barn	Main 2002	6,500	gal/acre	None	N/A		N/A	Urea Ammonium N
3982.06	16.5	AGE1	0	10	20	None	N/A		N/A	None	N/A		N/A	6-24-24
3982.07	25.6	COS4	98	20	0	Heifer Barn	Heifer 2002	15.0	tons/acre	None	N/A		N/A	Urea Ammonium N
3982.08	7	GIT19	203	25	83	Main Barn	Main 2002	5,000	gal/acre	Main Barn	Main 2002	5,000	gal/acre	Urea
3982.09	26.9	GIT19	197	0	0	Main Barn	Main 2002	5,000	gal/acre	Main Barn	Main 2002	5,000	gal/acre	Urea

Change Nutrient Balance Layout | Hide Manure Summary | Print Nutrient Balance | Print Manure Summary | Use Computed Lime Requirements

Figure 14.18

Click on the "Change Nutrient Balance Layout" button to show or hide columns on the table. Scroll through the pop-up box to see the options. To start with, choose the "Restore Defaults" button to display the default set of data columns. Click OK. Scroll laterally within the "Field Nutrient Balance" to view all of the default data columns.

Next, right-click on the "Crop" column heading and choose "Sort by Ascending Order". This option will alpha-numerically sort the data in the selected column. This may be helpful if you'd like to, for instance, arrange all of the corn fields in a single view for nutrient allocation. The column order is returned to the default order, based on the Field ID, once you leave and return to the Allocation screen.

Click OK. Scroll laterally within the Field Nutrient Balance to view all of the recently added columns.

Next, right-click on the "Crop" column heading and choose "Sort by Ascending Order". This option will alpha-numerically sort the data in the selected column. This may be helpful if you'd like to, for instance, arrange all of the corn fields in a single view for nutrient allocation. The column order is returned to the default order, based on the Field ID, once you leave and return to the Allocation screen.

Allocation Screen – Allocating Manure and Fertilizer to Fields

45. *Allocating Manure and Fertilizer to Fields:* Based your characterizations of the farm fields and the quantities and nutrient contents of the farm manures, you are now ready to allocate manure and fertilizer nutrients to fields. **Find field 628.10 in the "Field**

Nutrient Balance" table. Do the nutrient requirements match those in Figure 14.19 below?

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)
3982.01	19.6	ALT3	0	0	0
3982.02	28.4	COS2	75	0	0
3982.03	24.7	AGT4	26	0	0
3982.04	18.2	ALT2	0	10	0
3982.05	17.9	COS2	51	20	0
3982.06	16.5	AGE1	0	10	20
3982.07	25.6	COS4	98	20	0
3982.08	7	GIT19	203	25	83
3982.09	26.9	GIT19	197	0	0
628.10	8.5	COS3	100	30	0

Figure 14.19

Now scroll to the right and notice the Nutrient Balance columns, as shown in Figure 14.20.

Field ID	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	0	0	0
3982.02	-75	0	0
3982.03	-26	0	0
3982.04	0	-10	0
3982.05	-51	-20	0
3982.06	0	-10	-20
3982.07	-98	-20	0
3982.08	-203	-25	-83
3982.09	-197	0	0
628.10	-100	-30	0

Figure 14.20

For N, P_2O_5 and K_2O, the difference between the sum of nutrients supplied by manure and fertilizer applications and the Total Nutrients Required is calculated in the Nutrient Balance columns. If the manure and fertilizer nutrient contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrient contributions are less than the nutrients required, the difference will be displayed in this column as a negative number. Because you haven't allocated any manure or fertilizer nutrients, yet, many balance values are negative. **Consult the Nutrient Balance columns as you allocate manure and fertilizer nutrients to a particular field. So how to satisfy the nutrient requirement for field 628.10 with fertilizer and/or manure?**

Fertilizer Allocation for Field 628.10: Field 628.10 will be planted to third year corn and requires 100 lbs/acre N, 30 lbs/acre P_2O_5, and no K_2O. According to current guides for starter fertilizer use, a response can almost always be seen from 10-30 lbs/acre of nitrogen fertilizer in the starter band. Next, if the phosphorus requirement is 20 lbs/acre of P_2O_5 or less (indicating a High or Very High soil test phosphorus classification, corn yields are not likely to respond to phosphorus in the starter band. If the P requirement exceeds 20 lbs/acre P_2O_5 (indicating a Medium to Very Low soil test phosphorus level from the Cornell Nutrient Analysis Lab), apply 20 lbs/acre P_2O_5 in the starter band and balance the remaining P_2O_5 requirement with manure. Visit the Nutrient Management Spear Program website for the latest research on Starter Phosphorus management (http://nmsp.css.cornell.edu/projects/starterp.asp). The potassium requirement can come from manure or fertilizer, banded or broadcast.

Therefore, select a starter fertilizer and rate for Fertilizer #1 on field 628.10 that will supply ~10-30 lbs/acre N, ~20 lbs/acre P_2O_5, and 0 lbs/acre K_2O. To do this, scroll to the "Fertilizer #1 Name" column and select a starter fertilizer from the drop-down menu (remember that this list fertilizers was created on the Fertilizers screen). Since this farmer can apply liquid starter fertilizers through the corn planter, **choose 21-17-0. Next enter 9 gal/acre in the "Fertilizer #1 Rate" column for field 628.10, as shown in Figure 14.21.**

Field ID	Fertilizer #1 Name	Fertilizer #1 Formulation (N:P:K)	Fertilizer #1 Rate	Fertilizer #1 Units	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	None	N/A	N/A	N/A	0	0	0
3982.02	None	N/A	N/A	N/A	-75	0	0
3982.03	None	N/A	N/A	N/A	-26	0	0
3982.04	None	N/A	N/A	N/A	0	-10	0
3982.05	None	N/A	N/A	N/A	-51	-20	0
3982.06	None	N/A	N/A	N/A	0	-10	-20
3982.07	None	N/A	N/A	N/A	-98	-20	0
3982.08	None	N/A	N/A	N/A	-203	-25	-83
3982.09	None	N/A	N/A	N/A	-197	0	0
628.10	21-17-0	21:17:0	9	gal/acre	-79	-13	0

Figure 14.21

Notice that the "N Balance" and "P_2O_5 Balance" have decreased to –79 lbs/acre and –13 lbs/acre, respectively.

As a note, rates for liquid fertilizers are entered in gal/acre. The Density value entered on the Fertilizers library screen is then used to calculate the lbs/acre of N, P_2O_5, and K_2O supplied by the given volume of liquid fertilizer in the following manner:

N: (9 gal/acre) x (11.3 lbs/gal) x (21%N) = 21 lbs/acre N
P_2O_5: (9 gal/acre) x (11.3 lbs/gal) x (17% P_2O_5) = 17 lbs/acre P_2O_5
K_2O: (9 gal/acre) x (11.3 lbs/gal) x (0% K_2O) = 0 lbs/acre K_2O

Now toggle to the Fields—Fertilizers screen and select "May-Aug" for the Timing and "Subsurface Banded" for the Application Method as shown in Figure 14.22 below. This will complete the Phosphorus Index inputs for this fertilizer application.

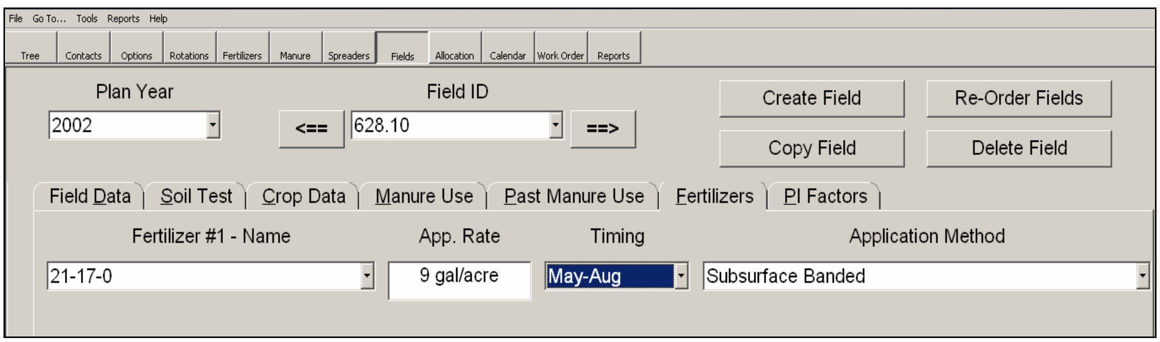


Figure 14.22

Manure Allocation for Field 628.10: Depending on manure quantities and environmental risk indices, the remainder of the nutrient requirement may be supplied by manure. Cropware 2.0 enables the user to choose up to two manure applications per field per plan year. For instance, the user can plan two applications each from a different source, application method, timing, and/or rate. This operates under the assumption that each application covers the entire field. Planning with two manure sources enables the plan to better reflect field operations and more site-specifically define applications relative to the conservation of ammonia-N in manure and the Phosphorus Index.

As an example of one option for allocating manure to field 628.10, scroll all the way to the left to view the "manure" columns. Click in the common "Primary Source" cell for field 628.10 and select the Heifer Barn from the drop-down list. Next, select the Heifer 2002 Manure Test and enter a rate of 15 tons/acre, as shown on Figure 14.23.

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units
3982.01	19.6	ALT3	0	0	0	None	N/A		N/A
3982.02	28.4	COS2	75	0	0	None	N/A		N/A
3982.03	24.7	AGT4	26	0	0	None	N/A		N/A
3982.04	18.2	ALT2	0	10	0	None	N/A		N/A
3982.05	17.9	COS2	51	20	0	None	N/A		N/A
3982.06	16.5	AGE1	0	10	20	None	N/A		N/A
3982.07	25.6	COS4	98	20	0	None	N/A		N/A
3982.08	7	GIT19	203	25	83	None	N/A		N/A
3982.09	26.9	GIT19	197	0	0	None	N/A		N/A
628.10	8.5	COS3	100	30	0	Heifer Barn	Heifer 2002	15.0	tons/acre

Figure 14.23

After choosing the starter fertilizer and 15 tons of Heifer Barn manure, field 628.10 still requires 52 lbs of N to meet the crop requirement (see "N Balance" column). **Click into the "Secondary Source" column for field 628.10 and enter an amount of Main Barn manure until the N Balance is roughly zero.**

How much did you allocate?…10,000 gallons/acre.
What is the P_2O_5 balance?…196 lbs/acre.
How about the K_2O balance?…370 lbs/acre. Why such an imbalance?
The rate(s) of manure application(s) entered on the Allocation screen is used in the Phosphorus Index ratings. What are the Phosphorus Index scores now?

Click on the "Update NMP" button to update the manure inventories for the Heifer Barn and Main Barn. The allocation of 15 tons/acre form the Heifer Barn and 10,000 gallons/acre from the Main Barn to field 628.10 (8.5 acres) amounts to 127.5 tons of Heifer Barn manure and 85,000 gallons of Main Barn manure.

Fertilizer and Manure Allocation for the Entire Farm: You've now balanced one field**. Realizing that the nutrient management plan requires an integration of all fields and all manure sources, enter the following manure and fertilizer data from Table 14.23 into the Allocation Screen.** Keep an eye on the changes in the Manure Balance, Nutrient Balances, the Phosphorus Index ratings, and whether the application is appropriate relative to the Nitrate Leaching Index. As you choose what manure to apply to what fields, you also may want to keep in mind the number of months of storage for a given manure source, the window when a field is open for manure application, the consistency of the manure, the number of different application rates practical on the farm, and any equipment or labor constraints that may favor one manure over another on a particular field. For example, liquid manures often interfere less with the re-growth of hayfields than solid manures or a manure source with little storage capacity may need to be applied across a variety of fields so as to allow spreading opportunities throughout the year or the number of recommended application rates may not be currently achievable on the farm or it may be more cost effective to haul a more nutrient dense manure a greater distance.

Table 14.23

	Manure				**Fertilizer**			
Field ID	Manure Application	Manure Source	Manure Test	Manure Rate (/acre)	Fertilizer #1 Name	Fertilizer #1 Rate (/acre)	Fertilizer #2 Name	Fertilizer #2 Rate (/acre)
3982.01	Primary Secondary							
3982.02	Primary Secondary	Main Barn	Main 2002	10000 gal	UAN*	6 gal		
3982.03	Primary Secondary	Heifer Barn	Heifer 2002	15 ton				
3982.04	Primary Secondary							
3982.05	Primary Secondary	Main Barn	Main 2002	6500 gal	21-17-0	9 gal		
3982.06	Primary Secondary				6-24-24	80 lbs		
3982.07	Primary Secondary	Heifer Barn	Heifer 2002	15 ton	UAN*	6 gal	UAN	15 gal
3982.08	Primary Secondary	Main Barn Main Barn	Main 2002 Main 2002	5000 gal 5000 gal	Urea	200 lbs	Urea	130 lbs
3982.09	Primary Secondary	Main Barn Main Barn	Main 2002 Main 2002	5000 gal 5000 gal	Urea	200 lbs	Urea	130 lbs
628.10	Primary Secondary	Heifer Barn Main Barn	Heifer 2002 Main 2002	15 ton 10000 gal	21-17-0	9 gal		

*Note: UAN = Urea Ammonium Nitrate

Notice the changes in nutrient balances and Phosphorus Index ratings resulting from the additions of manure and fertilizer to the plan.

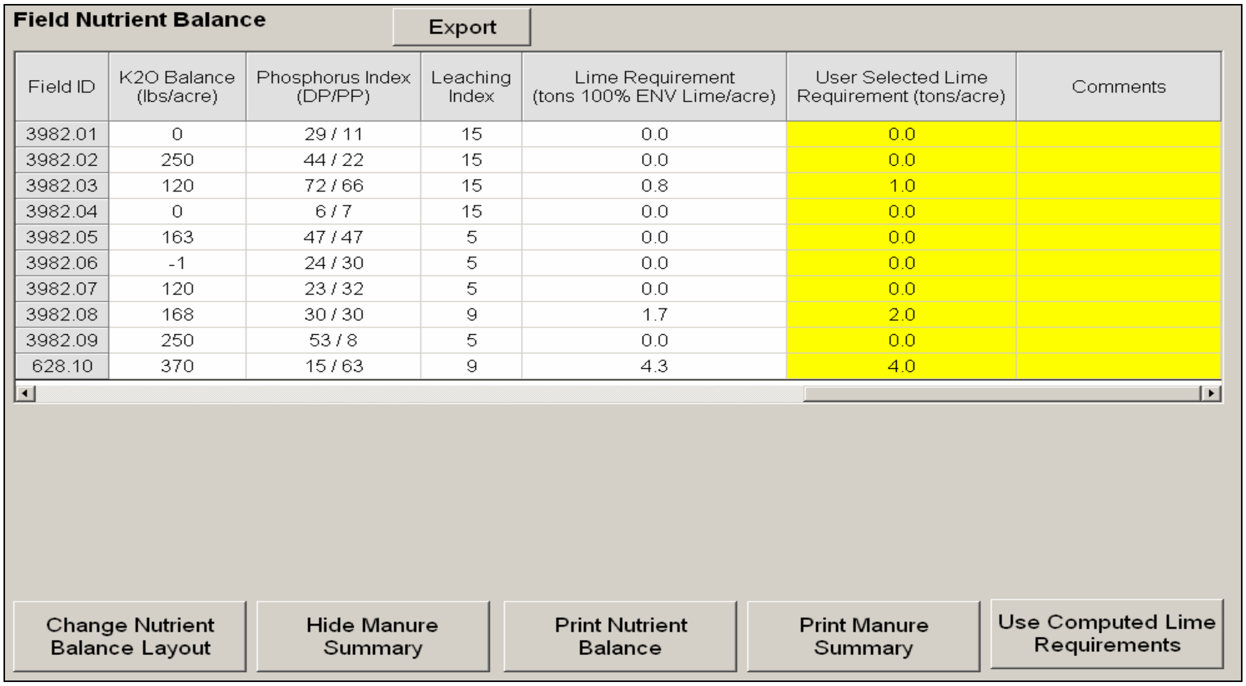
After clicking the "Update NMP" button, notice the Manure Summary, shown below as Figure 14.24. The Manure Balance is 26,729 gallons for the Main Barn and 18 tons for the Heifer Barn. The balances are near zero, so this plan is appropriate for the daily spread operation, which cannot carry over manure to the next plan year.

	Total Tons	Total Gal	Main Barn	Heifer Barn
Manure Available For Application	900.00	851,079	851,079 gal	900.00 tons
Manure Allocated	882.00	824,350	824,350 gal	882.00 tons
Manure Balance	18.00	26,729	26,729 gal	18.00 tons

Figure 14.24

You can print the Manure Summary or Nutrient Balance with the appropriate "Print" button on the lower right portion of the Allocation Screen. Similarly, each grid can be exported to an .rtf file (compatible with Microsoft Word®) by clicking on the appropriate "Export" button.

46. *Allocating Lime to Fields:* Lime guidelines, based on crop, current soil test, soil type, and tillage depth, are provided on the Allocation screen as well. The lime requirement is not modeled between soil samples, but instead based on the actual soil analysis. **Scroll to the far right on the Allocation screen and notice the "Lime Requirement" and "User Selected Lime Requirement" columns.** Computed lime guidelines for 100% ENV lime are provided in the "Lime Requirement" column. The user must choose the rate of 100% ENV lime to be applied for the current plan year in the "User Selected Lime Requirement" column. This can be accomplished by entering lime guidelines directly in the column or by clicking the "Use Computed Lime Requirement" button in the lower left corner of the screen. **Enter the User Selected Lime Requirements as shown in Figure 14.25, below.**



Field ID	K2O Balance (lbs/acre)	Phosphorus Index (DP/PP)	Leaching Index	Lime Requirement (tons 100% ENV Lime/acre)	User Selected Lime Requirement (tons/acre)	Comments
3982.01	0	29 / 11	15	0.0	0.0	
3982.02	250	44 / 22	15	0.0	0.0	
3982.03	120	72 / 66	15	0.8	1.0	
3982.04	0	6 / 7	15	0.0	0.0	
3982.05	163	47 / 47	5	0.0	0.0	
3982.06	-1	24 / 30	5	0.0	0.0	
3982.07	120	23 / 32	5	0.0	0.0	
3982.08	168	30 / 30	9	1.7	2.0	
3982.09	250	53 / 8	5	0.0	0.0	
628.10	370	15 / 63	9	4.3	4.0	

Figure 14.25

47. *Allocation Screen What If's:* So much of the balancing done on the Allocation screen depends on your definition of manure sources and fields from the previous screens. Take a moment to assess the effects of individual inputs on the nutrient management plan developed in this tutorial.

    Effect of % Legume in Sod on Crop N Requirement: **Considering field 3982.05, notice the "Total N Requirement" (51 lbs/acre) for the 2nd year corn field on the Allocation screen. Toggle to field 3982.05 on the Fields—Field Data screen and change the "Past or Present Sod" input from "1-25% Legume" to "+50% Legume". Flip to the Allocation screen and note the new Total N Requirement.** Any difference? If so, why?

    Effect of Soil Test P Level on Crop P_2O_5 Requirement: **Continuing with field 3982.05, return the "Past or Present Sod" input to "1-25% Legume". Move to the Fields—Soil Test screen and switch the "Soil Test P" value to 3 lbs/acre P and toggle to the Allocation screen to assess the "Total P Requirement". Repeat this progression for the following Soil Test P values: 7, 20, 45, and, finally, return back to the original 11 lbs/acre.**

    Effect of Years Since Sod on Crop N Requirement: **Continuing with field 3982.05, move to the Fields—Crop Data screen. Click on 2001, such that the crop rotation sequence rolls, making 2002 1st year COS after AGT. Toggle to the Allocation screen and assess the new "Total N Requirement".** Any difference? If so, why?

Effect of Manure Application Method on Application Rate to Satisfy Crop N requirement: **Continuing with field 3982.05, go to the "Fields—Crop Data screen" and roll the crop rotation sequence back to the original setting, making 2002 2nd year COS after AGT. Now, switch to the Fields—Manure Use screen and make sure the Application Method is "Top Dress or Incorporated After 5 Days". Go to the Allocation screen and note the "N Balance (lbs/acre)". Toggle back to the Fields—Manure Use screen and switch the Application Method to "Spring Incorporation Within 1 Day". Go to the Allocation screen and note the "N Balance (lbs/acre)" now.** *Any difference? If so, why?*

Effect of Manure Application Method on Phosphorus Index Rating: **Continuing with field 3982.05, while in the Allocation screen, note the Phosphorus Index ratings (DP and PP). Now, go to the Fields—Manure Use screen and change the Application Method back to "Top Dress or Incorporated After 5 Days". Toggle back to the Allocation screen and note the updated Phosphorus Index ratings (DP and PP).** *Any difference? If so, why?*

Effect of Manure Application Timing on Phosphorus Index Rating: **Continuing with field 3982.05, go to the Fields—Manure Use screen and set the Application Timing to "May-Aug". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP). Now, go back to the "Fields—Manure Use" screen and change current Application Timing to "Feb-Apr". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP).** *Any difference? If so, why?*

14.12 Calendar Screen

Calendar Screen – General Information

48. *Calendar:* The Calendar screen acts as a worksheet to budget the timing of manure applications across the Plan Year. An important consideration in the development of a nutrient management plan is determining whether the applications of manure planned on the Allocation screen are feasible given temporal constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor, machinery, or manure storage available to spread all the manure between corn harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides a Calendar with a running manure inventory to plan the timing of manure applications for each month of the year.

Calendar Screen – Temporally Planning Manure Applications with the Calendar

49. *Temporally Planning Manure Applications with the Calendar:* A calendar worksheet is created for all manure sources on the farm for each plan year as well as for individual manure sources. **Enter the Calendar screen. Your basic goals in the Calendar screen**

are to allocate the "Planned Quantity" of manure <u>per field</u> (*not* per acre) across un-shaded months, such that:

1. **The "Quantity Difference" <u>per field</u> is zero.**
2. **The "Ending manure Inventory" <u>per month</u> is greater than or equal to zero, but less than the manure storage capacity (if any) associated with the selected manure source.**
3. **The "Phosphorus Index" ratings are best minimized.**

All of the variables above can be adjusted on the Calendar screen. See Figure 14.26 for the basic layout of the Calendar screen.

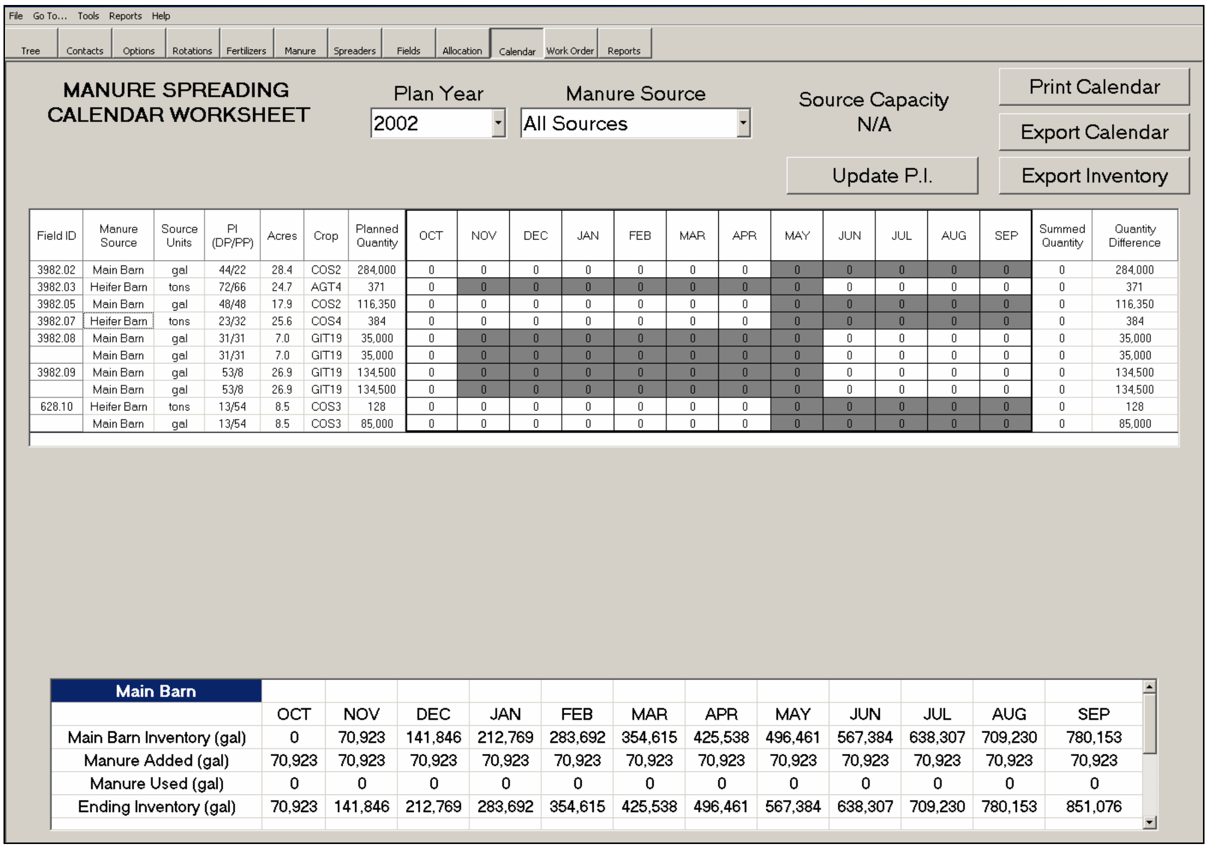


Figure 14.26

The manure inventory grid at the bottom of the screen is scrollable to show the running manure inventories for all sources on the farm. The quantities in the "Manure Added" row of the inventory grid can be adjusted on a monthly basis to reflect different amounts of manure produced by the manure source throughout the year, for instance on a grazing farm. The default values are calculated by dividing the total amount of manure produced annually from the Manure—Manure Source Data screen by 12, the number of months in a plan year. The default values may be changed in the "Manure Added" row, with the balance of the annual manure production kept in the last month of the plan year (September in the case above). Likewise, if the "Estimate Using Number and Average Weight of Manure Applications" method was used to determine the annual amount of manure produced on the Manure—Manure Source Data screen, then those values entered for each month will populate the respective months of the "Manure Added" row of the Calendar screen. Such values can still be adjusted on the Calendar screen. For this tutorial, assume that equal amounts of manure are added to the systems each month.

Quantity Difference and Ending Manure Inventory Considerations: **Find the Calendar row for field 628.10 in Figure 14.26, above. Remember that we allocated manure from both the Heifer Barn and the Main Barn to this field. You'll notice that the "Planned Quantity" of manure for this field is 128 tons from the Heifer Barn and 85,000 gallons from the Main Barn. The ending inventories are 75 tons for the Heifer Barn and 70,923 gallons for the Main Barn.** Note the zero gallon value in the "Main Barn Inventory" and "Heifer Barn Inventory" at the beginning of October. Since this is a daily spread system, no manure is carried over from the previous plan year, as defined in the "Manure Balance" cell on the Allocation screen for the last plan year and then the "Amount at Start of Plan Year" cell on the Manure screen for the current plan year. **Enter the amounts of manure for the Heifer Barn according to Table 14.24 below.**

Table 14.24

Field ID	Manure Source	OCT (tons)	NOV (tons)	DEC (tons)
628.10	Heifer Barn	75	53	
	Main Barn			

Since this is a daily spread system, the ending inventory at the end of each month should be zero. **For the months of October through November, are the Ending Inventories all zero?** If not, additional Heifer Barn Manure will need to be allocated to another field. **Has the entire Planned Quantity of manure been allocated for the field?** If not, additional manure will need to be allocated to that field during another month. **Complete the Calendar with the following allocations.**

Table 14.25

Field ID	Manure Source	Source Units	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
3982.02	Main Barn	gal	70,923	70,923	70,923	70,923	0	0	0	0	0	0	0	0
3982.03	Heifer Barn	tons	0	0	0	0	0	0	0	0	163	75	75	58
3982.05	Main Barn	gal	0	0	0	0	70,923	45,427	0	0	0	0	0	0
3982.07	Heifer Barn	tons	0	22	75	75	75	75	62	0	0	0	0	0
3982.08	Main Barn	gal	0	0	0	0	0	0	0	35,000	0	0	0	0
	Main Barn	gal	0	0	0	0	0	0	0	0	0	35,000	0	0
3982.09	Main Barn	gal	0	0	0	0	0	0	0	47,342	70,923	16,235	0	0
	Main Barn	gal	0	0	0	0	0	0	0	0	0	19,688	70,923	43,889
628.10	Heifer Barn	tons	75	53	0	0	0	0	0	0	0	0	0	0
	Main Barn	gal	0	0	0	0	0	25,496	59,504	0	0	0	0	0

Once entered on the Calendar, notice that the "Quantity Difference" for each field is nearly zero, except for field 3982.02. This means that not quite all the manure planned in the Allocation screen will be applied to this field. In fact, if you sum the Quantity Difference Column and subtract the sum from the ending manure inventory in September, you'll arrive at the Manure Balance for the Main Barn on the Allocation Screen.

Also, note the "Ending Inventories" for each manure source in the Figure 14.27, below. Field accessibility dictated that an ending inventory be carried for each source around the months of April and May. Therefore, a temporary manure pile strategy would need to be set in motion on the farm. The Calendar screen is helpful in assessing the feasibility of the manure management plan, thereby highlighting opportunities to change the system for more flexibility and efficiency, in terms of both production and environmental management.

Main Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Main Barn Inventory (gal)	0	0	0	0	0	0	0	11,419	0	0	0	0
Manure Added (gal)	70,923	70,923	70,923	70,923	70,923	70,923	70,923	70,923	70,923	70,923	70,923	70,923
Manure Used (gal)	70,923	70,923	70,923	70,923	70,923	70,923	59,504	82,342	70,923	70,923	70,923	43,889
Ending Inventory (gal)	0	0	0	0	0	0	11,419	0	0	0	0	27,034

Heifer Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	0	0	0	0	0	0	0	13	88	0	0	0
Manure Added (tons)	75	75	75	75	75	75	75	75	75	75	75	75
Manure Used (tons)	75	75	75	75	75	75	62	0	163	75	75	58
Ending Inventory (tons)	0	0	0	0	0	0	13	88	0	0	0	17

Figure 14.27

The Calendar screen is helpful in assessing the feasibility of the manure management plan, thereby highlighting opportunities to change the system for more flexibility and efficiency, in terms of both production and environmental management.

Calendar Screen – Phosphorus Index Considerations

50. *Phosphorus Index Considerations:* The more temporally specific plan developed in the Calendar screen can be used to update the "Timing" variable for manure applications for the Phosphorus Index. **By clicking on the "Update P.I." button and confirming that you want to change the manure application timing setting for all of the fields, you'll be setting the manure application "Timing" on the Fields—Manure Use screen to correspond with the timings set on the Calendar screen. Based on this change, the Phosphorus Index ratings displayed on both the Allocation and Calendar screens will be updated.**

The manure application timing for the Phosphorus Index is defined for each application (i.e. primary, secondary) within the following four periods, representing the lowest to highest risk of phosphorus loss: "May-Aug", "Sep-Oct", "Nov-Jan", and "Feb-Apr". If a timing defined on the Calendar screen spans two or more periods, Cropware will define the timing for the application to the range of months that represents the highest risk according to the Phosphorus Index. If two manure application events are planned for a field, the timing will be defined for each application and combined to calculate a single Dissolved Phosphorus Index rating and Particulate Phosphorus Index Rating for the entire field.

After clicking the Update P.I. button, the following timings in Table 14.26 should now be present on the Fields—Manure Use screen.

Table 14.26

Field ID	Primary Application Timing	Secondary Application Timing
3982.01	Choose any -- No manure applied	Choose any -- No manure applied
3982.02	Nov-Jan	Choose any -- No manure applied
3982.03	Sep-Oct	Choose any -- No manure applied
3982.04	Choose any -- No manure applied	Choose any -- No manure applied
3982.05	Feb-Apr	Choose any -- No manure applied
3982.06	Choose any -- No manure applied	Choose any -- No manure applied
3982.07	Feb-Apr	Choose any -- No manure applied
3982.08	May-Aug	May-Aug
3982.09	May-Aug	Sep-Oct
628.10	Nov-Jan	Feb-Apr

You will also likely need to update the manure "Application Method" after completing the Calendar screen. The manure "Application Method" is used in the Phosphorus Index calculations and should be appropriate for the Timing of the planned manure application. Within the same Timing period, you may also wish to alter the Application Method to impact ammonia-N conservation and/or Phosphorus Index ratings. The manure Application Method can only be changed on the **Fields—Manure Use screen**. **Change the "Application Method" in the "Fields—Manure use" tab to the following, in Table 14.27.**

Table 14.27

Field ID	Primary Application Method	Secondary Application Method
3982.01	Top dress or incorporated after 5 days	Choose any -- No manure applied
3982.02	Surface app. on frozen or saturated ground	Choose any -- No manure applied
3982.03	Top dress or incorporated after 5 days	Choose any -- No manure applied
3982.04	Choose any -- No manure applied	Choose any -- No manure applied
3982.05	Surface app. on frozen or saturated ground	Choose any -- No manure applied
3982.06	Choose any -- No manure applied	Choose any -- No manure applied
3982.07	Surface app. on frozen or saturated ground	Choose any -- No manure applied
3982.08	Top dress or incorporated after 5 days	Top dress or incorporated after 5 days
3982.09	Top dress or incorporated after 5 days	Top dress or incorporated after 5 days
628.10	Top dress or incorporated after 5 days	Surface app. on frozen or saturated ground

Congratulations! You just completed the first iteration of Nutrient Management Planning with Cropware….but there's more! Up to this point in the tutorial, the Phosphorus Index has been calculated with initial estimations of manure application timing, and method. Once the Calendar screen is completed and the manure application timing and method data are updated in the Fields—Manure Use screens, you can assess a more realistic Phosphorus Index rating on the Allocation screen. Go to the Allocation screen and scroll to the "Phosphorus Index" column. Compare both the Dissolved Phosphorus (DP) Index ratings and the Particulate Phosphorus (PP) Index ratings with the Phosphorus Index ranking rubric in Table 14.28. The higher ranking of the two indices will determine the necessary management.

Table 14.28

Phosphorus Index Rating	**Site Vulnerability**	**Management**
< 50	Low	N based management
50 - 74	Medium	N based management with BMPs
75 - 99	High	P applications to crop removal
≥ 100	Very High	No P_2O_5 fertilizer or manure application

The current plan is balanced on nitrogen, so any fields in the High or Very High ranking will require either: 1) switching to phosphorus crop removal planning or no phosphorus application at all, respectively, or 2) changing field management to reduce the ranking to at least the Medium risk category. Such changes could include reducing manure and fertilizer P application rates, improving P application timing and methods, establishing within-field buffers to increase the flow distance to the nearest watercourse, adopting a different crop rotation or field configuration to reduce soil erosion, addressing a concentrated flow, etc. As you can imagine, such changes will result in a different use of manure and fertilizer relative to the first iteration, so a second iteration through the Allocation screen, Calendar screen, Fields screen, and back to the Allocation screen is necessary to update the plan (as illustrated in Figure 14.1). The first iteration of the tutorial resulted in all low and medium ranked fields, so move on to the Work Orders screen to create detailed manure application instructions and records.

14.13 Work Order Screen

Work Order Screen – General Information

51. *Work Order:* This screen is used to produce a "work order" for the person(s) applying manure. It allows you to create a tactical plan of how many loads to apply per field per month per spreader based on the completed Calendar screen. The Work Order itself, once printed, provides space for recording the number of loads actually spread and any relevant comments from the field. Once the completed Work Order is returned to the

farm office, the number of loads applied can be entered to create a Manure Application Report for the farm.

Work Order Screen – Creating a Work Order

52. *Creating a Basic Work Order:* **Enter the data in Figure 14.28 to the Work Order screen.**

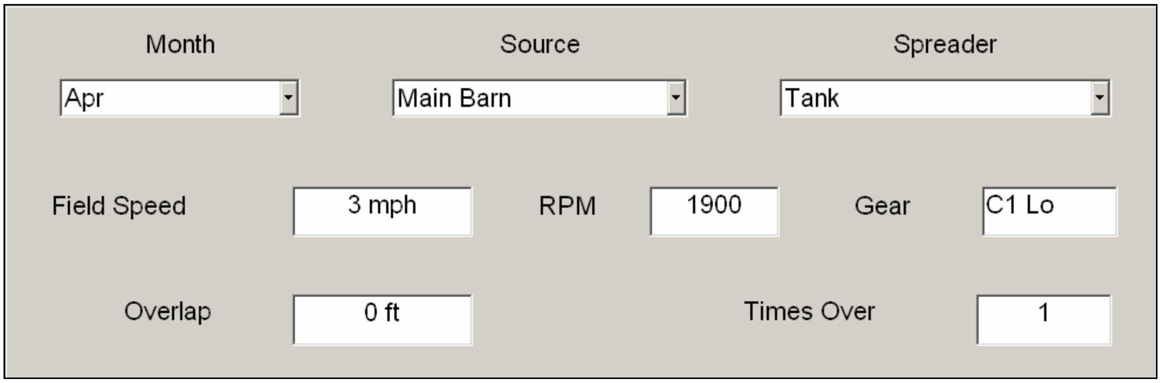


Figure 28

Spreader settings, such as Field Speed, RPM, Gear, Overlap, and Times Over can be determined by calibrating the spreader. For the month of April, field 628.10 is the only field scheduled to receive manure from the Main Barn, based on your work in the Calendar screen.

Overlap or Times Over: To determine the amount of Overlap or, similarly, the number of times to apply manure over the entire field, keep in mind the calibrated rate of the spreader and the planned rate per acre from the Allocation screen. For instance, assume that the Tank spreader settings entered in Figure 14.28 above result in a rate of 5,000 gal/acre, according to your calibration activities. The planned rate/acre for field 628.10 is 10,000 gallons, so the Tank spreader would need to apply manure two Times Over the field to achieve the planned rate. For this example, though, assume that the Tank spreader *is* calibrated for 10,000 gallons/acre, so the Times Over should be 1.

Check the "Select" box to add field 628.10 to the Work Order and add any "Site Comments". Click on "View Work Order" and a printable Work Order is created as shown in Figure 14.29 below.

Manure Application Work Order (Daily Spread Farm - 5/26/2003)

Spreader: Tank Manure Source: Main Barn Month: Apr

1. Spread At: Field Speed of 3 mph in C1 Lo Gear at 1900 RPM with 0 ft. Overlap
2. Spread evenly over entire field 1 Times Over
3. Stop spreading when Tally of Loads Applied = Loads Required

Field ID	Field Name	Acres	Site Comment	Loads Required	Driver Name	Application Date(s)	Tally of Loads Applied Per Field	Application Comments
628.10	10	9		17				

Figure 14.29

Multiple Spreaders Applying Manure to a Single Field the Same Month: Two methods exist.

1) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. Create and Print a Work Order for each spreader, outlining the spreader settings. Then multiply the "Loads Required" by the proportion of the manure handled by that spreader and manually write in the corrected Loads Required number on the printed Work Order.
2) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. To be safe, use the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized specifically for creating Work Orders. Next, go to the Calendar screen and find the field and month of interest within a given manure source. For each spreader, multiply the total quantity of manure allocated for the field during that month by the proportion of the manure to be applied by the particular spreader. Don't be concerned about the impact of such a change on the Allocation screen. Go to the Work Order screen and select the "Month", "Manure Source", and "Spreader". The "Monthly Planned Quantity" has now been updated based on your changes for that spreader in the Calendar screen. Check the "Select" box and print the work order. Repeat entire process for the remaining spreaders, unless the you assume that each spreader will apply the same proportion of the Monthly Planned Quantity, in which case you can simply select another spreader from the Spreader drop-down menu and print a Work Order.

Single Spreader Applying Manure to Different Fields with Different Spreader Settings in the Same Month: If a single spreader is used with multiple spreader settings within the same month, a Work Order for each spreader setting should be created. Choose the Month, Manure Source, and Spreader. Select the spreader settings necessary to achieve the desired rate of application, as determined by your calibration activities. Check the Select box for those fields to receive manure with the chosen spreader settings. View the Work Order and Print. Then change the spreader settings and repeat for fields requiring different rates.

Creating a Report of the Number of Loads Required for an Entire Plan Year Across All Fields: Some planners and producers will prefer to create a report of the number of loads required for a given spreader for the entire plan year across all fields receiving manure from a particular manure source. To accomplish this, choose the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized for the creating this specific report. Switch to the Calendar screen and sum all of the manure applications across the entire plan year for each manure source. Enter the totals per field into a single month column, for example October. Toggle to the Work Order screen. Select the month in which the annual totals were entered, October in this example. Select the Manure Source, Spreader, and spreader settings, if applicable to this somewhat coarse work order. Check the Select box for all of the fields and View the Work Order and Print. The month, October in this case, does not apply as this is a report for the entire plan year, so it can be manually blocked-out on the printed report. This process can be repeated for all manure sources and spreaders.

Work Order Screen – Creating a Manure Application Report

53. *Creating the Manure Application Report:* Once the person applying the manure has returned the completed Work Order, the tally of loads can be used to create a record of manure applications per month on a field-by-field basis for the Plan Year. **For example, assume that the Tank spreader was used to apply 17 loads to field 628.10 in April, per the Work Order in Figure 14.29 above. Multiply the number of loads applied (17) by the capacity per load (3500 gal found on the Spreaders screen). The resulting total is 59,500 gallons. Return to the Work Order screen and choose Apr, Main Barn, and Tank. Check the "Done" box to signal that manure applications are finished on field 628.10 for the month and enter 59,500 gallons into the teal-shaded "Quantity Applied" column. A running total of the amount of manure applied to field 628.10 in April with the Tank spreader is kept in the "Total Quantity Applied" column. Click on "View Manure Application Report". You'll notice that 59,500 gallons of manure have been recorded for field 628.10 in April.**

14.14 REPORTS

Reports – Cover Page

54. *Cover Page Report:* **Go the Reports screen and check the "Cover Page" box. Click on "View Report" and Print.**

Reports – Custom Report

55. *Custom Report:* Use the Custom Report option to create reports to your specifications. **De-select the "Cover Page" box and check the "Custom Report" box. Click on**

"View Report, "Settings", and the "Custom Report" tab. Gain experience in building custom reports by working through the following examples.

Create a Simple Recipe for Implementation: **Click Clear All under "Report Fields" and check the following items:**

Field ID, Acres, Current Crop, Fertilizer #1 Name, Fertilizer #1 Units, Fertilizer #1 Rate, and Fertilizer #1 Applied.

"Highlight Fertilizer #1 Rate" and using the large Up arrow, shift the highlighted item up the list or above "Fertilizer #1 Units". This changes the column order of items from left to right across the Custom Report. Re-check the "Fertilizer #1 Rate", if necessary.

Save Report Settings: Once you've created a useful Custom Report, you can save it as a template for use with other nutrient management plans on other farms. The selected data columns, sorts, queries, formats, etc. will be maintained, but the data for the report will be pulled from the plan currently loaded in Cropware. **Click Save Report Settings, keep the directory as My Documents, and name the file: Fertilizer #1 Applications. Hit Save.**

Load Report Settings: **Click on Settings and within the Custom Report Tab click on the Load Report Settings button. Select the file named: Fertilizer #1 Applications.set and hit Open.** You should see your originally selected report options on the Custom Report Settings screen. **Click on Return to Reports to view the report.**

Click "Return to Reports" to view the Custom Report, as below in Figure 14.30.

Custom Report

ID	Acres	Current Crop	Fert. #1 Name	Fert. #1 Rate/acre	Fert. #1 Units	Fert. #1 Applied
3982.01	19.6	ALT	None	0	N/A	0
3982.02	28.4	COS	Urea Ammonium Nitrate	6	gal	170
3982.03	24.7	AGT	None	0	N/A	0
3982.04	18.2	ALT	None	0	N/A	0
3982.05	17.9	COS	21-17-0	9	gal	161
3982.06	16.5	AGE	6-24-24	80	lbs	1,320
3982.07	25.6	COS	Urea Ammonium Nitrate	6	gal	154
3982.08	7.0	GIT	Urea	200	lbs	1,400
3982.09	26.9	GIT	Urea	200	lbs	5,380
628.10	8.5	COS	21-17-0	9	gal	77

Figure 14.30

Export Report: **Click Export Report to save the report as a Rich Text File (.rtf) in your chosen directory.**

Print Report: **Click on the Printer icon above the report.**

Create a Custom Report Using the Primary and Secondary Sorts, Column Constraints, and Row Constraints: **Click on "Settings" and the "Custom Report" tab.** For this report you'll consider the N, P_2O_5, and K_2O requirements for each field, grouped by crop and P_2O_5 requirement. This report is helpful for developing an initial starter fertilizer plan.**Click on "Clear All" under the Report Fields menu and select the following:**

Field ID, Acres, Current Crop, N Req. (lbs/acre), P Req. (lbs/acre), K Req. (lbs/acre), and Comments

In the Primary Sort menu, type "C" to find and select "Current Crop" and in the Secondary Sort, type "P" to find and select "P Req (lbs/acre)". Sort both in ascending order, resulting in a report with groupings by current crop and, within each crop, groupings of similar P_2O_5 requirements.

Next, in the Column Constraints section, we would like to total the acres for all fields that share the same crop and P_2O_5 requirement. **Select "Acres" from the "Column to Total" drop-down menu, "Sum" in the "Function" menu, and "Current Crop" from the "Column to Group By" menu.** Checking "Show Grand Total" will total the acres across all fields as well as sub-totals per the "Columns to Group By" selection, current crop in this case. If "Only Show Grand Total" is checked, the sub-totals will not appear. **Check "Show Grand Total". Finally, make sure that the "Time Range" in the lower left corner is set to "2002" to "2002" in order to capture only the current plan year.**

In the Row Constraints, we're interested in selecting only the fields that could require a starter fertilizer (i.e. those fields to be seeded or planted this year). For this farm, we have corn silage, alfalfa grass mixes, and alfalfa that could be planted/seeded during the plan year. Therefore, in the Crops Row Constraint column, click on the following crop codes, indicating: AGE, ALE, and COS. To deselect any crop, simply click on it a second time. **At this point, the settings should resemble the screen in Figure 14.31, below.**

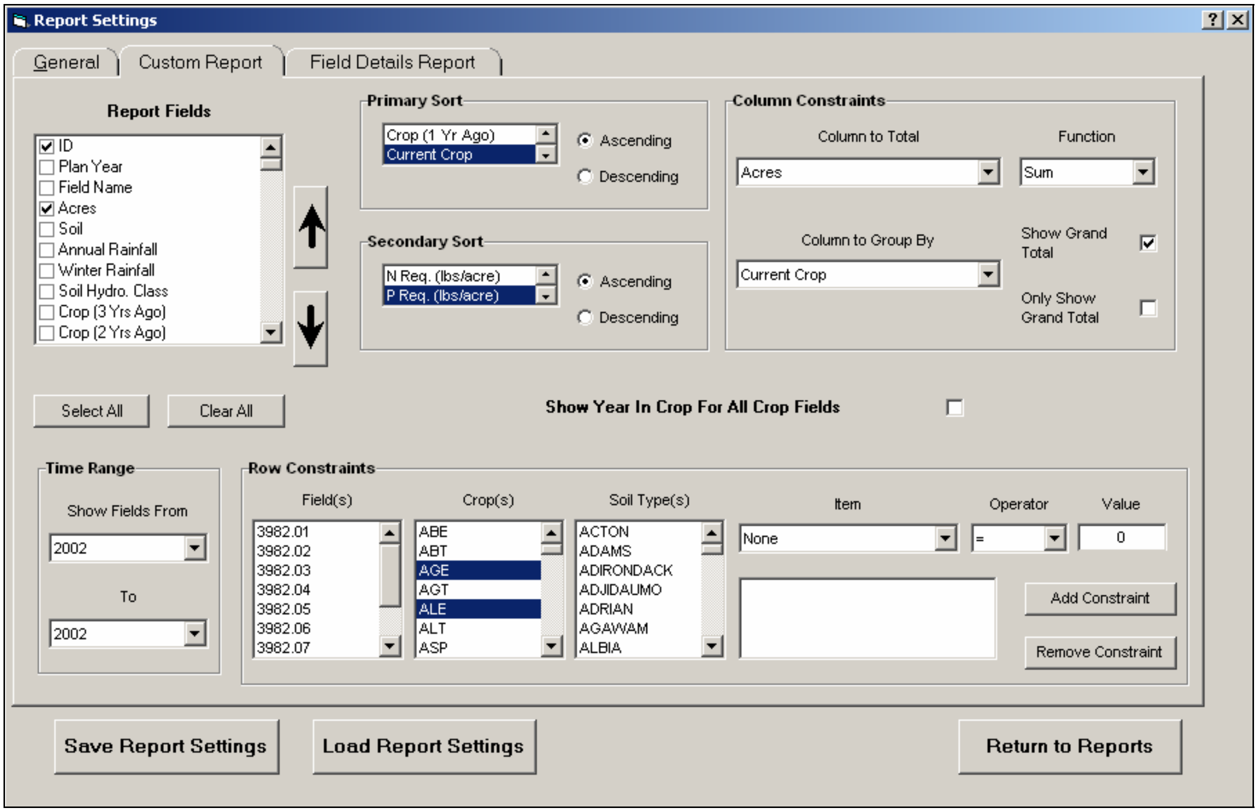


Figure 14.31

Click on "Save Report Settings", name the report template, "Starter Fertilizer Selection Aid", and save it in a file appropriate for your Cropware file management scheme (i.e. where it can be located again in the future!). Click on "Return to Reports" to view the new report, as shown in Figure 14.32.

Custom Report

ID	Acres	Current Crop	N Req. (lbs/acre)	P Req. (lbs/acre)	K Req. (lbs/acre)	Comments
3982.06	16.5	AGE	0	10	20	
	16.50					
3982.02	28.4	COS	75	0	0	
3982.07	25.6	COS	98	20	0	
3982.05	17.9	COS	51	25	0	
628.10	8.5	COS	100	30	0	
	80.40					
TOTAL	96.90					

Figure 14.32

As a note, if you check the "Show Year in Crop For All Crop Fields" as in Figure 14.33, then crop code data, such as in the "Current Crop" column in Figure 14.32, above, will be coupled with the year in crop within the rotation (i.e. COS1, ALT4, etc.).

Figure 14.33

Once printed, use the "Comments" column to write in the N-P_2O_5-K_2O fertilizer material of choice and the initial rate (lbs/acre) of application to satisfy the portion of the total nutrient requirement appropriate for starter fertilizer (refer to the Nitrogen, Phosphorus, and Potassium management sections for guidance, here). Based on your notes, choose starter fertilizer materials and rates on the Allocation screen. Now you're in a position to allocate manure and/or additional fertilizers to satisfy the remaining nutrient balance. You may also want to refine your initial starter fertilizer choices at this point.

Creating Custom Reports Using Row Constraints: The most basic use of the Row Constraint function is to build queries in order to subset the farm data. For example, to determine which fields in Plan Year 2002 have a Dissolved Phosphorus (PI-DP) Index of greater than 50, then **perform the following:**

1) **Reset the Report Fields to only include Field ID, Plan Year, Acres, Current Crop, and PI-DP.**
2) **Reset the Primary and Secondary Sorts to None.**
3) **Reset the "Column to Total" in the Column Constraints to None.**
4) **Set the "Time Range" to Show Fields From 2002 to 2002, so as to only analyze the 2002 Plan Year.**
5) **De-select any crops highlighted in the Crops row constraint.**
6) **Select PI-DP from the Item menu.**
7) **Select > from the Operator menu.**
8) **Enter 50 into the Value menu.**
9) **Click "Add Constraint".**
10) **Click Return to Reports.**

See Figure 14.34 for the set-up and Figure 14.35 for the resulting report.

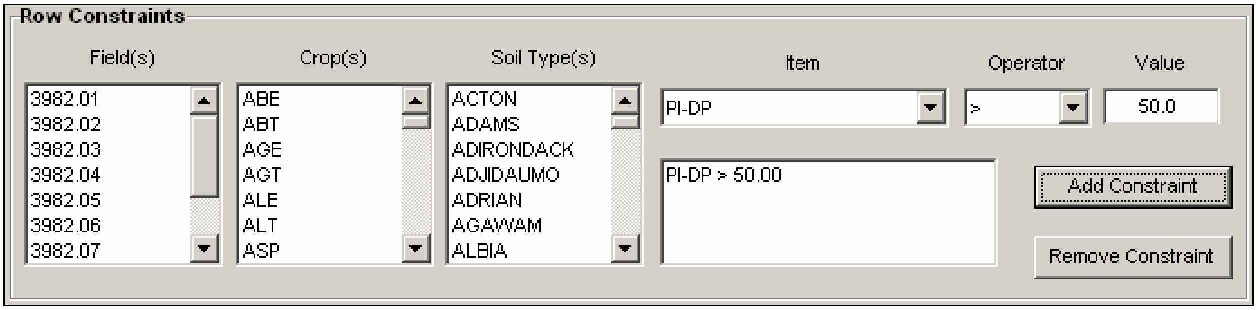


Figure 14.34

Custom Report

ID	Plan Year	Acres	Current Crop	PI-DP
3982.03	2002	24.7	AGT	72
3982.09	2002	26.9	GIT	53

Figure 14.35

Continue to experiment with creating and saving Custom Reports to assist you in planning, implementation, and evaluation of the nutrient management plan.

Reports – Crop, Livestock, and Nutrient Index Summary

56. *Crop, Livestock, and Nutrient Index Summary:* The Crop Summary component of this report provides absolute acreages and proportions of the different crops grown on the land base for the existing plan years. The Livestock Summary and Nutrient Index Summary components are helpful for quantifying changes on the farm overtime, such as increased stocking rate or farm weighted Phosphorus Index values.

Reports – Crop Plan Summary

57. *Crop Plan Summary Report:* The Crop Plan Summary Report provides the acreages of crops for the current plan year, 3 years prior, and 10 years to follow. This report is a summary of the crop rotations of individual fields defined on the Fields—Crop Data screen. Toggling between the Fields—Crop Data screen and the Crop Plan Summary report can aid in crop rotation development during the planning process. Cropware does not couple yield and dry matter measurements with the acreages of various crops. Such information can be coupled with this report to assess whether the current crop rotation plan will provide the necessary quantities of specific crops to meet herd feed requirements, while reducing soil erosion and nutrient loss.

Reports – Nutrient Balance

58. *Nutrient Balance Report:* The purpose of this report is to give the farmer and planner a broad view of the plant, soil and manure nutrient balance of the whole farm for the

current and future plan years. Changes in herd numbers, feeding management, land area, crop rotation, manure application method, manure storage, fertilizer use, etc. will impact a farm's nutrient balance over time. This report can help quantify some of those impacts and help plan a progressive future direction.

Reports – Nutrient Management Plan

59. *Nutrient Management Plan:* The Nutrient Management Plan report is a summary of the within field nutrient balance for the current Plan Year. It provides similar information as found on the Allocation screen, but is reported in a more concise manner. The report is useful for nutrient planning discussions between the farmer and the planner, because it clearly displays nutrient credits as well as how the crop nutrient requirement will be met (or not) by the application of manure and fertilizer nutrients. The reporting of the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index across all the farm fields also provides a clear picture of where additional resources may need to be focused.

Reports – Manure Analysis, Collection, and Storage

60. *Manure Analysis, Collection, and Storage:* The purpose of this report is to give a summary of the manure nutrient composition, quantity, and storage capacity for each waste source. The Manure Nutrient Analysis component is populated by the latest manure analysis for the given manure system. The Annual Nutrient Collection component reports the total annual amount of nitrogen, phosphorus, and potassium collected by a given manure system. The Waste Storage component compares the existing waste storage capacity with the annual amount of manure produced by the source, resulting in the number of months of storage available.

Reports – Manure Analyses

61. *Manure Analyses:* This report lists all of the manure analyses entered into the Manure screen. Farms with manure storage systems often couple historic manure analyses with the estimated quantity in storage to determine the manure allocation plan, because quick tests for manure nutrient composition and immediate allocation planning are not currently feasible options. This concise summary of a farm's manure analyses is helpful in calculating long-term, farm-specific average manure nutrient compositions.

Reports – Fertilizer and Manure Management Summary

62. *Fertilizer and Manure Management Summary:* The Fertilizer and Manure Management Report shows a summary of fertilizer and manure information for all of the fields. In addition to fertilizer and manure application rates, lime requirement and the latest soil sample date are also shown. The lime requirement is calculated to 100% ENV and assumes that no lime has been applied since the last soil test date.

Reports – Fertilizer Shopping List

63. *Fertilizer Shopping List:* The Fertilizer Shopping List is simply a list of the total quantity of each fertilizer used in the current year plan. This report can be used to plan fertilizer purchases or re-evaluate the fertilizer selection. For instance, if the supplier had

inadequate inventory of a given fertilizer blend, you may choose to not use that blend and, instead, purchase a different fertilizer for those fields. You can also track fertilizer material costs over the plan years.

Reports – Field Details Report

64. *Field Details Report:* Depending on the preferences of the farmer and/or planner, the Field Details Report can be used as recipe for the nutrient management of a field for the current Plan Year. A one-page report is generated for each field, providing a comprehensive summary of nutrient management inputs and recommendations for the particular field. **To view the report, check the Field Details Report within the "Select Reports" menu and click "View Report". On the following screen, click "Settings". Click the "Field Details Report" tab and check the fields of interest. Click "Return to Reports" to review the Field Details Reports for the chosen fields.**

15. CROPWARE 2.0 STORAGE FARM TUTORIAL

15.1 CROPWARE 2.0 MANURE STORAGE FARM TUTORIAL INTRODUCTION

Developing a Plan for a Farm with Manure Storage

In this tutorial, you will learn how to develop a nutrient management plan for a farm with a manure storage system using Cropware 2.0. The tutorial will provide all the data and direction necessary to build the plan from scratch, but if you would prefer to progress through the tutorial with a completed plan for the Storage Farm, the “Cropware 2.0 Storage Farm Tutorial.mdb” file can be loaded into Cropware from the Cropware CD or downloaded from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). As another alternative, if you’d like to create the nutrient management plan using only the farm data without any instruction, you can access the basic data in the “Storage Farm Tutorial (Data only).xls” file from the Cropware CD or from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu).

15.2 Basic Nutrient Management Planning Flow

Before launching into the nutrient management plan tutorial, it's helpful to look at the big picture. Figure 15.1 below outlines the basic steps involved in nutrient management planning, including characterizing sources of manure and information about the farm fields, using that information to develop agronomic and environmental nutrient guidelines (performed by Cropware), allocating manure and fertilizer to meet crop and environmental goals (this step is often iterative), and generating a plan for implementation and evaluation. It may be helpful to refer back to this flow as you progress through the nutrient management planning process with Cropware.

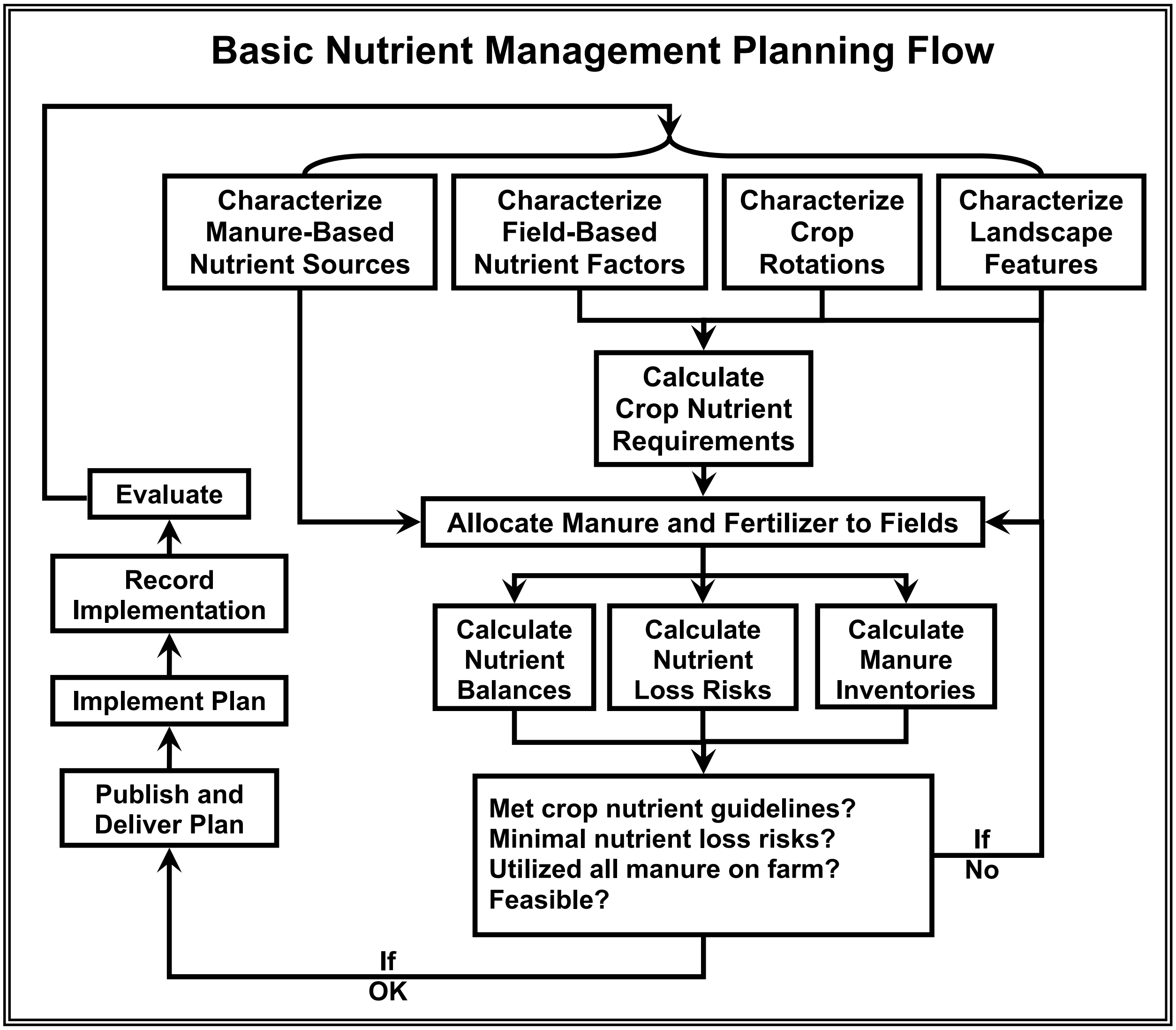


Figure 15.1

15.3 GETTING STARTED

1. *Creating the Plan:* If this is the first time you have opened Cropware, a "No Plan in Memory" alert will be displayed. Click OK. Without a plan in memory, you must click on the File menu and select either New Plan or Load Plan. To create a new plan from scratch with the information provided in this tutorial, click on New Plan, name the plan Storage Tutorial, and click on Save. Or, to load an existing plan, click on Load Plan, select "Cropware 2.0 Storage Farm Tutorial.mdb" from the Cropware CD or the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu), and click on Open.

   As an alternative, if you've created the Daily Spread Farm Tutorial with Cropware 1.0, you may convert that file to the version 2.0 format according to the following instructions: click on Tools; select "Convert Version 1.0 Plan Files to Current Version"; select the "Storage Tutorial Completed.cpw" file to convert and hit Open; next, name the converted file "Cropware 2.0 Storage Farm Tutorial.mdb"; and click Save. The previous plan file has been converted to the Cropware 2.0 format and is ready for use.

2. *Saving the Plan:* You will want to save your plan as you populate it with the information provided in the tutorial. Click on the File menu and select Save to save the plan with its current name and folder or choose Save As to change the file name, folder, and/or drive. While in the File menu, you will also notice Auto-Save Plan on Exit option. This option can be selected and de-selected depending on whether you want the plan to be automatically saved when exiting Cropware.

3. *Exiting and Resuming a Cropware Session at a Later Time:* You may want to work through the tutorial during multiple sessions. For safety, save the plan before exiting, unless you've made changes since your last save that you would prefer not to be included in the plan. To exit the program, click on the File Menu, select Exit, and strike OK within the Confirm Exit box. Regardless your choice of Auto-Save options, upon exiting Cropware, a "Cropware Default Settings File.def" will be created in the Cropware folder on your hard drive. The default settings file will direct Cropware to bring up your last plan the next time you start the program, thereby eliminating the need to load the plan, as described in Step 1.

4. *Moving around the Program:* Take a minute to familiarize yourself with the flow of the program.

   Drop-Down Menus

   File: Allows the management of program files as described in Steps 1 through 3.

   Go To…: Provides an alternative method of moving to the various screens relative to clicking on one of the series of buttons below the drop-down menus.

   Tools: Allows the management of future plan years, the importation of soil test data via electronic download, and the conversion of Cropware 1.0 plan files to the Cropware 2.0 format.

Reports: Provides an alternative method of moving directly to a chosen report relative to clicking on the Reports button.

Help: Provides a standard help system describing the use of Cropware, the nutrient management concepts driving the software, as well as a What's This? contact-sensitive help system that allows you to click on a point of interest to display information about the item. The Help system is in .PDF format and requires Adobe Acrobat Reader (a free download from www.adobe.com) to be installed.

Planning Buttons: The Planning Buttons lead you from left to right through screens that assist you in characterizing the farm, developing the strategic nutrient management plan, and creating tactical work orders and summary reports. As a note, you must create a manure source on the Manure screen in order to have full use of the screens accessed by the buttons to the right of the Manure button.

Tree: Provides an alternative method of moving among the rotation, fertilizer, plan year, manure source, and field options within a given plan. The tree can be hidden to allow larger views of program screens.

Contacts: Input screen for basic farm and planner contact info and first plan year definition.

Options: Input screen for the plan-wide definition of the first month of the plan year and the default manure application field access per crop.

Rotations: Crop rotation library. Allows you to define the list of crop rotations that will be available for application to individual fields in the Fields screen.

Fertilizers: Fertilizer library. Allows you to define the list of fertilizers that will be available for application to individual fields in the Fields screen.

Manure: Input screen for: 1) characterizing the total annual quantity and nutrient content of the manure from each manure source on a farm, and 2) defining the manure storage capacity associated with each manure source.

Spreaders: Input screen for the defining the capacity of each manure spreader on a farm.

Fields: Input screen for characterizing each farm field in terms of, for example, soil type, soil nutrient analysis, crop rotation, past and future manure use, fertilizer use, and Phosphorus Index factors.

Allocation: Allows for the allocation of manures and fertilizers to meet agronomic and environmental goals on a field-by-field basis while fully utilizing the manure available for application from all manure sources across the land base.

Calendar: Allows for the distribution of the manure selected for application on the Allocation screen for each field on a monthly basis within the plan year. Phosphorus Index timings may also be updated based on the monthly allocations of manure. Also, calculates end-of-month manure inventories for each manure source, so that storage capacities (if any) are not exceeded by manure supply.

Work Order: Input screen for the development of manure application work orders for a selected month, manure source, manure spreader, and application rate based on the temporal allocation of manure from the Calendar screen. Also allows for the recording and reporting of manure application activities on a monthly basis for each field.
Reports: Provides pre-designed reports and user-defined, custom reports for communication and documentation of the nutrient management plan.

15.4 CONTACTS SCREEN

5. *Defining Contacts:* **Enter the following information about the farm, planner, and first plan year.**

Table 15.1

Click in….	Enter the following
Producer Name	Freemont Board
Farm Name	The Storage Farm
Address	19 Green Road
City	Tankerton
State	New York
Zip Code	11111
Phone	333-333-3333
FAX	333-333-3333
E-Mail	Board@storagefarm.com
Watershed	Susquehanna
County	Cortland
Township	Harford
Planner Name	Russell Low
Company	CNMP ASAP
Address	10 Recycling Way
City	Cleanville
State	New York
Zip Code	10000
Phone	777-777-7777
FAX	777-777-7777
E-Mail	cnmp@cnmpasap.com
First Plan Year	2002

The Watershed designation is purely a record and not utilized by Cropware. The County and Township designations link the farm-wide plan to a database of site-specific precipitation data for basic manure storage sizing (county precipitation data) and Nitrogen Leaching Index (township precipitation data) determinations. The county and township can be changed on a field-by-field basis in the Fields—Field Data screen for more accurate determination of the Nitrogen Leaching Index. The First Plan Year defines the starting plan year and sets a base for building future plan years. Once the First Plan Year is defined, you'll add subsequent plan years with the Create New Plan Year function within the Tools drop-down menu.

Save plan.

15.5 OPTIONS SCREEN

6. *Defining First Month of the Plan Year:* Click on the down arrow to view the list of months. **Select October.** By selecting October, you are defining the plan year as beginning October 1 and ending September 30. October will be the beginning month displayed on the manure application Calendar screen. You may want to change this definition for the plans that you will create depending on your growing season and plan communication style.

7. *Defining the Default Monthly Field Access as a Function of Current Crop:* This section defines which months a particular crop is open for the application of manure. For example, on many farms a corn field is only accessible for manure applications before planting and after harvest. **Click on the down arrow next to Crop and find COS, the crop code for corn silage (as a note, striking the "C" or "COS" until COS is highlighted may ease your search and is a function found in all of Cropware's drop-down menus).** Cropware's default settings define the period when manure can be physically applied to a COS field as from Oct-Apr. Therefore, this is the default accessibility period for COS for the entire plan. As you'll see later, the accessibility definition can be changed on a field-by-field basis in the Fields—Manure Use screen to accommodate soils with varying trafficability, different planting times, labor and machinery constraints, etc. The accessibility definition results in the shading of months closed to spreading in the Calendar screen, thereby assisting in the temporal allocation of manure.

   Now, select GIT, the code for intensively managed grass, from the crop drop-down menu. By clicking on the "Allow Manure Application All Months" button, the accessibility is changed accordingly from the default (all of the "Manure Application" buttons are selected).

   Next, by clicking on the "No Spreading Any Month" button you'll notice the crop is now closed to manure applications (all of the "No Spreading" buttons are selected).

   Finally, re-define the accessibility period for GIT by clicking on the months of May through October in the "Manure Application" row.

   Save plan.

15.6 ROTATIONS SCREEN

8. *Reviewing Default List of Crop Rotations:* The list of default crop rotations may be modified by creating new rotations or deleting existing rotations. The list of rotations will be utilized in the Fields—Crop Data screen in order to couple a particular field with a specific crop rotation. **Click on the down arrow next to Rotation Name and scroll down the list of default rotations.** By clicking on a particular default rotation, you'll see the individual crops comprising the rotation within the Rotation Crops box.

9. *Creating a New Rotation:* You will likely want to add more rotations in the rotation library for later use in the Fields screen. **Click on the "Create New Rotation" button and name the new rotation, 4 Clover/Grass – 3 Corn Silage. Click OK. Now populate the rotation with individual crops. Click on CGE within the Perennial Crops – Establishment menu and notice CGE appears in the "Rotation Crops" box. Next click on CGT in the Perennial Crops – Established menu three times. Now you've described a rotation containing four years of Clover/Grass. Click on COS three times in the Annual Crops Menu. Now the rotation should look like the following.**

Table 15.2

Yr 1: CGE
Yr 2: CGT
Yr 3: CGT
Yr 4: CGT
Yr 5: COS
Yr 6: COS
Yr 7: COS

If you made a mistake in the order, you can change the order of the individual crops by highlighting a particular crop and moving it up or down within the rotation by clicking on the appropriate arrow to the right of the Rotation Crops box.

10. *Deleting a Rotation:* **If you made a mistake and inputted an incorrect crop code or an incorrect number of a certain crop code, you must delete the crop rotation and start over. You will not be using the 4 Clover/Grass – 3 Corn Silage rotation in the tutorial, so delete the rotation by highlighting it in the Rotation Name menu and clicking the "Delete Current Rotation" button. Click OK to confirm the deletion and voila!** As a note, you will not be allowed to delete a rotation from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the rotation is currently utilized upon the attempted deletion.

Save plan.

15.7 FERTILIZERS SCREEN

11. *Reviewing Default List of Fertilizers:* The list of default crop fertilizers may be modified by creating new fertilizers or deleting existing fertilizers. The list of fertilizers will be utilized in the Fields—Fertilizers screen and the Allocation screen in order to couple a particular field with specific fertilizers. **Scroll down the list of default fertilizers in the Fertilizer menu.** By clicking on a particular default fertilizer, you'll see the following details about the fertilizer: cost (no costs have been entered for the default list of fertilizers), dry or liquid consistency, density (if liquid), and nutrient concentration (%).

12. *Creating a New Fertilizer:* You will likely want to add more fertilizers in the fertilizer library for later use in the Fields screen and the Allocation Screen. **Click on the"Add Fertilizer" button and name the fertilizer, Corn Starter #1. Click OK. With Corn Starter #1 highlighted in the Fertilizer Menu, characterize the fertilizer as follows:**

Table 15.3

Click in….	Enter the following
Solid or Liquid	Liquid
Density	11.0
Cost	$1.51/gal
N (%)	20
P_2O_5 (%)	10
K_2O (%)	0
B (%)	0
Fe (%)	0
Mg (%)	0
Mn (%)	0
Zn (%)	0
S (%)	0

Save plan.

13. *Deleting a Fertilizer:* **You will not be using the fertilizer named "Corn Starter #1" in the tutorial, so delete the fertilizer by highlighting it in the Fertilizer menu and clicking the "Remove Fertilizer" button. Click OK to confirm the deletion.** As a note, you will not be allowed to delete a fertilizer from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the fertilizer is currently utilized upon the attempted deletion.

14. *Reset to Default Fertilizers:* If you'd like to return the list of fertilizers in the Fertilizer menu to the original default list packaged with Cropware, **click on "Reset to Default Fertilizers", as the default list is used for the tutorial.**

Save plan.

15.8 MANURE SCREENS

Manure Screen – General Information

15. *Manure Screen:* To create a nutrient management plan, you will need to determine both the quantity and composition of manure to be allocated to crop land. To aid in this effort, the Manure screen is divided into three tabs: Manure Source Data, Manure Analyses, and Manure Storage.

    As a note, at least one waste source must be created before any field information can be entered in the Fields screens; otherwise, a message requesting the creation of a waste source will appear. The waste source is any manure or other waste handling system where the nutrients or waste are produced and must be accounted for. Examples of waste sources are "daily spread", "silage leachate", "bedded pack", "earthen storage system", "pasture", etc.

16. *Creating a Waste Source:* In this tutorial, you'll be working with two sources of waste on a dairy farm: waste from the Main Barn, containing lactating and dry cows and milking center waste, and manure from the Heifer Barn, containing young stock. **Click "Add Source", type Main Barn, and hit OK. Next, click "Add Source" again, type Heifer Barn, and hit OK.** You should be able to toggle between the two manure sources using the arrow buttons or the down arrow next to the Choose Waste Source drop-down menu. In order to enter or change data for a particular waste source, it must be selected in the Choose Waste Source menu. If you make a mistake and wish to delete a source, click the "Delete Source" button and confirm, but don't do this for the tutorial. As a note, you will not be allowed to delete a manure source from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the source is currently utilized upon the attempted deletion.

Manure Screen – Manure Source Data Tab

17. *Entering Information in the Manure Source Data Tab:* **Select Main Barn in the Choose Waste Source drop-down menu. Within the Manure Source Data tab, enter the following information about the Main Barn system.**

    Table 15.4

Click in….	Enter the following
Waste Source Units	Gallons
Manure Density	8.34 lbs/gal
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Select Heifer Barn in the Choose Waste Source menu. Within the Manure Source Data tab, enter the following information about the Heifer Barn system.

Table 15.5

Click in….	Enter the following
Waste Source Units	Tons
Manure Density	N/A
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Save plan.

18. *Estimate Waste Available for Application in the Plan Year:* The quantity of "Annual Waste Available for Application" is not a user entry but is calculated and displayed by the program, where:

"Amount at Start of Plan Year"
plus "Amount Added to System Annually"
less "Amount Exported from System Annually"
equals "Annual Waste Available for Application".

See Figure 15.2 below.

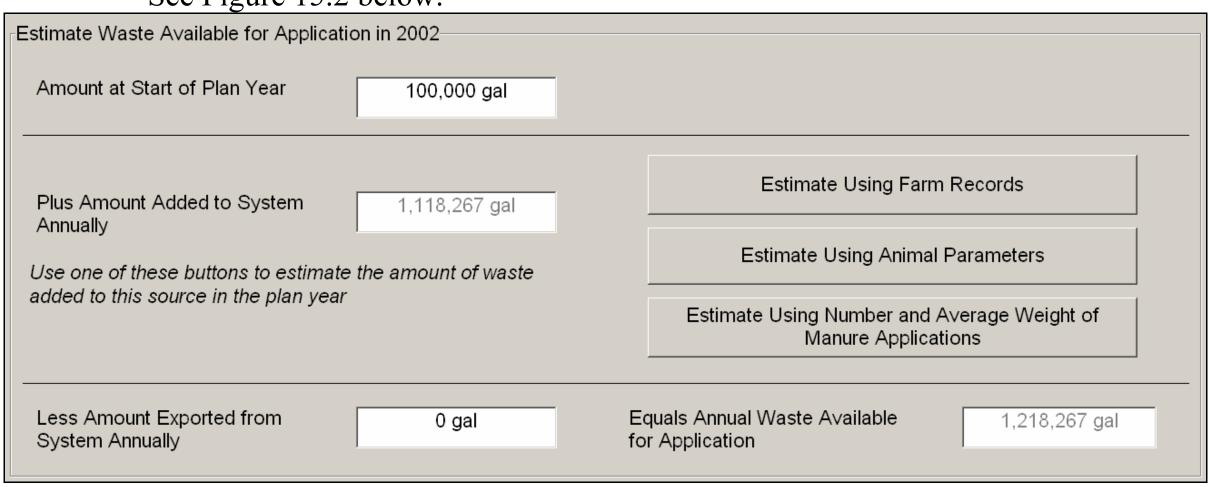


Figure 15.2

Amount at Start of Plan Year: **This tutorial focuses on a farm with manure storage capacity associated with both waste sources. Enter the following data based on farm records.**

Table 15.6

Waste Source	Amount at Start of Plan Year
Main Barn	100,000 gallons
Heifer Barn	175 tons

As a note, when a new plan year is created the "Amount at start of plan year" is set as the manure available for application less the amount of manure allocated to crop land (i.e. last plan year's "Manure Balance" from the Allocation screen) or, in other words, it's the un-applied manure carried over from the previous plan year. However, if you use the manure spreading Calendar screen to plan the manure allocation through the year, the ending inventory amount in the last month may be a better estimate of the "Amount at start of plan year" than the program set value. In that case, you can manually enter the correct beginning inventory quantity here.

Amount Added to System Annually: In Cropware, you have the option of choosing one of three ways to estimate the amount of waste added to a waste system annually, as shown in Figure 15.2, above.

1. Estimate Amount Added Using Farm Records, or
2. Estimate Using Animal Parameters, or
3. Estimate Using Number and Average Weight of Manure Applications.

Estimate Amount Added Using Farm Records: **Select Main Barn from the Choose Waste Source drop-down menu and click on the "Estimate Amount Using Farm Records" button. Enter 1,500,000 gallons and click OK. You have just directly defined the amount of waste produced annually for the Main Barn.**

Estimate Using Animal Parameters: **With Main Barn still selected, click on "Estimate Using Animal Parameters" to gain experience with another estimation method.** A data entry screen will displayed as in Figure 15.3 below.

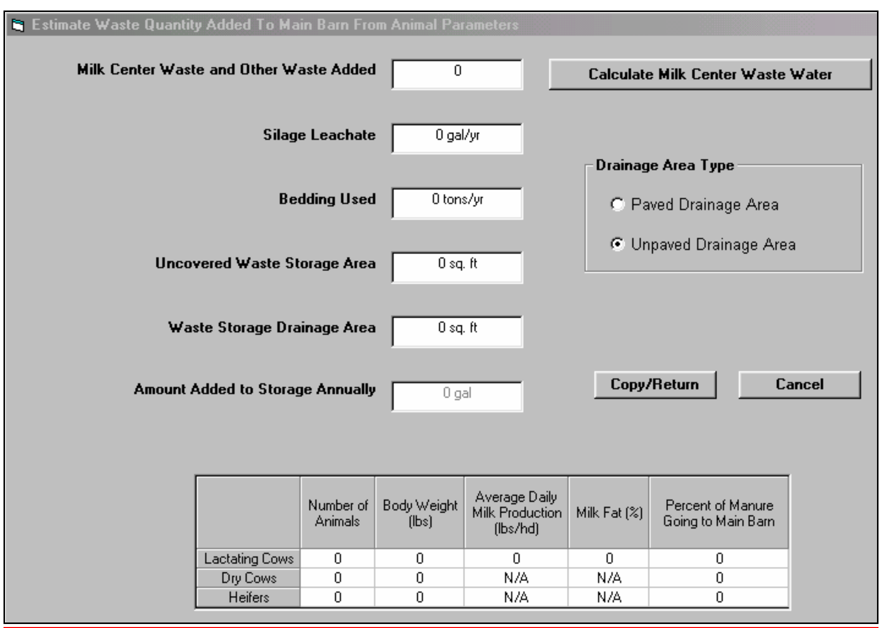


Figure 15.3

From Figure 15.3 you can see the factors considered in this estimation method. Starting from the top, to calculate Milk Center Waste and Other Waste Added you can enter a value directly into the cell from records or, as for the tutorial, **click on "Calculate Milk Center Waste Water" to display a screen similar to Figure 15.4 below.**

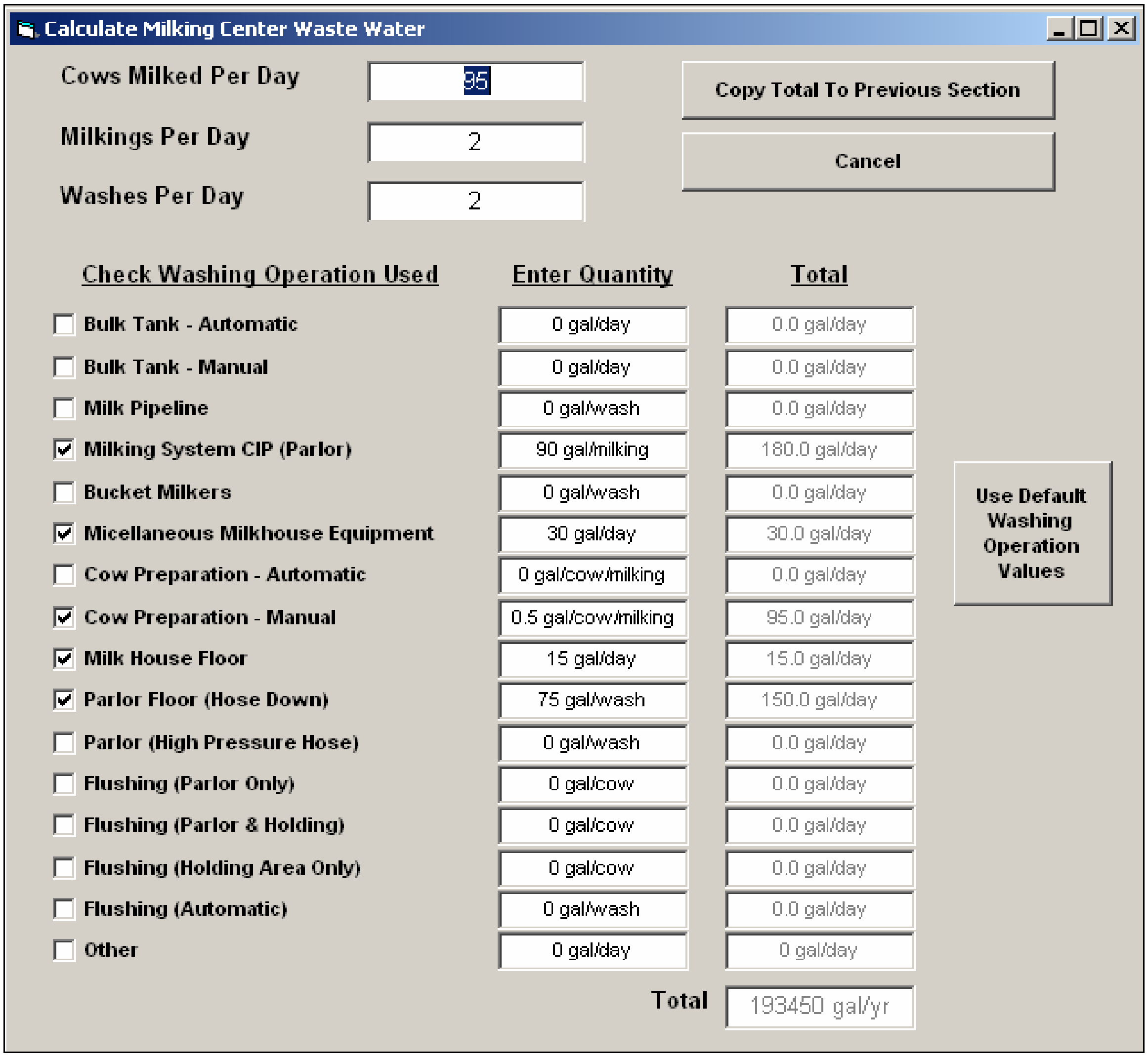


Figure 15.4

Enter the data contained in Figure 15.4 into the "Calculate Milking Center Waste Water" screen. In order for the volumes of wash water to be added to the total, the Washing Operation must be checked. To utilize a set of Default Washing Operation Values from NRAES-115, "Guideline for Milking Center Wastewater", you can click on the "Use Default Washing Operation Values" button, but do not take this step for the tutorial. **Click "Copy Total to Previous Screen". Now, enter the data for the remaining waste contributing sources from Figure 15.5 below.**

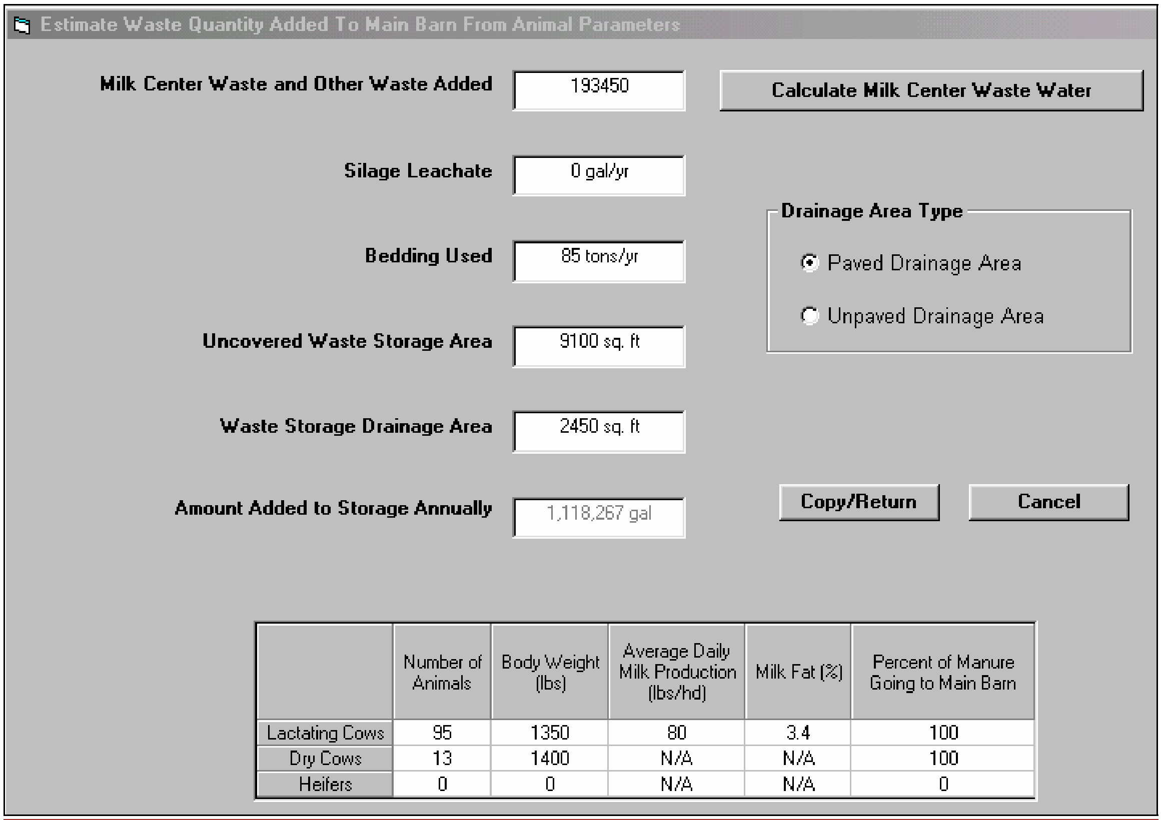


Figure 15.5

Silage Leachate: Estimated from farm records.
Bedding Used: Estimated from farm records or daily bedding use recommendations.
Uncovered Waste Storage Area: Measured from designs or in the field.
Waste Storage Drainage Area: Represents any area that drains into the waste system. Measured from plans, maps, or in the field.
Drainage Area Type: Paved drainage areas will contribute a greater volume of runoff than unpaved areas. **Toggle between paved and unpaved to observe the effect.** Assess in the field.
Animal Parameters: Herd records. Note that 100% of the manure is collected in the Main Barn system. A farm utilizing pasture would contribute a portion of the manure to the Main Barn and the remainder to the Pasture System (see Grazing Farm Tutorial and/or Estimating manure on pasture).

Click on Copy/Return and notice that 1,129,110 gallons now populates the "Amount Added to System Annually" cell, replacing the 1,500,000 gallons that you directly entered using the initial "Estimate Amount Using Farm Records" method. The waste quantity estimation method utilized most recently will always populate the "Amount Added to System Annually" cell. Use the 1,129,110 gallon estimation for the Main Barn. Note the Animal Units cell has been populated with 146 as a result of entering the animal parameter information.

Save plan.

Estimate Using Number and Average Weight of Manure Applications: The final method offered in Cropware for waste quantity estimation is based on the number of loads removed from the system each day or from the number of loads taken out of storage coupled with the average weight of each spreader load. **Select the Heifer Barn from the "Choose Waste Source" drop-down menu and click on the "Estimate Using Number and Average Weight of Manure Applications" button. If you haven't characterized any spreaders yet, you'll encounter a "No Spreaders Defined" pop-up box. Click Yes to define a spreader.** The Spreaders screen that appears is the same screen represented by the Spreaders button positioned across the top of the Cropware interface. **Click "Create Spreader", enter Box as the spreader name, click OK, and a screen similar to Figure 15.6 should appear.**

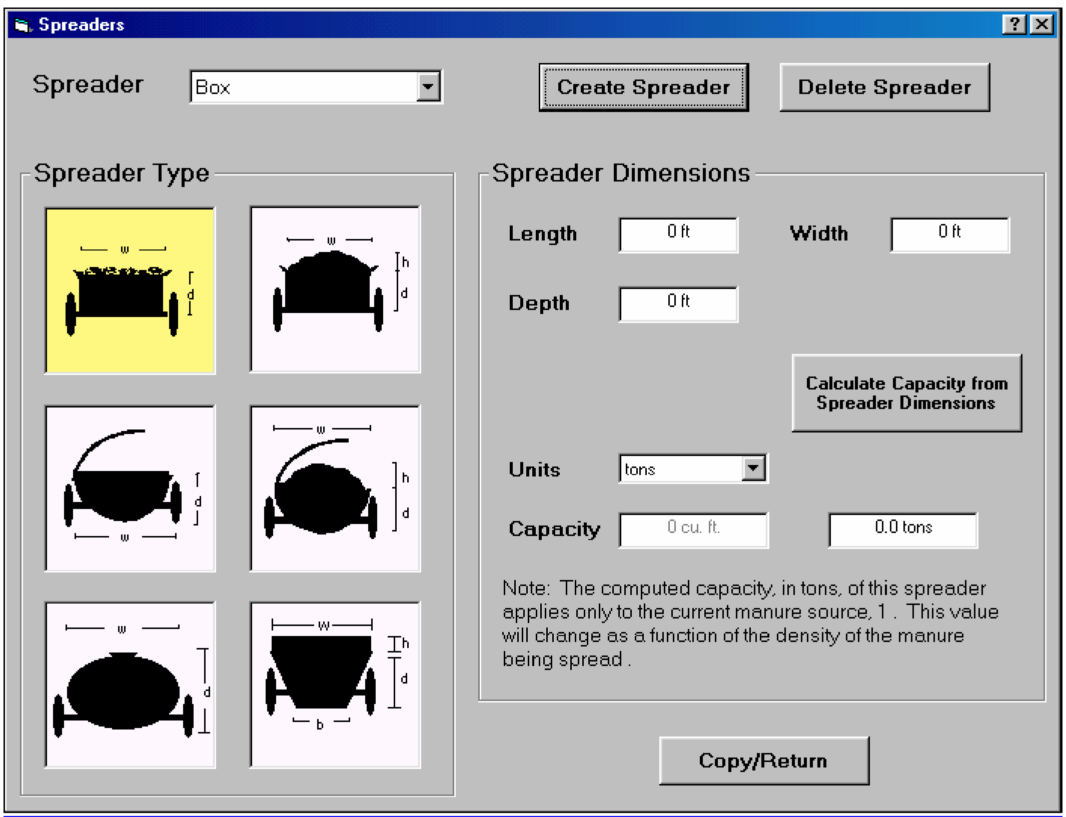


Figure 15.6

Choosing Spreader Type and Determining Spreader Capacity: Cropware allows you to define spreader capacity by entering the dimensions of the spreader (Spreader Dimensions) or by entering the weight or volume of the spreader directly based on field measurements. Regardless of the method, Spreader

Capacity is stored by Cropware in cubic feet and converted to gallons or tons depending on the units and density of the waste currently selected in the "Choose Waste Source" drop-down menu. **Toggle through the 6 spreader options in the "Spreader Type" menu and notice the change in Spreader Dimension options.** The "Calculate Capacity from Spreader Dimensions" button signals Cropware to compute the Spreader capacity from entered dimensions. **For the tutorial, highlight the symbol for the box-style spreader in the upper-left corner of Figure 15.6 above and enter the Capacity for the Box spreader directly into the rightmost "Capacity" cell based on Table 15.7 below.**

Table15.7

Spreader ID	Capacity
Box	5 tons

Click on Copy/Return and you should return to the "Manure Source Data" screen. Click on the "Estimate Using Number and Average Weight of Manure Applications" button again and a screen similar to Figure 15.7 will appear.

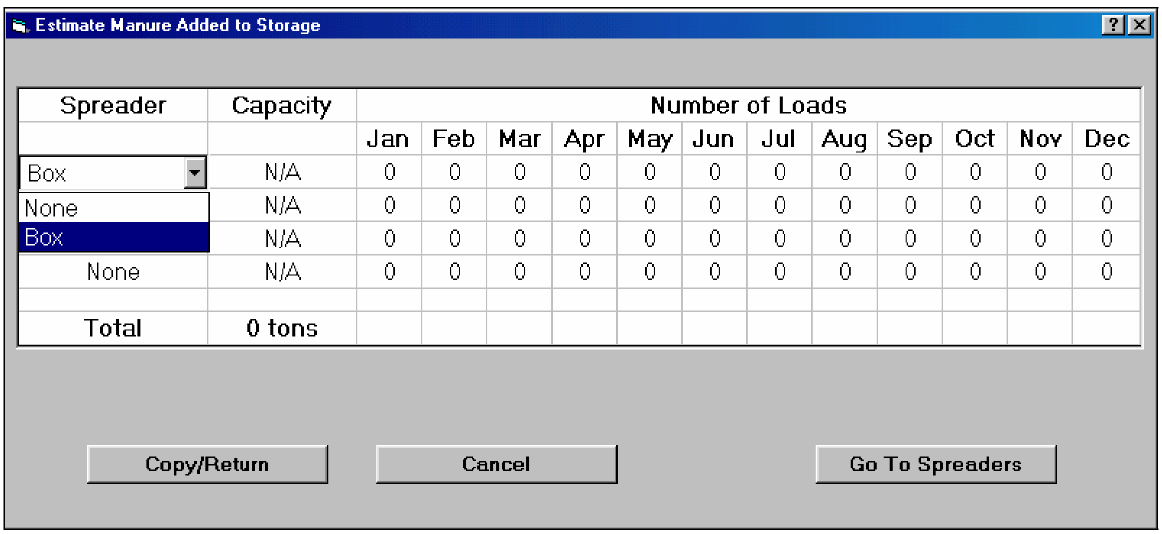


Figure 15.7

The "Estimate Manure Added to Storage" screen depicted in Figure 15.7 allows you to select the recently defined Box spreader, or up to four spreaders total, from the Spreader drop-down menus. **Click in the "Spreader" column, select the Box spreader, and click on another cell in the grid. The 5 ton capacity entered on the Spreaders screen will appear in the Capacity column.** At this point, you are set to enter the number of loads applied per month with the Box spreader over the course of a year from the Heifer Barn. The number of loads will be multiplied by the average weight of the spreader and recorded in the Total cell. **Enter the number of loads according to the manure application history in Table 15.8.**

Table 15.8

	Number of Loads											
Spreader	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Box	15	0	0	40	0	0	0	50	0	45	15	15

The Heifer Barn has generated approximately 180 loads of manure per year according to the farm records, resulting in a total manure quantity estimation of 900 tons. Notice that the records characterize periods of concentrated spreading activity often associated with manure storage. The records entered on this screen are also carried over to the "Manure Added" row of the Calendar screen, in order to define the amount of manure that is available for applications on a monthly basis during the current plan year. If the amount of manure applied per month does not always follow the pattern of the previous year's records (i.e. Table 15.8), the amount of manure available for application may be adjusted on the Calendar screen, itself. Further explanation of the link between the "Estimate Using Number and Average Weight of Manure Applications" function and the Calendar screen is offered in the Calendar screen portion of the tutorial. **Click on Copy/Return to record the 900 ton value in the "Amount Added to System Annually" cell on the Manure Source Data tab.**

As a note, it's possible to calculate the number of animal units contributing to a given waste system without using the "Estimate Using Animal Parameters" method of determining waste quantity. Select the Heifer Barn system in the Choose Waste Source menu and click on "Estimate Using Animal Parameters". Enter the animal parameters from Table 15.9 below into the grid.

Table 15.9

Animal Type	Number	Body Wt.	Milk Prod.	Milk Fat	% Going to Heifer Barn
Heifer	70	850	N/A	N/A	100

Click Copy/Return and you'll notice that 60 animal units now populate the Animal Units cell. Because "Estimate Using Animal Parameters" was the last manure quantity estimation method used, the Amount Added to System Annually cell now reads 888 tons! Have no fear, **click on the "Estimate Using Number and Average Weight of Manure Applications" button again and hit Copy/Return.** Now both the waste quantity based on number and weight of loads and the animal units are displayed for the Heifer Barn. A report of the animal units per acre exists in the "Crop, Livestock, and Nutrient Index Summary". In order to correctly account for the all animal units on the farm in this report, the animal units must be entered or calculated on the Manure screen.

Save plan.

Amount Exported from System Annually: You can enter the amount of manure exported from the farm and, therefore, not intended for application to the farm's land base. **No manure is exported from the farm for the tutorial.**

Manure Screen – Manure Analyses Tab

19. *Entering Information in the Manure Analyses Tab:* Once you've described the quantity of manure on the farm, you must characterize the nutrient content of the manure from each Waste Source. The quantity of manure will be paired with the nutrient content to calculate the total amount of nitrogen (ammonium-N and organic-N), phosphorus, and potassium available from manure for recycling back through the farm's crops, then animals, and so on. Manure analyses can be entered and deleted. The list of available manure analyses exists in the "Test Description" drop-down menu for each Waste Source and is accessible from Fields—Manure Use screen, Fields—Past Manure Use screen, and the Allocation screen once you begin allocating manure to the crop land. In addition, a listing of the all of the entered manure analysis details is created in the "Manure Analyses" report and the most recent manure analysis for each source is presented in the "Manure Analysis and Collection" report. **Click on the "Test Description" down arrow and notice that currently only the Default Dairy Cattle analysis populates the list.**

    Select Main Barn from the "Choose Waste Source" menu, click on the "Add Test" button, enter a Test Description name, hit OK, and repeat for the following list of manure Test Descriptions from Table 15.10.

    Table 15.10

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002

Once the Test Description names are entered, click in the test attribute cells and enter the data from Table 15.11 for each of the Test Descriptions. As a note, entering Ammonia N and Organic N will automatically populate the Total N cell by addition.

Table 15.11

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002
Ammonia N %	0.17	0.2	0.18
Organic N %	0.18	0.21	0.19
P_2O_5 Equivalent %	0.15	0.18	0.16
K_2O Equivalent %	0.26	0.23	0.3
Total Solids %	6.0	6.5	6.5
Manure Analysis Date	8-19-99	8-15-00	5-15-01

As a note, the nutrients are entered as percentages from your manure analysis report. Should you lack such data, to compute nutrient percentages from lbs of nutrient per ton:

4 lbs organic N/ton = 4 lbs/2000 lbs = 0.002 or 0.2%

or to compute nutrient percentages from lbs of nutrient per 1000 gallons:

12 lbs organic N/1000 gal = (12 lbs/1000 gal) / (8.34 lbs/gal) = 0.0014 or 0.14%

Save plan.

Next, repeat the preceding steps for the Heifer Barn with the data in Table 15.12.

Table 15.12

Test Description	Heifer Barn 2000	Heifer Barn 2001	Heifer Barn 2002
Ammonia N %	0.27	0.17	0.25
Organic N %	0.31	0.33	0.35
P_2O_5 Equivalent %	0.23	0.17	0.25
K_2O Equivalent %	0.44	0.43	0.40
Total Solids %	18.0	16.0	18.0
Manure Analysis Date	8-19-99	8-15-00	5-15-01

Save plan.

Manure Screen – Manure Storage Tab

20. *Entering Information in the Manure Storage Tab:* For each waste source, the storage capacity (if any) can be entered or calculated. This function is for planning, not design purposes. This is not a required input, but it is a necessary entry if you want to compare waste storage capacity to storage requirements and calculate months of storage duration in the "Manure Analysis, Collection and Storage Report". In addition, if a waste storage is associated with a Waste Source, it's helpful to quantify its capacity for comparison with Ending Monthly manure Inventories in the Calendar screen. Are the end of the month manure inventories less than your storage capacity?…hope so!

    Select Main Barn in the "Choose Waste Source" menu and click on the "Calculate Capacity from Structure" button. The Calculate Waste Storage Capacity screen will appear and offer three choices of waste storage configurations. **Select the Rectangular Storage option by clicking anywhere on the image. Enter the dimensions of the system according to Figure 15.8 below.**

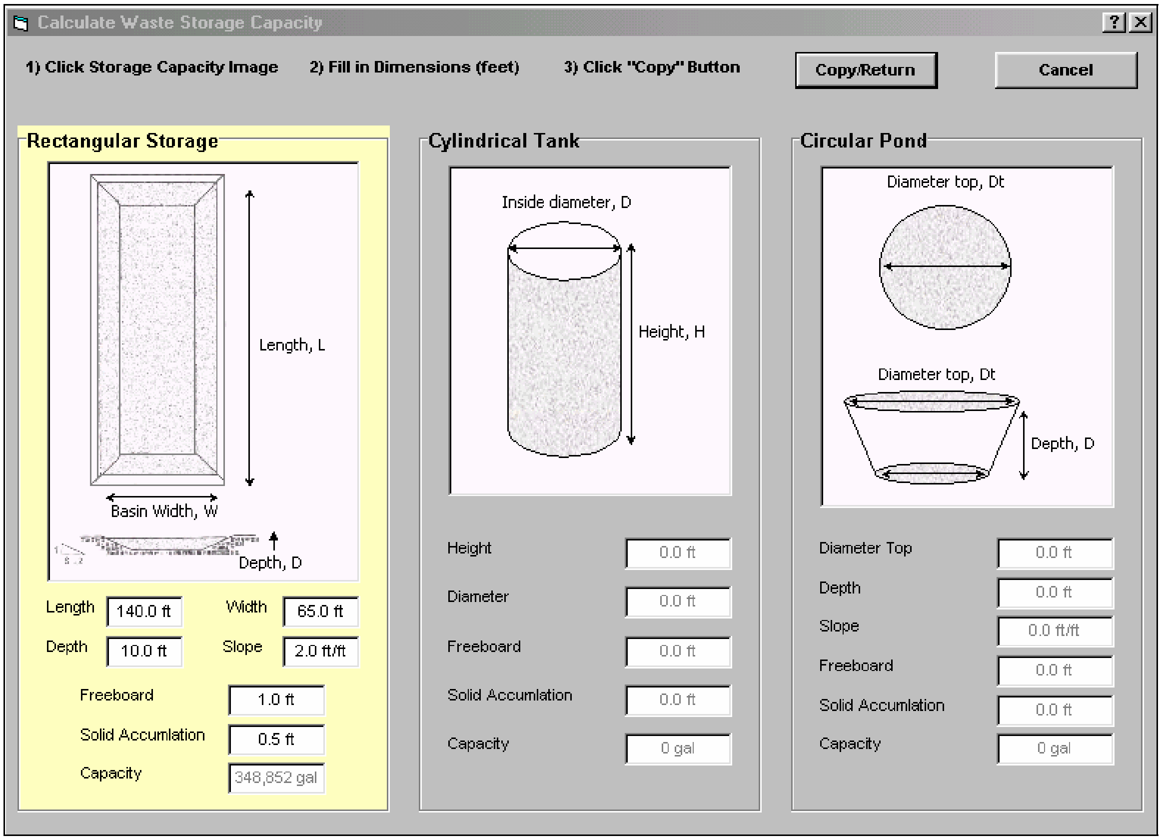


Figure 15.8

As a note, the slope is Run/Rise. **When finished, click Copy/Return and the calculated capacity (348,852 gallons) will be displayed in the "Waste Storage Capacity" cell of the Manure Storage tab.**

Next, select Heifer Barn in the "Choose Waste Source" drop-down menu and click on the "Calculate Capacity from Structure" button. Select the Rectangular Storage Option and enter the dimensions of the system according the Figure 15.9 below. As a note, the Heifer Barn storage is a walled stacking pad, so the slope is zero.

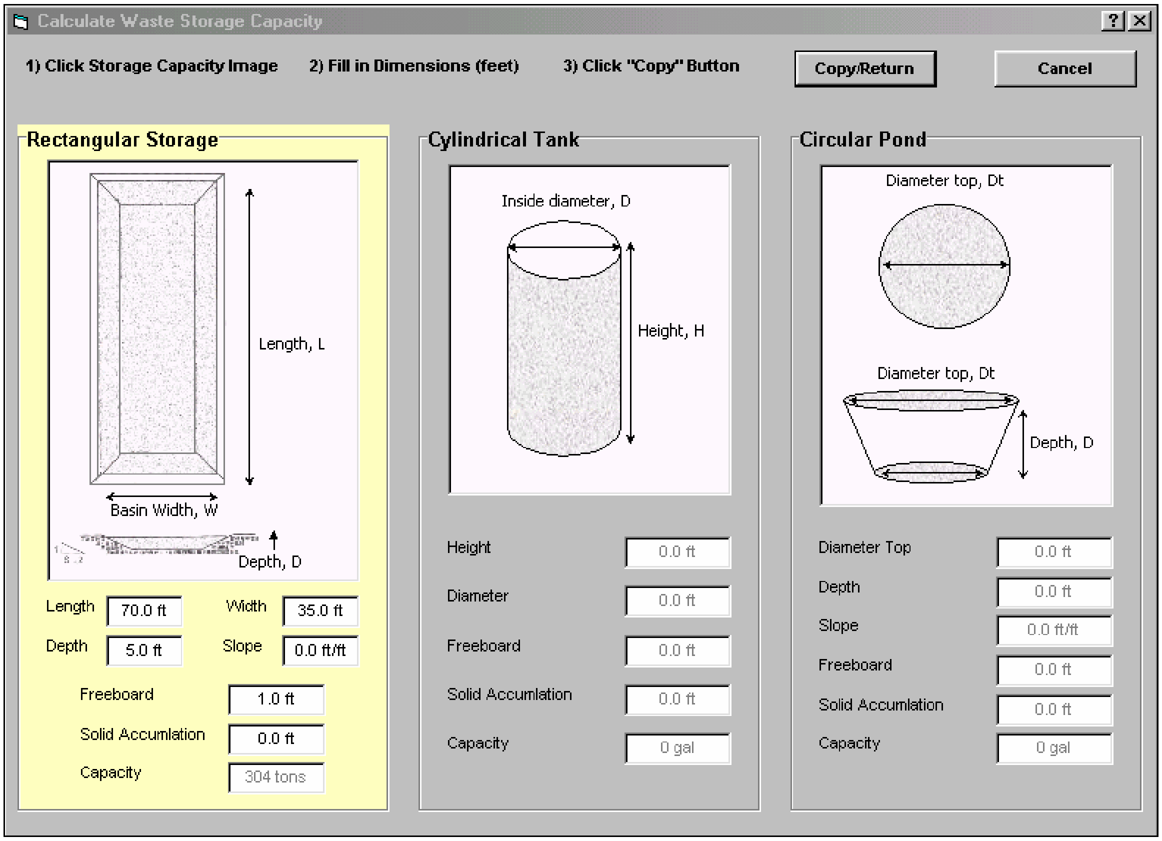


Figure 15.9

When finished, click Copy/Return and the calculated capacity (304 tons) will be displayed in the *Waste Storage Capacity cell of the *Manure Storage screen.

Save plan.

15.9 Spreaders Screen

21. *Spreaders:* Manure spreader capacity is entered on this screen. The capacity can be entered directly or calculated by the program from the size and shape of the spreader. The computed capacity applies only to the current manure source as the value computed will change as a function of the density of the manure being spread and the units selected.

22. *Create a new Spreader:* **Click on the "Spreaders" tab and hit the "Create Spreader" button. A tanker spreader has yet to be defined, so enter "Tank" as the name and click OK. Highlight the Tanker image in the lower left corner and enter the capacity according to Figure 15.10 below.**

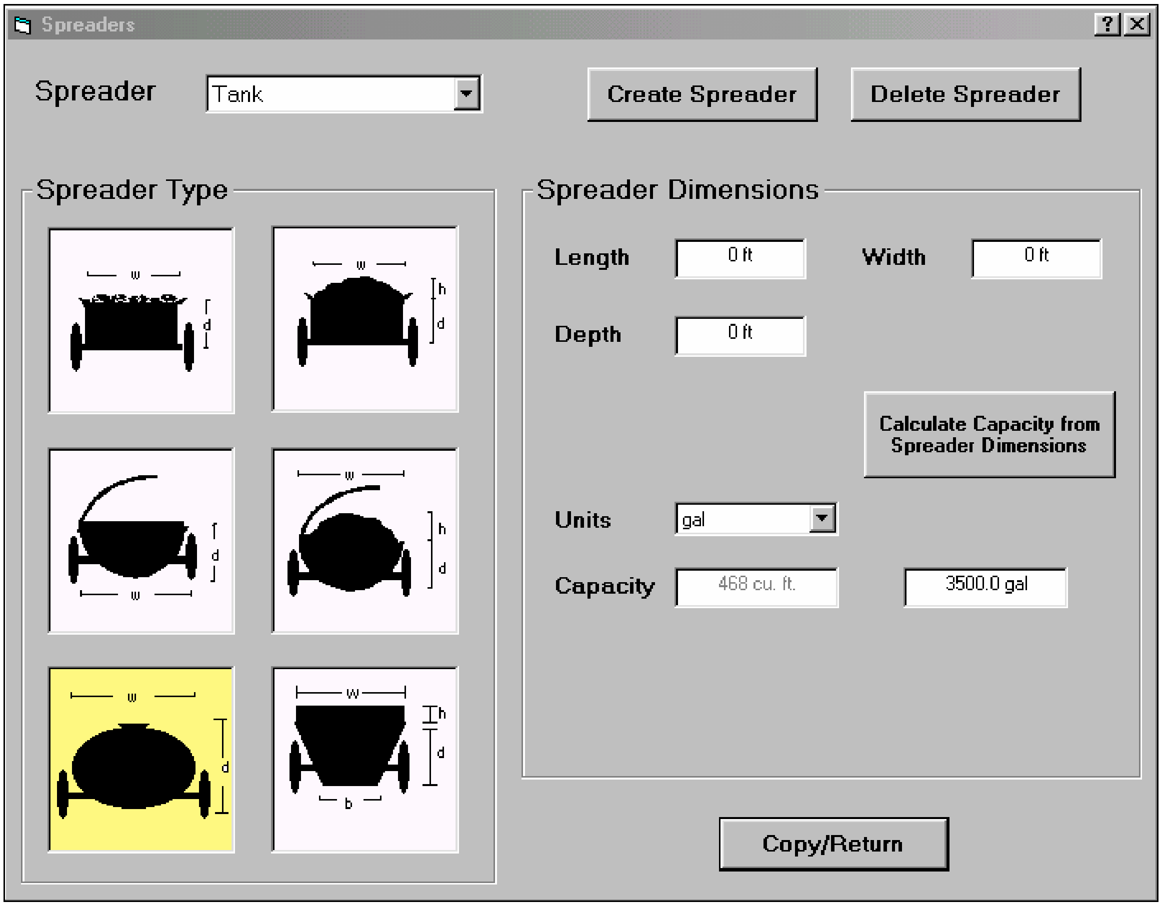


Figure 15.10

Click on Copy/Return. Now both the Box spreader and the Tank spreader have been defined and will be available for developing manure application work orders from the Work Order screen.

Save plan.

15.10 Fields Screens

Field Screens – General Information

23. *Create a Field:* The first step in characterizing a farm field is to create a field and name it. **Click on "Create Field", enter the Field ID, click OK, and repeat the process for the following list of fields.** As a note, the Field ID should be the Farm Service Agency tract and field number, according to the following example format: 3982.01A (where 3982 = Tract ID, 1 = Field ID, and A = Strip ID, if present).

Table 15.13

Field ID
3982.01
3982.02
3982.03
3982.04
3982.05
3982.06
3982.07
3982.08
3982.09
628.10

Once created, the list of Field ID's will populate the "Field ID" drop down menu. You can select a field by highlighting it in the drop-down menu or by using the left or right arrow. The newly created fields will also appear under the Fields limb of the Tree (if not currently displayed, activate the tree by clicking on the Tree button). You can navigate among different fields using either the Field ID menu or the Tree.

Save plan.

24. *Copy Field:* If you have a group of similar fields, perhaps in terms of soil type, crop rotation, manure history, etc., you may wish to fully create and populate a representative field and copy it repeatedly depending on the number of similar fields. This can minimize data entry time by reducing the number of redundant keystrokes. The copy function will not be used in tutorial, but to get a feel for it, **select field 628.10 within the "Field ID" menu and click "Copy Field". Enter 628.10A as a field ID for the copy of 628.10 and hit OK. Repeat this process, but now enter 628.10B.** As a result, Field 628.10A and Field 628.10B have both been added to the list of fields in the Field ID menu. This could be a common change as fields are divided into smaller management units for production and/or environmental conservation purposes. On an actual plan, you would adjust the acreage of each "sub-field" to reflect the area of each management unit.

25. *Re-Order Fields:* Now let's re-order Field 628.10A and Field 628.10B above the original Field 628.10 in the list. **Click "Re-Order Fields", highlight 628.10A, and click the UP**

arrow once. Repeat this for 628.10B. Both of the "sub-fields" should appear above the original 628.10. Hit OK when finished re-ordering the fields.

26. *Delete Field:* Field 628.10A and Field 628.10B will not be used in the tutorial, so **select field 628.10A within the "Field ID" menu, click on "Delete Field", and hit OK on the warning screen. Repeat for Field 628.10B.** Field 628.10A and Field 628.10B will no longer be listed in the Field ID menu.

Field Screens – Field Data Tab

27. *Field Data:* The Field Data screen is designed for characterizing the following field attributes.

Field Name	Soil Name	Artificial Drainage
Acres	Present or Past Sod	Corn Yield Potential
County	Tillage Depth	Highly Erodible Land
Township		

28. *Enter Field Data:* **Enter the following data into the Field Data screen.**

Table 15.14

Field ID	**Field Name**	**Acres**	**County**	**Town-ship**	**Soil Name**	**Present or Past Sod**	**Tillage Depth**	**Artificial Drainage**	**Corn Yield Potential**	**HEL**
3982.01	1	19.6	Cortland	Harford	Langford	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.02	2	28.4	Cortland	Harford	Howard	50+% Leg.	7-9 Inches	None	Use CU	N
3982.03	3	24.7	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.04	4	18.2	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	Adeq.	Use CU	N
3982.05	5	17.9	Cortland	Harford	Bath	1-25% Leg.	7-9 Inches	Adeq.	Use CU	Y
3982.06	6	16.5	Cortland	Harford	Langford	1-25% Leg.	7-9 Inches	None	Use CU	N
3982.07	7	25.6	Cortland	Harford	Howard	1-25% Leg.	7-9 Inches	Adeq.	Use CU	N
3982.08	8	13.3	Cortland	Harford	Valois	100% Grass	7-9 Inches	None	Use CU	Y
3982.09	9	26.9	Cortland	Harford	Erie	100% Grass	7-9 Inches	Adeq.	Use CU	N
628.10	10	17.1	Cortland	Harford	Chagrin	26-50% Leg.	7-9 Inches	None	Use CU	N

Save plan.

Field Screens – Soil Test Tab

29. *Soil Test:* The Soil Test Data screen is designed for characterizing the following field attributes.

Lab ID	P	Fe
Extraction Method	K	Mn
Sample Date	Al	Zn
pH	Ca	Organic Matter
Exchange Acidity	Mg	Pre Side-Dress N Test (PSNT)

30. *Enter Soil Test Data:* **Enter the following data into the Soil Test screen:**

Table 15.15

Field ID	Lab ID	Extraction Method	Sample Date	pH	Exch. Acidity	P	K	Al	Ca
3982.01	CNAL	Morgan	4/11/01	7.0		77	360	25	4210
3982.02	CNAL	Morgan	4/11/01	7.2		46	335	23	3470
3982.03	CNAL	Morgan	3/30/00	6.6		32	325	34	4470
3982.04	CNAL	Morgan	4/11/01	6.7		17	280	31	3950
3982.05	CNAL	Morgan	4/11/01	7.0		11	245	60	3400
3982.06	CNAL	Morgan	4/11/01	6.8		64	310	21	3790
3982.07	CNAL	Morgan	4/11/01	7.0		8	235	21	3350
3982.08	CNAL	Morgan	11/1/99	5.8	13	5	110	106	2190
3982.09	CNAL	Morgan	11/30/99	7.0		25	100	41	4230
628.10	CNAL	Morgan	4/11/01	6.0	14	7	215	52	2780

Table 15.16

Field ID	Mg	Fe	Mn	Zn	Organic Matter	PSNT
3982.01	620	3	19	2.6	4.1	
3982.02	450	1	9	2.3	4.4	
3982.03	635	3	18	3.3	3.9	
3982.04	705	3	21	2.9	4.6	
3982.05	520	6	19	1.8	4.3	
3982.06	610	1	11	2.5	4.0	
3982.07	640	1	9	1.5	4.6	
3982.08	250	21	32	1.8	5.4	
3982.09	620	4	22	2.7	4.8	
628.10	420	5	25	1.2	4.5	

Save plan.

Field Screens -- Crop Data Tab

31. *Crop Data:* The crop history and planned rotation for each field is entered on the Crop Data tab. The stock rotations that you defined in the Rotations screen are used to quickly setup the planned rotation for each field. Any changes made to a rotation in the Crop Data screen impact the rotation for the field only and do not change the stored, stock rotations defined on the Rotations Screen.

    The crop data from the past three crop years is used in the nutrient requirement equations. If a sod crop has been plowed down or killed during the past three years, the organic nitrogen will become available to the plants through mineralization. The amount of nitrogen available is a function of the amount of legume in the stand and the years since plow down, as defined by the user-selected cropping sequence on the Crop Data screen.

    In addition, for planning purposes, the Crop Data screen can be used in combination with the "Crop, Livestock, and Nutrient Index Summary" report and the "Crop Summary Report" to assess the acres of each crop across the entire farm for the plan year and over the course of the rotation, respectively.

32. *Selecting a Pre-Defined Crop Rotation:* **Click on the down arrow in the "Rotation" menu and select the desired rotation to fill the year fields with the rotation crop codes.**

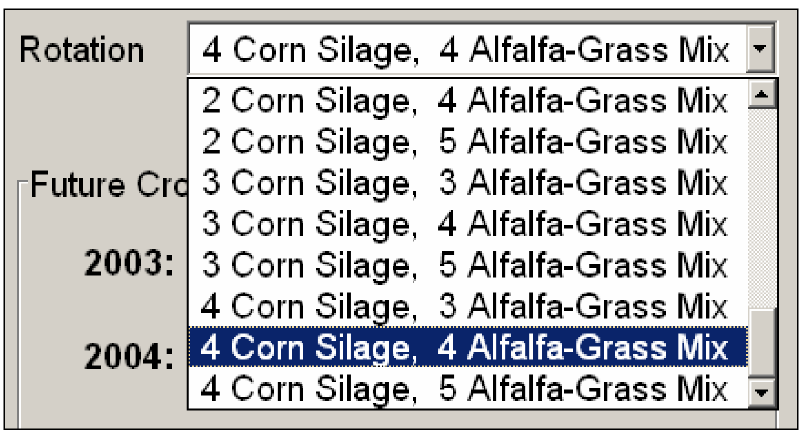


Figure 15.11

For field 3982.01, select the 4 Corn Silage, 4 Alfalfa-Grass Mix rotation according to Table 15.17, below. Click OK to accept the rotation change. Repeat this progression for the remaining fields.

Table 15.17

Field ID	Rotation Goal
3982.01	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.02	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.03	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.04	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.05	3 Corn Silage, 4 Alfalfa-Grass Mix
3982.06	3 Corn Silage, 3 Alfalfa-Grass Mix
3982.07	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.08	Continuous Intensively Managed Grass
3982.09	Continuous Intensively Managed Grass
628.10	4 Corn Silage, 4 Alfalfa-Grass Mix

Save plan.

33. *Temporally Aligning a Crop Rotation:* Notice how the pre-defined rotation populated the rotation planning cells for field 3982.01 as shown in Figure 15.12.

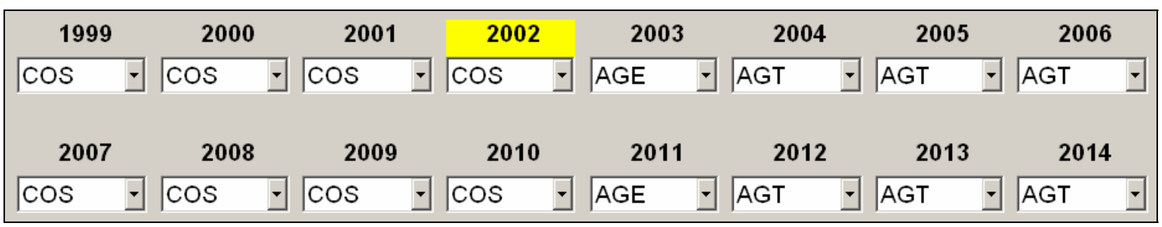


Figure 15.12

For field 3982.01, compare the sequence of crops within the rotation from Figure 15.12 to the true sequence of the rotation plan in Table 15.18.

Table 15.18

Field ID	1999	2000	2001	2002	2003	2004	2005	2006
3982.01	COS	AGE	AGT	AGT	AGT	COS	COS	COS

Notice that the initial crop sequence in the Cropware rotation displays COS for the current year (highlighted in Figure 15.12), but the true crop rotation plan (Table 15.18) specifies that 2002 should be in 3rd year alfalfa-grass mix, that is AGT, preceded by AGT in 2001 and AGE in 2000. **In order to align the sequence of crops within a rotation correctly with the plan years, you can roll the entire rotation sequence forward or backward through the years. To do this, click on the year label above any rotation planning cell that matches the true crop's position in the rotation for the current**

plan year (i.e. any year with 3rd year alfalfa-grass mix). The crop code for the year you click will become the crop for the yellow-highlighted, current plan year. So, considering Figure 15.12, clicking on 2005 or 2013 will roll the entire rotation around, resulting in correct alignment of the rotation with the past and future plan years, while maintaining the sequence of crops within the rotation. It's still a 4 Corn Silage, 4 Alfalfa-Grass Mix rotation (Figure 15.13) over time!

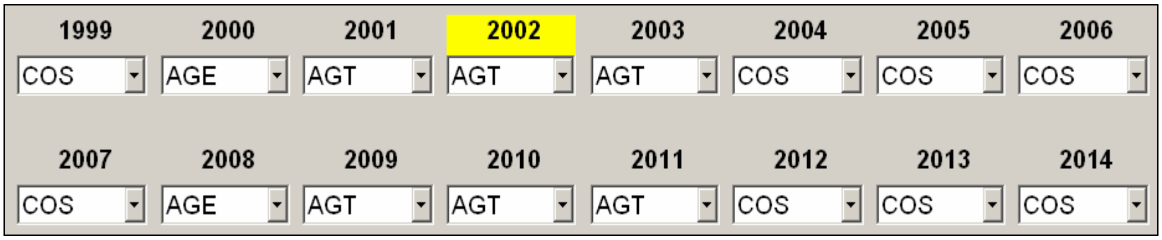


Figure 15.13

Now, correctly align the rotations for the remaining fields according to the rotation plan in Table 15.19.

Table 15.19

Field ID	1999	2000	2001	2002	2003	2004	2005	2006
3982.02	AGT	AGT	COS	COS	COS	COS	AGE	AGT
3982.03	AGE	AGT	AGT	AGT	COS	COS	COS	COS
3982.04	COS	COS	ALE	AGT	AGT	AGT	COS	COS
3982.05	AGT	AGT	COS	COS	COS	AGE	AGT	AGT
3982.06	COS	COS	COS	AGE	AGT	AGT	COS	COS
3982.07	COS	COS	COS	COS	AGE	AGT	AGT	AGT
3982.08	GIT	GIT	GIT	GIT	GIT	GIT	GIT	GIT
3982.09	GIT	GIT	GIT	GIT	GIT	GIT	GIT	GIT
628.10	AGT	COS	COS	COS	COS	AGE	AGT	AGT

Save plan.

34. *Changing Crops within a Rotation:* You can also edit the rotation for each field by clicking on the down arrow key next to the crop code in each year of the rotation and changing the crop code. In order to maintain the rotation sequence in future years, though, you'll need to change the crop code for each subsequent year in a similar manner.

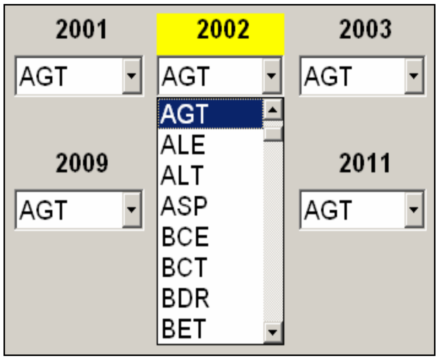


Figure 15.14

35. *Inserting or Removing Crops within a Rotation:* If the sequence of crops within a pre-defined rotation from the Rotation drop-down menu cannot be maintained precisely over time, you can choose to insert or remove a crop from the rotation without altering the crop sequence of the rotation in future plan years. **Select field 3982.06 in the Field ID menu.** After reviewing the crop rotation plan for 2002, you fear that not enough acres of corn silage were planned to meet the herd forage requirements. The pre-defined, long-term crop rotation plan for 2002 should be altered, such that field 3982.06 will be planted to a 4th year of COS instead of AGE. The farmer plans to resume the pre-defined crop sequence (i.e. 3 Corn Silage, 3 Alfalfa-Grass Mix) after 2002, so you must insert another COS crop into the rotation for 2002. **Click on the "Insert Crop" button, select 2002 from the "Year" drop-down menu, choose "COS" from the "Crop" drop-down menu, and hit OK. Compare the pre-defined rotation sequence in Figure 15.15 with the updated sequence in Figure 15.16.**

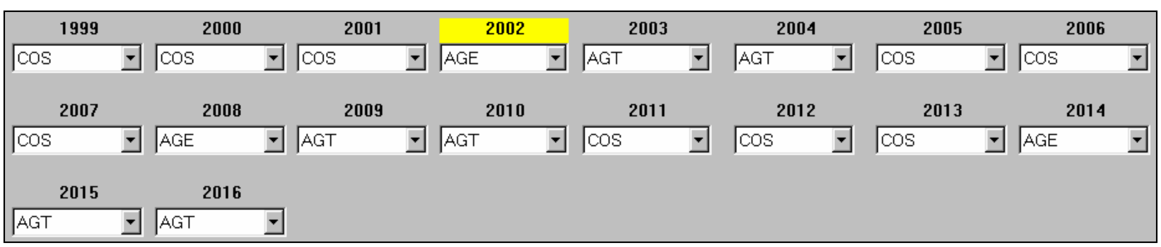


Figure 15.15

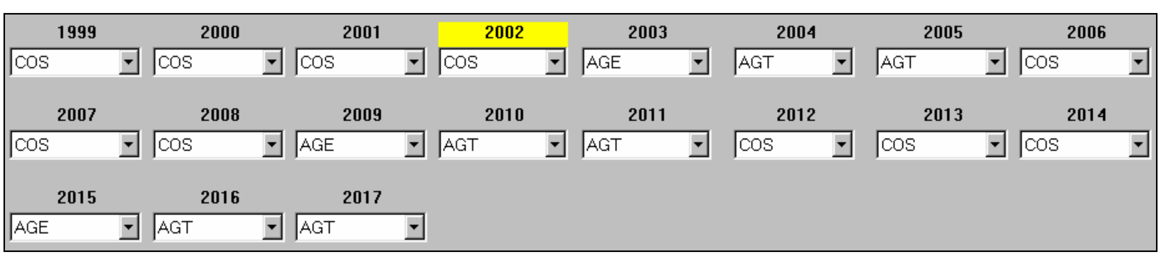


Figure 15.16

Now, after a talk with the herd nutritionist, you realize that plenty of corn silage will be produced relative to herd demand with the original crop plan for 2002, so **click on the**

"Remove Crop" button, select "2002" from the Year menu, and hit OK. The rotation for Field 3982.06 should mirror Figure 15.15 again.

Save plan.

Field Screens – Manure Use Tab

36. *Manure Use:* In the Manure Use screen, you can enter information about the planned manure applications for the current plan year. **The screen is designed to accommodate two manure application events per field per plan year, as distinguished by Primary Application and Secondary Application.**

37. *Entering Current Year Data:* The following outlines the Manure Use screen for the Primary Application and the Secondary Application.

    Manure Source and Test Description: **Click on the drop-down menus to view the lists of manure Source Names and manure Test Descriptions, originally entered on the Manure Screen. These data can also be selected for a given field on the Allocation screen.** So, unless you know that manure from a particular source will be applied to a particular field based on your knowledge of the field or the planned crop (see the Crop Summary portion of the Manure Use screen), it's often more efficient to **select this information on the Allocation screen. Use this method for the tutorial.** The Manure Source and Test are coupled with the rate of manure application from the Allocation screen in the Phosphorus Index calculation.

    Timing: The months of the year during which manure will be applied. The manure application timing is utilized in the Phosphorus Index calculation. In some cases, perhaps based on the planned crop, you'll know when manure will be applied to a field at this stage of the planning process. Otherwise, the Timing of application should be defined after the manure has been temporally allocated in the Calendar screen. As a default setting, manure application timings are set to "Feb-Apr" as this represents the highest risk timing in the Phosphorus Index. This default setting is a good starting point for allocating manure on the Allocation screen, because it represents a conservative approach. **Don't define the Timing for the tutorial at this point. Instead, return to the Manure Use screen to define the Timing of application after completion of the Calendar screen.**

    Application Method: The selection of an Application Method depends on the manure source chosen for a field, the amount of manure storage for the given source, the equipment and labor resources, the crop, the risk of runoff and/or leaching, etc. With experience on a given farm, you may be able to initially select the application method per field at this stage in the planning process, but you will likely find it necessary to confirm the application method after planning manure applications across the land base in the Allocation screen and the Calendar screen.

It's often helpful to toggle among the Fields—Manure Use, Allocation, and Calendar screens through the planning process. **For the tutorial, utilize the "Top Dress or Incorporated After 5 Days" option initially.** The method of manure application is utilized in the Phosphorus Index calculation and ammonia conservation determination.

Hydrologic Sensitivity Description: Enter comments on hydrologically sensitive areas for a given field. This is only used as a comment space by Cropware. **Enter the following:**

Table 15.20

Field ID	Hydrologic Sensitivity Description (Primary Application)	Hydrologic Sensitivity Description (Secondary Application)
3982.01		
3982.02		
3982.03	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP
3982.04		
3982.05	AVOID APPLICATION IN WET POCKET--NE CORNER	AVOID APPLICATION IN WET POCKET--NE CORNER
3982.06		
3982.07	AVOID APPLICATION IN GRASSED WATERWAY	AVOID APPLICATION IN GRASSED WATERWAY
3982.08		
3982.09		
628.10	AVOID APPLICATION IN FILTER STRIP	AVOID APPLICATION IN FILTER STRIP

Priority Nutrient: **Use Nitrogen as the Priority Nutrient for all fields in the tutorial.**

Field Access: In the Options screen, you defined the time period available for manure applications based on crop. Having defined the crop for the plan year in the Crop Data screen, Cropware now displays the months available for spreading on the "Field Access" button. At this point, you can change the manure application access periods from the default settings on a field-by-field basis. **Select field 3982.07 in the "Field ID" menu and notice the default field accessibility, based on the definition for COS in the Options screen.**

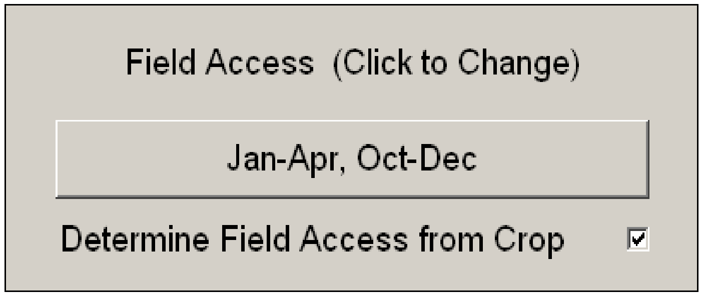


Figure 15.17

Click on the checkbox next to "Determine Field Access from Crop" to de-select this option. Click on the "Field Access" button to define the field accessibility for this field specifically. By clicking in Manure Application row, allow manure applications on this field from Oct-May and hit Return.

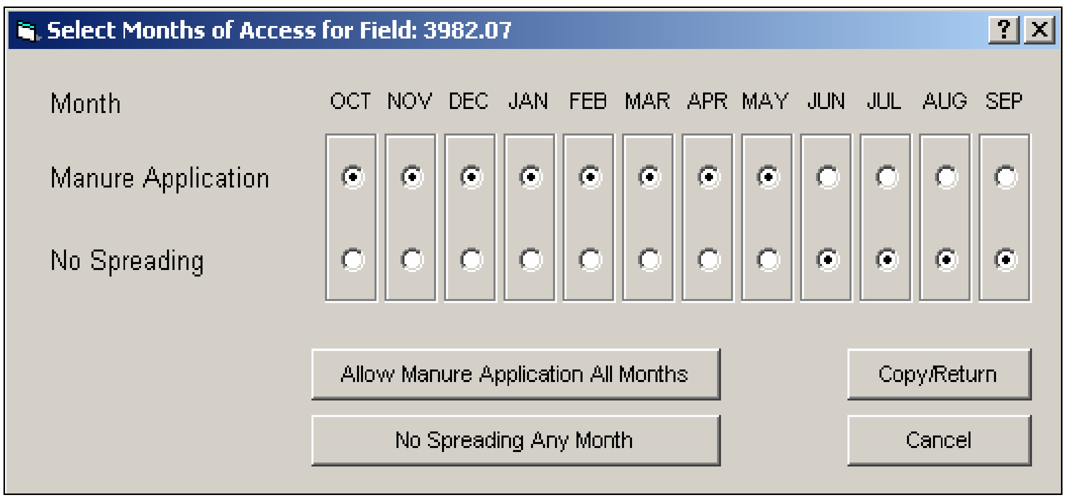


Figure 15.18

"Jan-May, Oct-Dec" will appear on the Field Access button now and the shaded, no-spreading period on the Calendar screen will reflect this change. **Select the "Determine Access from Crop" checkbox to return field 3982.07 to its original accessibility status, as in Figure 15.17 above.**

Save plan.

Field Screens – Past Manure Use Tab

38. *Enter Past Manure Use Data:* Past manure application data are used to determine the residual nitrogen available from the last two years of manure application activity for the plan year's crop nitrogen requirement. **Enter the Manure Source, associated historic Test Description, and the Quantity Applied per acre on a given field for both two years ago and last year according to the Table 15.21.**

Table 15.21

	Last Year				2 Years Ago			
Field ID	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)
3982.01	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary				Secondary	Heifer Barn	Heifer 2000	10
3982.02	Primary				Primary			
	Secondary				Secondary			
3982.03	Primary				Primary			
	Secondary				Secondary			
3982.04	Primary	Main Barn	Main 2001	5000	Primary	Heifer Barn	Heifer 2000	15
	Secondary				Secondary			
3982.05	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	7500
	Secondary	Heifer Barn	Heifer 2001	10	Secondary	Heifer Barn	Heifer 2000	10
3982.06	Primary	Heifer Barn	Heifer 2001	15	Primary	Heifer Barn	Heifer 2000	15
	Secondary	Main Barn	Main 2001	5000	Secondary			
3982.07	Primary	Heifer Barn	Heifer 2001	10	Primary	Heifer Barn	Heifer 2000	10
	Secondary	Main Barn	Main 2001	6000	Secondary			
3982.08	Primary	Main Barn	Main 2001	10000	Primary	Main Barn	Main 2000	10000
	Secondary				Secondary			
3982.09	Primary	Main Barn	Main 2001	10000	Primary	Main Barn	Main 2000	10000
	Secondary				Secondary			
628.10	Primary	Main Barn	Main 2001	6000	Primary	Heifer Barn	Heifer 2000	10
	Secondary				Secondary	Main Barn	Main 2000	5000

Save plan.

Manure applications planned in the previous two plan years on the Allocation Screen will be carried forward to the Fields—Past Manure Use screen in the newly created plan year to save data entry effort. Please check these "planned" quantities with the actual records of manure application and update where necessary.

Field Screens – Fertilizers Tab

39. *Fertilizers:* On this tab, you can enter up to four fertilizers to be applied to this field in the plan year. You'll be selecting fertilizers from the list housed on the Fertilizers library screen.

40. *Entering Fertilizer Application Data:*

Fertilizer Name: As in the Manure Use screen, you'll be choosing soil fertility amendments for application in the Allocation screen. In some cases, perhaps depending on crop (notice the crop summary on the bottom of the Fertilizers screen), knowledge of past management, etc., you'll know what fertilizer material(s) a particular field should receive. **In most cases, though, fertilizer selection should be made on the Allocation Screen, where the crop nutrient requirement can be assessed.**

Planned Application Rate: **Wait to select the application rate on the Allocation screen while you're balancing the field's nutrient requirements.** The rate of fertilizer application is used in the Phosphorus Index calculation.

Timing: If a Fertilizer Name is not chosen, you won't be able to input a Timing. If fertilizer has been chosen, depending on the crop and your knowledge of the field, you may be able to assume a timing of application on the Fields—Fertilizers tab before consulting the Allocation screen. Regardless of whether a fertilizer material and rate are chosen on the Allocation screen or the Fields—Fertilizer tab, the timing of application will need to be selected from the Field—Fertilizer tab. The timing of fertilizer application is used in the Phosphorus Index calculation.

Application Method: If a Fertilizer Name is not chosen, you won't be able to input an Application Method. If fertilizer has been chosen, depending on the crop, your knowledge of field management, etc., you may be able to assume an application method at this point. Otherwise, you can toggle back to the Fields—Fertilizers tab from the Allocation screen. The method of fertilizer application is used in the Phosphorus Index calculation.

Save plan.

Field Screens – Phosphorus Index Factors Tab

41. *Phosphorus Index Factors:* This tab collects information used with other entered data to rank the fields according to their risk of P losses via the Phosphorus Index. The following remaining information is necessary to calculate the Phosphorus Index: Soil Erosion –RUSLE (tons/acre), Proximate Waterbody Type, Predominant Flow Distance to Blue Line Stream or Equivalent, Soil Drainage Class, Flooding Frequency, and presence of Concentrated Flows.

42. *Entering Phosphorus Index Factors:* **Enter the remaining information necessary to calculate the Phosphorus Index from Table 15.22:**

Table 15.22

Field ID	Soil Erosion RUSLE	Watercourse (Intermittent or Perennial)	Flow Distance to Watercourse (ft)	Soil Drainage Class	Flooding Frequency	Concentrated Flows (Y/N)
3982.01	1.1	I	1500	MWD	Rare	N
3982.02	1.5	I	1300	MWD	Rare	N
3982.03	1.5	I	65	MWD	Rare	N
3982.04	1.4	I	4500	MWD	Rare	Y
3982.05	1.0	I	110	WD	Rare	N
3982.06	1.7	P	1350	MWD	Rare	Y
3982.07	2.2	P	400	MWD	Rare	Y
3982.08	1.0	P	130	WD	Rare	N
3982.09	1.0	P	1300	SPD	Rare	N
628.10	2.2	P	850	MWD	Rare	Y

Save plan.

15.11 ALLOCATION SCREEN

Allocation Screen – General Information

43. *Allocation:* The Allocation Screen is the step in the nutrient management plan where the farm's spatial nutrient balance is created. Considering the crop nutrient requirements, available manure, and risk indices (Phosphorus Runoff Index and Nitrate Leaching Index), you'll assign the source and rate of manure applications and rates of fertilizer applications for each field on this screen. The table at the top of the screen titled Manure Summary shows the quantity of manure available for application, the current quantity allocated to the fields and the difference between the two for each manure source and for the whole farm. The Field Nutrient Balance table is where you balance the crop nutrient requirements for each field with nutrients from manure and fertilizer. All cells allowing data entry are shaded yellow. **Your basic goals in the Allocation screen are to optimally:**

1. **Meet crop nutrient guidelines on a field-by-field basis by allocating manure and/or fertilizer at achievable rates on the farm.**
2. **Allocate all of the farm's manure across the land base (otherwise you may need to reconsider the "Amount Exported from System Annually" option on the Manure screen).**

3. **Minimize the risk of nutrient losses via runoff, erosion, and leaching, as indicated by the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index, respectively.**

Refer to the Nitrogen, Phosphorus, and Potassium management sections in the Help for a better understanding of the Nutrient Management concepts applied in Cropware.

Allocation Screen – Configuring the Allocation Screen

44. *Configuring the Allocation Screen:* You can change what information is displayed on the Allocation screen in order to best suit your nutrient balancing efforts. You'll likely develop your own preferences, but to get a feel for the screen, consider the following.

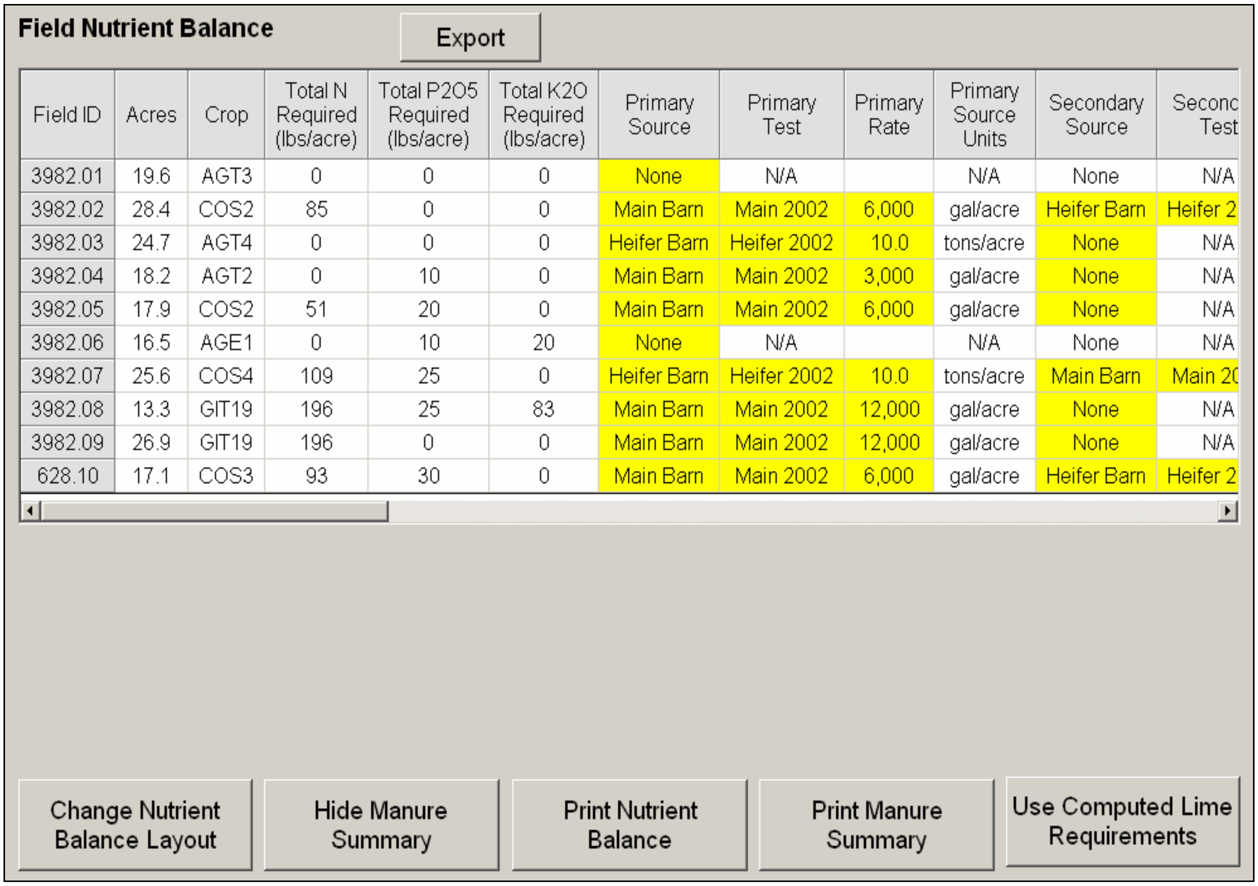
Manure Summary: The Manure Summary is helpful to consider while allocating manure in order to monitor manure inventories. The Manure Summary values will include changes made to the Field Nutrient Balance table when the **Update NMP** button is clicked. To have the Manure Summary updated after each entry, check the **Update NMP with Each Change** box. However, selecting this option will slow down the Allocation screen operation. **The Manure Summary can be hidden to expand the view of the Field Nutrient Balance table, by clicking on the "Hide Manure Summary" button. Try this. Then click on the "Show Manure Summary" button to re-display the Manure Summary, as in Figure 15.19 below.**

Manure Summary Export

	Total Tons	Total Gal	Main Barn	Heifer Barn
Manure Available For Application	1075.00	1,229,110	1,229,110 gal	1075.00 tons
Manure Allocated	958.00	1,071,000	1,071,000 gal	958.00 tons
Manure Balance	117.00	158,110	158,110 gal	117.00 tons

Figure 15.19

Field Nutrient Balance: On this screen you can decide the rate, source, and test of manure to be applied, the rate of up to four fertilizers to be applied, and whether any comments should be assigned to a given field (see yellow input columns). All inputs should be entered on a "per acre" basis. To assist such decisions, you can choose the columns of data to view on the Field Nutrient Balance Table.



Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units	Secondary Source	Seconc Test
3982.01	19.6	AGT3	0	0	0	None	N/A		N/A	None	N/A
3982.02	28.4	COS2	85	0	0	Main Barn	Main 2002	6,000	gal/acre	Heifer Barn	Heifer 2
3982.03	24.7	AGT4	0	0	0	Heifer Barn	Heifer 2002	10.0	tons/acre	None	N/A
3982.04	18.2	AGT2	0	10	0	Main Barn	Main 2002	3,000	gal/acre	None	N/A
3982.05	17.9	COS2	51	20	0	Main Barn	Main 2002	6,000	gal/acre	None	N/A
3982.06	16.5	AGE1	0	10	20	None	N/A		N/A	None	N/A
3982.07	25.6	COS4	109	25	0	Heifer Barn	Heifer 2002	10.0	tons/acre	Main Barn	Main 20
3982.08	13.3	GIT19	196	25	83	Main Barn	Main 2002	12,000	gal/acre	None	N/A
3982.09	26.9	GIT19	196	0	0	Main Barn	Main 2002	12,000	gal/acre	None	N/A
628.10	17.1	COS3	93	30	0	Main Barn	Main 2002	6,000	gal/acre	Heifer Barn	Heifer 2

Figure 15.20

Click on the "Change Nutrient Balance Layout" button to show or hide columns on the table. Scroll through the pop-up box to see the options. To start with, choose the "Restore Defaults" to display the default set of data columns. Click OK. Scroll laterally within the Field Nutrient Balance to view all of the default data columns.

Next, right-click on the "Crop" column heading and choose "Sort by Ascending Order". This option will alpha-numerically sort the data in the selected column. This may be helpful if you'd like to, for instance, arrange all of the corn fields in a single view for nutrient allocation. The column order is returned to the default order, based on the Field ID, once you leave and return to the Allocation screen.

Click OK. Scroll laterally within the Field Nutrient Balance to view all of the recently added columns.

Next, right-click on the "Crop" column heading and choose "Sort by Ascending Order". This option will alpha-numerically sort the data in the selected column. This may be helpful if you'd like to, for instance, arrange all of the corn fields in a single view for nutrient allocation. The column order is returned to the default order, based on the Field ID, once you leave and return to the Allocation screen.

Allocation Screen – Allocating Manure and Fertilizer to Fields

45. *Allocating Manure and Fertilizer to Fields:* Based your characterizations of the farm fields and the quantities and nutrient contents of the farm manures, you are now ready to allocate manure and fertilizer nutrients to fields. **Find field 628.10 in the "Field Nutrient Balance" table. Do the nutrient requirements match those in Figure 15.21 below?**

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)
3982.01	19.6	AGT3	0	0	0
3982.02	28.4	COS2	85	0	0
3982.03	24.7	AGT4	0	0	0
3982.04	18.2	AGT2	0	10	0
3982.05	17.9	COS2	51	20	0
3982.06	16.5	AGE1	0	10	20
3982.07	25.6	COS4	109	25	0
3982.08	13.3	GIT19	196	25	83
3982.09	26.9	GIT19	196	0	0
628.10	17.1	COS3	93	30	0

Figure 15.21

Now scroll to the right and notice the Nutrient Balance columns, as shown in Figure 15.22.

Field ID	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	0	0	0
3982.02	-85	0	0
3982.03	0	0	0
3982.04	0	-10	0
3982.05	-51	-20	0
3982.06	0	-10	-20
3982.07	-109	-25	0
3982.08	-196	-25	-83
3982.09	-196	0	0
628.10	-93	-30	0

Figure15.22

For N, P_2O_5 and K_2O, the difference between the sum of nutrients supplied by manure and fertilizer applications and the Total Nutrients Required is calculated in the Nutrient Balance columns. If the manure and fertilizer nutrient contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrient contributions are less than the nutrients required, the difference will be displayed in this column as a negative number. Because you haven't allocated any manure or fertilizer nutrients, yet, many balance values are negative. **Consult the Nutrient Balance columns as you allocate manure and fertilizer nutrients to a particular field. So how to satisfy the nutrient requirement for field 628.10 with fertilizer and/or manure?**

Fertilizer Allocation for Field 628.10: Field 628.10 will be planted to third year corn and requires 93 lbs/acre N, 30 lbs/acre P_2O_5, and no K_2O. According to current guides for starter fertilizer use, a response can almost always be seen from 10-30 lbs/acre of nitrogen fertilizer in the starter band. Next, if the phosphorus requirement is 20 lbs/acre of P_2O_5 or less (indicating a High or Very High soil test phosphorus classification), corn yields are not likely to respond to phosphorus in the starter band. If the P requirement exceeds 20 lbs/acre P_2O_5 (indicating a Medium to Very Low soil test phosphorus level), apply 20 lbs/acre P_2O_5 in the starter band and balance the remaining P_2O_5 requirement with manure. Visit the Nutrient Management Spear Program website for the latest research on Starter Phosphorus management (http://nmsp.css.cornell.edu/projects/starterp.asp). The potassium requirement can come from manure or fertilizer, banded or broadcast.

Therefore, select a starter fertilizer and rate for Fertilizer #1 on field 628.10 that will supply ~10-30 lbs/acre N, ~20 lbs/acre P_2O_5, and 0 lbs/acre K_2O. To do this, scroll to the "Fertilizer #1 Name" column and select a starter fertilizer from the drop-down menu (remember that this list of fertilizers was created on the Fertilizers screen). Since this farmer can apply liquid starter fertilizers through the corn planter, **choose 21-17-0. Next enter 9 gal/acre in the "Fertilizer #1 Rate" column for field 628.10,, as shown in Figure 15.23.**

Field ID	Fertilizer #1 Name	Fertilizer #1 Formulation (N:P:K)	Fertilizer #1 Rate	Fertilizer #1 Units	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	None	N/A	N/A	N/A	0	0	0
3982.02	None	N/A	N/A	N/A	-85	0	0
3982.03	None	N/A	N/A	N/A	0	0	0
3982.04	None	N/A	N/A	N/A	0	-10	0
3982.05	None	N/A	N/A	N/A	-51	-20	0
3982.06	None	N/A	N/A	N/A	0	-10	-20
3982.07	None	N/A	N/A	N/A	-109	-25	0
3982.08	None	N/A	N/A	N/A	-196	-25	-83
3982.09	None	N/A	N/A	N/A	-196	0	0
628.10	21-17-0	21:17:0	9	gal/acre	-72	-13	0

Figure 15.23

Notice that the "N Balance" and "P_2O_5 Balance" have decreased to –72 lbs/acre and –13 lbs/acre, respectively.

As a note, rates for liquid fertilizers are entered in gal/acre. The Density value entered on the Fertilizers library screen is then used to calculate the lbs/acre of N, P_2O_5, and K_2O supplied by the given volume of liquid fertilizer in the following manner:

N: (9 gal/acre) x (11.3 lbs/gal) x (21%N) = 21 lbs/acre N
P_2O_5: (9 gal/acre) x (11.3 lbs/gal) x (17% P_2O_5) = 17 lbs/acre P_2O_5
K_2O: (9 gal/acre) x (11.3 lbs/gal) x (0% K_2O) = 0 lbs/acre K_2O

Now toggle to the Fields—Fertilizers screen and select "May-Aug" for the Timing and "Subsurface Banded" for the Application Method as shown in Figure 15.24 below. This will complete the Phosphorus Index inputs for this fertilizer application.

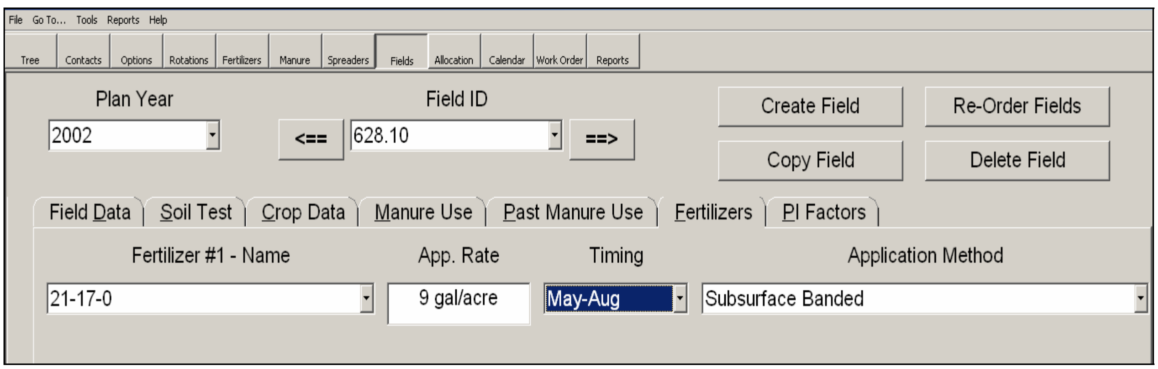


Figure 15.24

Manure Allocation for Field 628.10: Depending on manure quantities and environmental risk indices, the remainder of the nutrient requirement may be supplied by manure. Cropware 2.0 enables the user to choose up to two manure applications per field per plan year. For instance, the user can plan two applications each from a different source, application method, timing, and/or rate. This operates under the assumption that each application covers the entire field. Planning with two manure sources enables the plan to better reflect field operations and more site-specifically define applications relative to the conservation of ammonia-N in manure and the Phosphorus Index.

As an example of one option for allocating manure to field 628.10, scroll all the way to the left to view the "manure" columns. Click in the common "Primary Source" cell for field 628.10 and select the Main Barn from the drop-down list. Next, select the Main 2002 Manure Test and enter a rate of 6000 gallons/acre, as shown on Figure 15.25.

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units
3982.01	19.6	AGT3	0	0	0	None	N/A		N/A
3982.02	28.4	COS2	85	0	0	None	N/A		N/A
3982.03	24.7	AGT4	0	0	0	None	N/A		N/A
3982.04	18.2	AGT2	0	10	0	None	N/A		N/A
3982.05	17.9	COS2	51	20	0	None	N/A		N/A
3982.06	16.5	AGE1	0	10	20	None	N/A		N/A
3982.07	25.6	COS4	109	25	0	None	N/A		N/A
3982.08	13.3	GIT19	196	25	83	None	N/A		N/A
3982.09	26.9	GIT19	196	0	0	None	N/A		N/A
628.10	17.1	COS3	93	30	0	Main Barn	Main 2002	6,000	gal/acre

Figure 15.25

After choosing the starter fertilizer and 6000 gallons of Main Barn manure, field 628.10 still requires 38 lbs of N to meet the crop requirement (see "N Balance" column). **Try to satisfy the remaining N guideline with Heifer Barn manure. Because the farm has approximately 4 months of manure storage and tries to incorporate manure quickly after application in the spring, change the application method of this second coat of manure from "Top Dress/Incorp. After 5 Days" to "Spring Incorp. Within 2 Days" on the Fields—Manure Use screen. Now toggle back to the Allocation screen, click into the "Secondary Source" column for field 628.10 and enter an amount of Heifer Barn manure until the N Balance is roughly zero.**

How much did you allocate?…10 tons/acre.
What is the P_2O_5 balance?…117 lbs/acre.
How about the K_2O balance?…230 lbs/acre. Why such an imbalance?
The rate(s) of manure application(s) entered on the Allocation screen is used in the Phosphorus Index ratings. What are the Phosphorus Index scores now?

Click on the "Update NMP" button to update the manure inventories for the Heifer Barn and Main Barn. The allocation of 6,000 gallons/acre from the Main Barn and 10 tons/acre form the Heifer Barn to field 628.10 (17.1 acres) amounts to 102,600 gallons of Main Barn manure and 171 tons of Heifer Barn manure.

Fertilizer and Manure Allocation for the Entire Farm: You've now balanced one field. **Realizing that the nutrient management plan requires an integration of all fields and all manure sources, enter the following manure and fertilizer data from Table 15.23 into the Allocation Screen.** Keep an eye on the changes in the Manure Balance, Nutrient Balances, the Phosphorus Index ratings, and whether the application is appropriate relative to the Nitrate Leaching Index. As you choose what manure to apply to what fields, you also may want to keep in mind the number of months of storage for a given manure source, the window when a field is open for manure application, the consistency of the manure, the number of different application rates practical on the farm, and any equipment or labor constraints that may favor one manure over another on a particular field. For example, liquid manures often interfere less with the re-growth of hayfields than solid manures, or a manure source with little storage capacity may need to be applied across a variety of fields so as to allow spreading opportunities throughout the year, or the number of recommended application rates may not be currently achievable on the farm, or it may be more cost effective to haul a more nutrient dense manure a greater distance.

Table 15.23

	Manure				**Fertilizer**			
Field ID	Manure Application	Manure Source	Manure Test	Manure Rate (/acre)	Fertilizer #1 Name	Fertilizer #1 Rate (/acre)	Fertilizer #2 Name	Fertilizer #2 Rate (/acre)
3982.01	Primary Secondary							
3982.02	Primary Secondary	Main Barn Heifer Barn	Main 2002 Heifer 2002	6000 gal 10 ton	UAN*	6 gal		
3982.03	Primary Secondary	Heifer Barn	Heifer 2002	10 ton				
3982.04	Primary Secondary	Main Barn	Main 2002	3000 gal				
3982.05	Primary Secondary	Main Barn	Main 2002	6000 gal	UAN*	6 gal		
3982.06	Primary Secondary				6-24-24	90 lbs		
3982.07	Primary Secondary	Heifer Barn Main Barn	Heifer 2002 Main 2002	10 ton 6000 gal	21-17-0	9 gal		
3982.08	Primary Secondary	Main Barn	Main 2002	12000 gal	Urea	215 lbs		
3982.09	Primary Secondary	Main Barn	Main 2002	12000 gal	Urea	215 lbs		
628.10	Primary Secondary	Main Barn Heifer Barn	Main 2002 Heifer 2002	6000 gal 10 ton	21-17-0	9 gal		

*Note: UAN = Urea Ammonium Nitrate

Notice the changes in nutrient balances and Phosphorus Index ratings resulting from the additions of manure and fertilizer to the plan.

After clicking the "Update NMP" button, notice the Manure Summary, shown below as Figure 15.26. The Manure Balance is 158,110 gallons for the Main Barn and -117 tons for the Heifer Barn. The balances are safely within the manure storage capacity for both the Main Barn (350,000 gallons of storage capacity) and Heifer Barn (300 tons of storage capacity). The Manure Balance will be carried over to the "Amount at Start of Plan Year" on the Manure—Manure Source Data screen for the 2003 plan year.

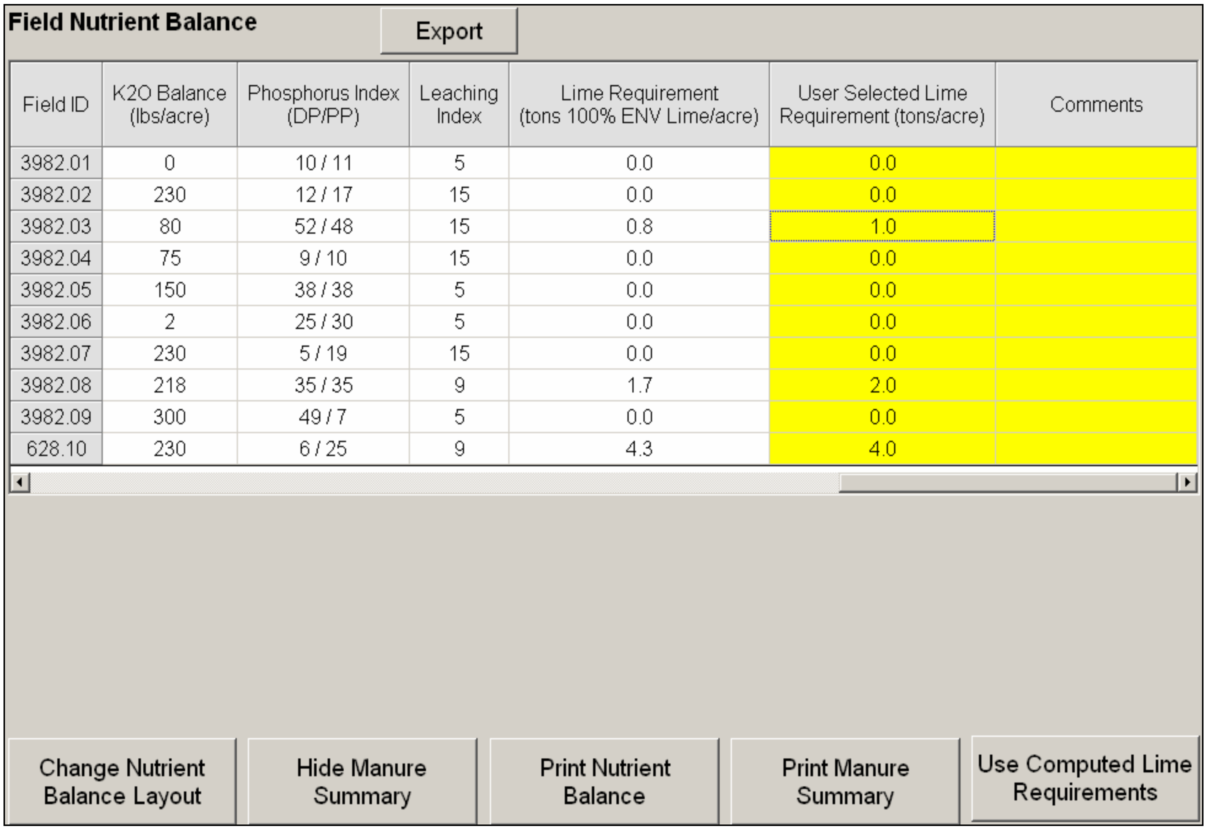
Manure Summary Export

	Total Tons	Total Gal	Main Barn	Heifer Barn
Manure Available For Application	1075.00	1,229,110	1,229,110 gal	1075.00 tons
Manure Allocated	958.00	1,071,000	1,071,000 gal	958.00 tons
Manure Balance	117.00	158,110	158,110 gal	117.00 tons

Figure 15.26

You can print the Manure Summary or Nutrient Balance with the appropriate "Print" button on the lower right portion of the Allocation Screen. Similarly, each grid can be exported to an .rtf file (compatible with Microsoft Word®) by clicking on the appropriate "Export" button.

46. *Allocating Lime to Fields:* Lime guidelines, based on crop, current soil test, soil type, and tillage depth, are provided on the Allocation screen as well. The lime requirement is not modeled between soil samples, but instead based on the actual soil analysis. **Scroll to the far right on the Allocation screen and notice the "Lime Requirement" and "User Selected Lime Requirement" columns.** Computed lime guidelines for 100% ENV lime are provided in the "Lime Requirement" column. The user must choose the rate of 100% ENV lime to be applied for the current plan year in the "User Selected Lime Requirement" column. This can be accomplished by entering lime guidelines directly in the column or by clicking the "Use Computed Lime Requirement" button in the lower left corner of the screen. **Enter the User Selected Lime Requirements as shown in Figure 15.27, below.**



Field ID	K2O Balance (lbs/acre)	Phosphorus Index (DP/PP)	Leaching Index	Lime Requirement (tons 100% ENV Lime/acre)	User Selected Lime Requirement (tons/acre)	Comments
3982.01	0	10 / 11	5	0.0	0.0	
3982.02	230	12 / 17	15	0.0	0.0	
3982.03	80	52 / 48	15	0.8	1.0	
3982.04	75	9 / 10	15	0.0	0.0	
3982.05	150	38 / 38	5	0.0	0.0	
3982.06	2	25 / 30	5	0.0	0.0	
3982.07	230	5 / 19	15	0.0	0.0	
3982.08	218	35 / 35	9	1.7	2.0	
3982.09	300	49 / 7	5	0.0	0.0	
628.10	230	6 / 25	9	4.3	4.0	

Figure 15.27

47. *Allocation Screen What If's:* So much of the balancing done on the Allocation screen depends on your definition of manure sources and fields from the previous screens. Take a moment to assess the effects of individual inputs on the nutrient management plan developed in this tutorial.

    Effect of % Legume in Sod on Crop N Requirement: **Considering field 3982.05, notice the "Total N Requirement" (51 lbs/acre) for the 2nd year corn field on the Allocation screen. Toggle to field 3982.05 on the Fields—Field Data screen and change the "Past or Present Sod" input from "1-25% Legume" to "+50% Legume". Flip to the Allocation screen and note the new Total N Requirement.** Any difference? If so, why?

    Effect of Soil Test P Level on Crop P_2O_5 Requirement: **Continuing with field 3982.05, return the "Past or Present Sod" input to "1-25% Legume". Move to the Fields—Soil Test screen and switch the "Soil Test P" value to 3 lbs/acre P and toggle to the Allocation screen to assess the "Total P Requirement". Repeat this progression for the following Soil Test P values: 7, 20, 45, and, finally, return back to the original 11 lbs/acre.**

    Effect of Years Since Sod on Crop N Requirement: **Continuing with field 3982.05, move to the Fields—Crop Data screen. Click on 2001, such that the**

crop rotation sequence rolls, making 2002 1st year COS after AGT. Toggle to the Allocation screen and assess the new "Total N Requirement". Any difference? If so, why?

Effect of Manure Application Method on Application Rate to Satisfy Crop N requirement: **Continuing with field 3982.05, go to the "Fields—Crop Data screen" and roll the crop rotation sequence back to the original setting, making 2002 2nd year COS after AGT. Now, switch to the Fields—Manure Use screen and make sure the Application Method is "Top Dress or Incorporated After 5 Days". Go to the Allocation screen and note the "N Balance (lbs/acre)". Toggle back to the Fields—Manure Use screen and switch the Application Method to "Spring Incorporation Within 1 Day". Go to the Allocation screen and note the "N Balance (lbs/acre)" now.** *Any difference? If so, why?*

Effect of Manure Application Method on Phosphorus Index Rating: **Continuing with field 3982.05, while in the Allocation screen, note the Phosphorus Index ratings (DP and PP). Now, go to the Fields—Manure Use screen and change the Application Method back to "Top Dress or Incorporated After 5 Days". Toggle back to the Allocation screen and note the updated Phosphorus Index ratings (DP and PP).** *Any difference? If so, why?*

Effect of Manure Application Timing on Phosphorus Index Rating: **Continuing with field 3982.05, go to the Fields—Manure Use screen and set the Application Timing to "May-Aug". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP). Now, go back to the Fields—Manure Use screen and change current Application Timing to "Feb-Apr". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP).** *Any difference? If so, why?*

15.12 CALENDAR SCREEN

Calendar Screen – General Information

48. *Calendar:* The Calendar screen acts as a worksheet to budget the timing of manure applications across the Plan Year. An important consideration in the development of a nutrient management plan is determining whether the applications of manure planned on the Allocation screen are feasible given temporal constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor, machinery, or manure storage available to spread all the manure between corn harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides a Calendar with a running manure inventory to plan the timing of manure applications for each month of the year.

Calendar Screen – Temporally Planning Manure Applications with the Calendar

49. *Temporally Planning Manure Applications with the Calendar:* A calendar worksheet is created for all manure sources on the farm for each plan year as well as for individual manure sources. **Enter the Calendar screen. Your basic goals in the Calendar screen are to allocate the "Planned Quantity" of manure per field (*not* per acre) across un-shaded months, such that:**
    1. **The "Quantity Difference" per field is zero.**
    2. **The "Ending manure Inventory" per month is greater than or equal to zero, but less than the manure storage capacity (if any) associated with the selected manure source.**
    3. **The "Phosphorus Index" ratings are best minimized.**

    All of the variables above can be adjusted on the Calendar screen. See Figure 15.28 for the basic layout of the Calendar screen.

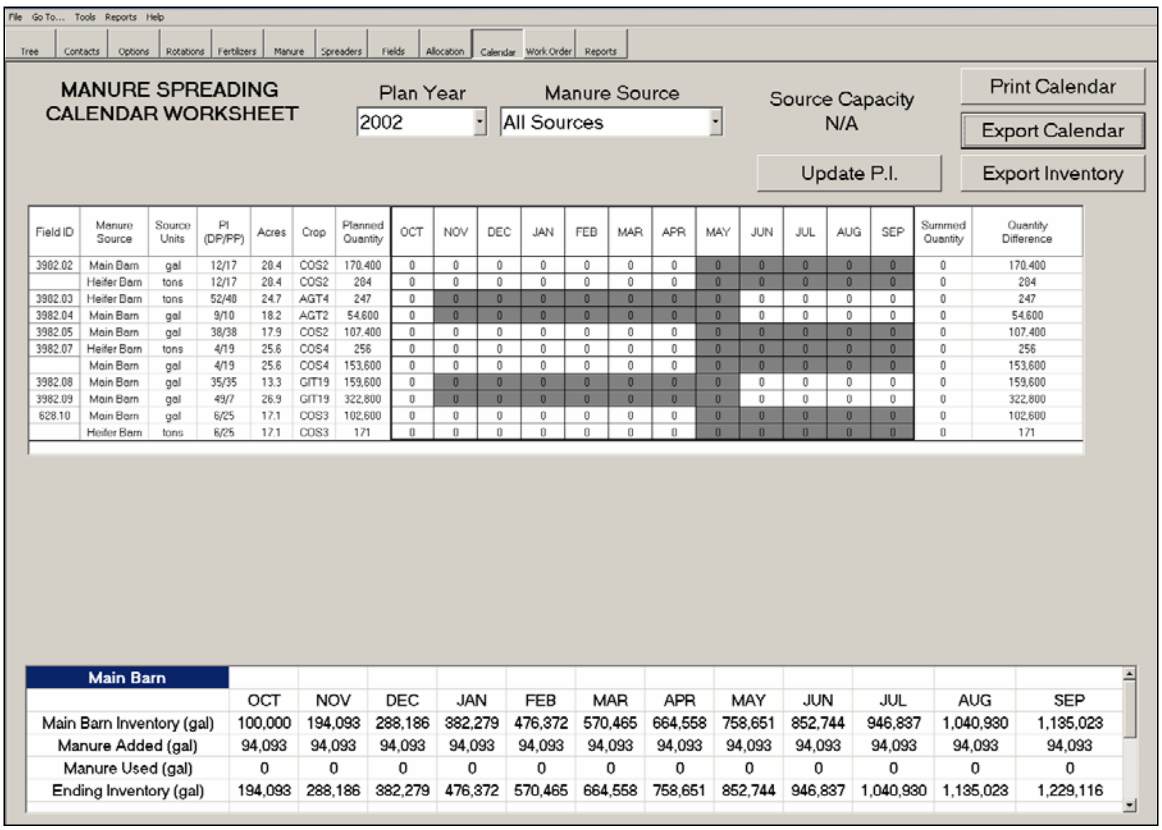


Figure 15.28

The manure inventory grid at the bottom of the screen is scrollable to show the running manure inventories for all sources on the farm. The quantities in the "Manure Added" row of the inventory grid can be adjusted on a monthly basis to reflect different amounts of manure produced by the manure source throughout the year, for instance on a grazing farm. The default values are calculated by dividing the total amount of manure produced annually from the Manure—

Manure Source Data screen by 12, the number of months in a plan year. The default values may be changed in the "Manure Added" row, with the balance of the annual manure production kept in the last month of the plan year (September in the case above). Likewise, if the "Estimate Using Number and Average Weight of Manure Applications" method was used to determine the annual amount of manure produced on the Manure—Manure Source Data screen, then those values entered for each month will populate the respective months of the "Manure Added" row of the Calendar screen. **This can be seen by scrolling to the Heifer Barn portion of the manure inventory grid and observing the monthly "Manure Added" values (Figure 15.29).**

Heifer Barn												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	175	400	475	550	625	625	625	825	825	825	825	1075
Manure Added (tons)	225	75	75	75	0	0	200	0	0	0	250	0
Manure Used (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Ending Inventory (tons)	400	475	550	625	625	625	825	825	825	825	1,075	1,075

Figure 15.29

The pattern of "Manure Added" values reflects the concentrated application events during the year, feasible through the presence of manure storage on the farm. In reality, manure is continually added to the system and the exact pattern of manure applications from storage will not likely be matched with this year's planned applications. As a result, for a farm with manure storage, change the "Manure Added" values to best reflect the amount of manure added to storage each month. **As a start, divide the total amount of manure produced per year by the 12 months of the plan year and enter the value for each month of the "Manure Added" row (i.e. for the Heifer Barn 900 tons divided by 12 months equals 75 tons/month), as in Figure 15.30.** If you have knowledge of seasonal variation in quantity of manure added to storage, entering values to reflect such variation would represent an improvement over the average monthly value suggested above. **For this tutorial, assume that equal amounts of manure are added to the systems each month, so enter 75 tons for each month of the "Manure Added" row.**

Heifer Barn												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	175	250	325	400	475	550	625	700	775	850	925	1000
Manure Added (tons)	75	75	75	75	75	75	75	75	75	75	75	75
Manure Used (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Ending Inventory (tons)	250	325	400	475	550	625	700	775	850	925	1,000	1,075

Figure 15.30

Quantity Difference and Ending Manure Inventory Considerations: Find the Calendar row for field 628.10 in Figure 15.28, above. Remember that we allocated manure from both the Main Barn and the Heifer Barn to this field. You'll notice that the "Planned Quantity" of manure for this field is 102,600 gallons from the Main Barn and 171 tons from the Heifer Barn. **Next, scroll to the Main Barn in the manure inventory grid at the bottom of the screen. Find the "Ending Inventory" for October, the first month of the plan year as defined on the Options screen; you should see 194,093 gallons. This end-of-the-month inventory is comprised of the Main Barn Inventory plus the Manure Added during October less the Manure Used during October. Note the 100,000 gallon "Main Barn Inventory" at the beginning of October.** This quantity was carried over from the last plan year, as defined in the "Manure Balance" cell on the Allocation screen for the last plan year and then the "Amount at Start of Plan Year" cell on the Manure screen for the current plan year. **Begin populating the Calendar screen by entering the following amount of manure according to Table 15.24 below.**

Table 15.24

Field ID	OCT (gal)
628.10	184

Remember that the total storage capacity for the Main Barn system as defined on the Manure screen, is approximately 350,000 gallons. **Is the Ending Inventory for October less than the manure storage capacity? Has the entire Planned Quantity of manure been allocated for the field (i.e. is the Quantity Difference approximately zero)? Complete the Calendar with the following allocations.**

Table 15.25

Field ID	Manure Source	Source Units	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
3982.02	Main Barn	gal	90,589	79,811	0	0	0	0	0	0	0	0	0	0
	Heifer Barn	tons	0	0	0	0	0	50	234	0	0	0	0	0
3982.03	Heifer Barn	tons	0	0	0	0	0	0	0	0	0	0	247	0
3982.04	Main Barn	gal	0	0	0	0	0	0	0	0	0	0	54,600	0
3982.05	Main Barn	gal	0	0	0	0	0	107,400	0	0	0	0	0	0
3982.07	Heifer Barn	tons	256	0	0	0	0	0	0	0	0	0	0	0
	Main Barn	gal	0	0	0	0	0	0	153,600	0	0	0	0	0
3982.08	Main Barn	gal	0	0	0	0	0	0	0	0	79,800	79,800	0	0
3982.09	Main Barn	gal	0	0	0	0	0	0	0	0	161,400	161,400	0	0
628.10	Main Barn	gal	102,600	0	0	0	0	0	0	0	0	0	0	0
	Heifer Barn	tons	0	0	0	0	0	0	171	0	0	0	0	0

Once entered, notice that the "Quantity Difference" for each field is nearly zero. Also, note the "Ending Inventories" for each manure source in the Figure 15.31, below. Is the Ending Inventory for the Main Barn within the storage capacity (i.e. 350,000 gallons)? For the Heifer Barn (i.e 300 tons)?

Main Barn												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Main Barn Inventory (gal)	100,000	904	15,186	109,279	203,372	297,465	284,158	224,651	318,744	171,637	24,530	64,023
Manure Added (gal)	94,093	94,093	94,093	94,093	94,093	94,093	94,093	94,093	94,093	94,093	94,093	94,093
Manure Used (gal)	193,189	79,811	0	0	0	107,400	153,600	0	241,200	241,200	54,600	0
Ending Inventory (gal)	904	15,186	109,279	203,372	297,465	284,158	224,651	318,744	171,637	24,530	64,023	158,116

Heifer Barn												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	175	-6	69	144	219	294	319	-11	64	139	214	42
Manure Added (tons)	75	75	75	75	75	75	75	75	75	75	75	75
Manure Used (tons)	256	0	0	0	0	50	405	0	0	0	247	0
Ending Inventory (tons)	-6	69	144	219	294	319	-11	64	139	214	42	117

Figure 15.31

The Calendar screen is helpful in assessing the feasibility of the manure management plan, thereby highlighting opportunities to change the system for more flexibility and efficiency, in terms of both production and environmental management.

Calendar Screen – Phosphorus Index Considerations

50. *Phosphorus Index Considerations:* The more temporally specific plan developed in the Calendar screen can be used to update the "Timing" variable for manure applications for the Phosphorus Index. **By clicking on the "Update P.I." button and confirming that you want to change the manure application timing setting for all of the fields, you'll be setting the manure application "Timing" on the Fields—Manure Use screen to correspond with the timings set on the Calendar screen. Based on this change, the Phosphorus Index ratings displayed on both the Allocation and Calendar screens will be updated.**

The manure application timing for the Phosphorus Index is defined for each application (i.e. primary, secondary) within the following four periods, representing the lowest to highest risk of phosphorus loss: "May-Aug", "Sep-Oct", "Nov-Jan", and "Feb-Apr". If a timing defined on the Calendar screen spans two or more periods, Cropware will define the timing for the application to the range of months that represents the highest risk according to the Phosphorus Index. If two manure application events are planned for a field, the timing will be defined for each application and combined to calculate a single Dissolved Phosphorus Index rating and Particulate Phosphorus Index Rating for the entire field.

After clicking the Update P.I. button, the following timings in Table 15.26 should now be present on the Fields—Manure Use screen.

Table 15.26

Field ID	Primary Application Timing	Secondary Application Timing
3982.01	Choose any -- No manure applied	Choose any -- No manure applied
3982.02	Nov-Jan	Feb-Apr
3982.03	May-Aug	Choose any -- No manure applied
3982.04	May-Aug	Choose any -- No manure applied
3982.05	Feb-Apr	Choose any -- No manure applied
3982.06	Choose any -- No manure applied	Choose any -- No manure applied
3982.07	Sep-Oct	Feb-Apr
3982.08	May-Aug	Choose any -- No manure applied
3982.09	May-Aug	Choose any -- No manure applied
628.10	Feb-Apr	Feb-Apr

You will also likely need to update the manure "Application Method" after completing the Calendar screen. The manure "Application Method" is used in the Phosphorus Index calculations and should be appropriate for the Timing of the planned manure application. Within the same Timing period, you may also wish to alter the Application Method to impact ammonia-N conservation and/or Phosphorus Index ratings; such adjustments can be aided by the presence of manure storage on the farm. The manure Application Method can only be changed on the Fields—Manure Use screen. **Change the "Application Method" in the Fields—Manure use screen to the following.**

Table 15.27

Field ID	Primary Application Method	Secondary Application Method
3982.01	Choose any -- No manure applied	Choose any -- No manure applied
3982.02	Top Dress/Incorp. After 5 days	Spring Incorp. Within 2 Days
3982.03	Top Dress/Incorp. After 5 days	Choose any -- No manure applied
3982.04	Top Dress/Incorp. After 5 days	Choose any -- No manure applied
3982.05	Top Dress/Incorp. After 5 days	Choose any -- No manure applied
3982.06	Choose any -- No manure applied	Choose any -- No manure applied
3982.07	Top Dress/Incorp. After 5 days	Spring Incorp. Within 2 Days
3982.08	Top Dress/Incorp. After 5 days	Choose any -- No manure applied
3982.09	Top Dress/Incorp. After 5 days	Choose any -- No manure applied
628.10	Top Dress/Incorp. After 5 days	Spring Incorp. Within 2 Days

Congratulations! You just completed the first iteration of Nutrient Management Planning with Cropware….but there's more! Up to this point in the tutorial, the Phosphorus Index has been calculated with initial estimations of manure application timing, and method. Once the Calendar screen is completed and the manure application timing and method data are updated in the Fields—Manure Use screens, you can assess a more realistic Phosphorus Index rating on the Allocation screen. Go to the Allocation screen and scroll to the "Phosphorus Index" column. Compare both the Dissolved Phosphorus (DP) Index ratings and the Particulate Phosphorus (PP) Index ratings with the Phosphorus Index ranking rubric in Table 15.28. The higher ranking of the two indices will determine the necessary management.

Table 15.28

Phosphorus Index Rating	Site Vulnerability	Management
< 50	Low	N based management
50 - 74	Medium	N based management with BMPs
75 - 99	High	P applications to crop removal
≥ 100	Very High	No P_2O_5 fertilizer or manure application

The current plan is balanced on nitrogen, so any fields in the High or Very High ranking will require either: 1) switching to phosphorus crop removal planning or no phosphorus application at all, respectively, or 2) changing field management to reduce the ranking to at least the Medium risk category. Such changes could include reducing manure and fertilizer P application rates, improving P application timing and methods, establishing within-field buffers to increase the flow distance to the nearest watercourse, adopting a different crop rotation or field configuration to reduce soil erosion, addressing a concentrated flow, etc. As you can imagine, such changes will result in a different use of manure and fertilizer relative to the first iteration, so a second iteration through the Allocation screen, Calendar screen, Fields screen, and back to the Allocation screen is necessary to update the plan (as illustrated in Figure 15.1). The first iteration of the tutorial resulted in all low and medium ranked fields, so move on to the Work Orders screen to create detailed manure application instructions and records.

15.13 Work Order Screen

Work Order Screen – General Information

51. *Work Order:* This screen is used to produce a "work order" for the person(s) applying manure. It allows you to create a tactical plan of how many loads to apply per field per

month per spreader based on the completed Calendar screen. The Work Order itself, once printed, provides space for recording the number of loads actually spread and any relevant comments from the field. Once the completed Work Order is returned to the farm office, the number of loads applied can be entered to create a Manure Application Report for the farm.

Work Order Screen – Creating a Work Order

52. *Creating a Basic Work Order:* **Enter the data in Figure 15.32 to the Work Order screen.**

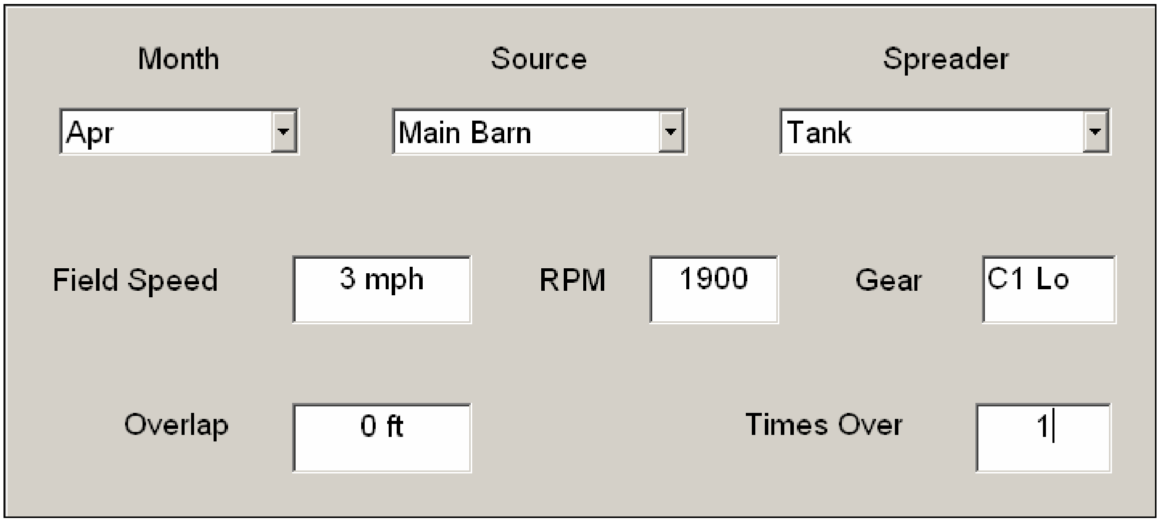


Figure 15.32

Spreader settings, such as Field Speed, RPM, Gear, Overlap, and Times Over can be determined by calibrating the spreader. For the month of April, field 628.10 is the only field scheduled to receive manure from the Main Barn, based on your work in the Calendar screen.

Overlap or Times Over: To determine the amount of Overlap or, similarly, the number of Times to apply manure Over the entire field, keep in mind the calibrated rate of the spreader and the planned rate per acre from the Allocation screen. For instance, assume that the Tank spreader settings entered in Figure 15.32 above result in a rate of 3,000 gal/acre, according to your calibration activities. The planned rate/acre for field 3982.07 is 6,000 gallons, so the Tank spreader would need to apply manure two Times Over the field to achieve the planned rate. For this example, though, assume that the Tank spreader *is* calibrated for 6,000 gallons/acre, so the Times Over should be 1.

Check the "Select" box to add field 3982.07 to the Work Order and add any "Site Comments". Click on "View Work Order" and a printable Work Order is created as shown in Figure 15.33 below.

Manure Application Work Order (The Storage Farm - 6/22/2003)

Spreader: Tank Manure Source: Main Barn Month: Apr

1. Spread At: Field Speed of 3 mph in C1 Lo Gear at 1900 RPM with 0 ft. Overlap
2. Spread evenly over entire field 1 Times Over
3. Stop spreading when Tally of Loads Applied = Loads Required

Field ID	Field Name	Acres	Site Comment	Loads Required	Driver Name	Application Date(s)	Tally of Loads Applied Per Field	Application Comments
3982.07	7	26		44				

Figure 15.33

Multiple Spreaders Applying Manure to a Single Field the Same Month: Two methods exist.

1) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. Create and Print a Work Order for each spreader, outlining the spreader settings. Then multiply the "Loads Required" by the proportion of the manure handled by that spreader and manually write in the corrected Loads Required number on the printed Work Order.
2) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. To be safe, use the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized specifically for creating Work Orders. Next, go to the Calendar screen and find the field and month of interest within a given manure source. For each spreader, multiply the total quantity of manure allocated for the field during that month by the proportion of the manure to be applied by the particular spreader. Don't be concerned about the impact of such a change on the Allocation screen. Go to the Work Order screen and select the "Month", "Manure Source", and "Spreader". The "Monthly Planned Quantity" has now been updated based on your changes for that spreader in the Calendar screen. Check the "Select" box and print the work order. Repeat entire process for the remaining spreaders, unless the you assume that each spreader will apply the same proportion of the Monthly Planned Quantity, in which case you can simply select another spreader from the Spreader drop-down menu and print a Work Order.

Single Spreader Applying Manure to Different Fields with Different Spreader Settings in the Same Month: If a single spreader is used with multiple spreader settings within the same month, a Work Order for each spreader setting should be created. Choose the Month, Manure Source, and Spreader. Select the spreader settings necessary to achieve the desired rate of application, as determined by your calibration activities. Check the Select box for those fields to receive manure with the chosen spreader settings. View the Work Order and Print. Then change the spreader settings and repeat for fields requiring different rates.

Creating a Report of the Number of Loads Required for an Entire Plan Year Across All Fields: Some planners and producers will prefer to create a report of the number of loads required for a given spreader for the entire plan year across all fields receiving manure from a particular manure source. To accomplish this, choose the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized for the creating this specific report. Switch to the Calendar screen and sum all of the manure applications across the entire plan year for each manure source. Enter the totals per field into a single month column, for example October. Toggle to the Work Order screen. Select the month in which the annual totals were entered, October in this example. Select the Manure Source, Spreader, and spreader settings, if applicable to this somewhat coarse work order. Check the Select box for all of the fields and View the Work Order and Print. The month, October in this case, does not apply as this is a report for the entire plan year, so it can be manually blocked-out on the printed report. This process can be repeated for all manure sources and spreaders.

Work Order Screen – Creating a Manure Application Report

53. *Creating the Manure Application Report:* Once the person applying the manure has returned the completed Work Order, the tally of loads can be used to create a record of manure applications per month on a field-by-field basis for the Plan Year. **For example, assume that the Tank spreader was used to apply 44 loads to field 3982.07 in April, per the Work Order in Figure 15.33 above. Multiply the number of loads applied (44) by the capacity per load (3500 gal found on the Spreaders screen). The resulting total is 154,00 gallons. Return to the Work Order screen and choose Apr, Main Barn, and Tank. Check the "Done" box to signal that manure applications are finished on field 3982.07 for the month and enter 154,000 gallons into the teal-shaded "Quantity Applied" column. A running total of the amount of manure applied to field 3982.07 in April with the Tank spreader is kept in the "Total Quantity Applied" column. Click on "View Manure Application Report". You'll notice that 154,000 gallons of manure have been recorded for field 3982.07 in April.**

15.14 Reports

Reports – Cover Page

54. *Cover Page Report:* **Go the Reports screen and check the "Cover Page" box. Click on "View Report" and Print.**

Reports – Custom Report

55. *Custom Report:* Use the Custom Report option to create reports to your specifications. **De-select the "Cover Page" box and check the "Custom Report" box. Click on**

"View Report, "Settings", and the "Custom Report" tab. Gain experience in building custom reports by working through the following examples.

Create a Simple Recipe for Implementation: **Click "Clear All" under "Report Fields" and check the following items:**

Field ID, Acres, Current Crop, Fertilizer #1 Name, Fertilizer #1 Units, Fertilizer #1 Rate, and Fertilizer #1 Applied.

"Highlight Fertilizer #1 Rate" and using the large Up arrow, shift the highlighted item up the list or above "Fertilizer #1 Units". This changes the column order of items from left to right across the Custom Report. Re-check the "Fertilizer #1 Rate", if necessary.

Save Report Settings: Once you've created a useful Custom Report, you can save it as a template for use with other nutrient management plans on other farms. The selected data columns, sorts, queries, formats, etc. will be maintained, but the data for the report will be pulled from the plan currently loaded in Cropware. **Click Save Report Settings, keep the directory as My Documents, and name the file: Fertilizer #1 Applications. Hit Save.**

Load Report Settings: **Click on Settings and within the Custom Report Tab click on the Load Report Settings button. Select the file named: Fertilizer #1 Applications.set and hit Open.** You should see your originally selected report options on the Custom Report Settings screen. **Click on Return to Reports to view the report.**

Click "Return to Reports" to view the Custom Report, as in Figure 15.34.

Custom Report

ID	Acres	Current Crop	Fert. #1 Name	Fert. #1 Rate/acre	Fert. #1 Units	Fert. #1 Applied
3982.01	19.6	AGT	None	0	N/A	0
3982.02	28.4	COS	Urea Ammonium Nitrate	6	gal	170
3982.03	24.7	AGT	None	0	N/A	0
3982.04	18.2	AGT	None	0	N/A	0
3982.05	17.9	COS	Urea Ammonium Nitrate	6	gal	107
3982.06	16.5	AGE	6-24-24	90	lbs	1,485
3982.07	25.6	COS	21-17-0	9	gal	230
3982.08	13.3	GIT	Urea	215	lbs	2,860
3982.09	26.9	GIT	Urea	215	lbs	5,784
628.10	17.1	COS	21-17-0	9	gal	154

Figure 15.34

Export Report: **Click Export Report to save the report as a Rich Text File (.rtf) in your chosen directory.**

Print Report: **Click on the Printer icon above the report.**

Create a Custom Report Using the Primary and Secondary Sorts, Column Constraints, and Row Constraints: **Click on "Settings" and the "Custom Report" tab.** For this report you'll consider the N, P_2O_5, and K_2O requirements for each field, grouped by crop and P_2O_5 requirement. This report is helpful for developing an initial starter fertilizer plan. **Click on "Clear All" under the Report Fields menu and select the following:**

> **Field ID, Acres, Current Crop, N Req. (lbs/acre), P Req. (lbs/acre), K Req. (lbs/acre), and Comments**

In the Primary Sort menu, type "C" to find and select "Current Crop" and in the Secondary Sort, type "P" to find and select "P Req (lbs/acre)". Sort both in ascending order, resulting in a report with groupings by current crop and, within each crop, groupings of similar P_2O_5 requirements.

Next, in the Column Constraints section, we would like to total the acres for all fields that share the same crop and P_2O_5 requirement. **Select "Acres" from the "Column to Total" drop-down menu, "Sum" in the "Function" menu, and "Current Crop" from the "Column to Group By" menu.** Checking "Show Grand Total" will total the acres across all fields as well as sub-totals per the "Columns to Group By" selection, current crop in this case. If "Only Show Grand Total" is checked, the sub-totals will not appear. **Check "Show Grand Total". Finally, make sure that the "Time Range" in the lower left corner is set to "2002" to "2002" in order to capture only the current plan year.**

In the Row Constraints, we're interested in selecting only the fields that could require a starter fertilizer (i.e. those fields to be seeded or planted this year). For this farm, we have corn silage and alfalfa grass mixes that could be planted/seeded during the plan year. Therefore, in the Crops Row Constraint column, click on the following crop codes, indicating: AGE and COS. To deselect any crop, simply click on it a second time. **At this point, the settings should resemble the screen in Figure 15.35, below.**

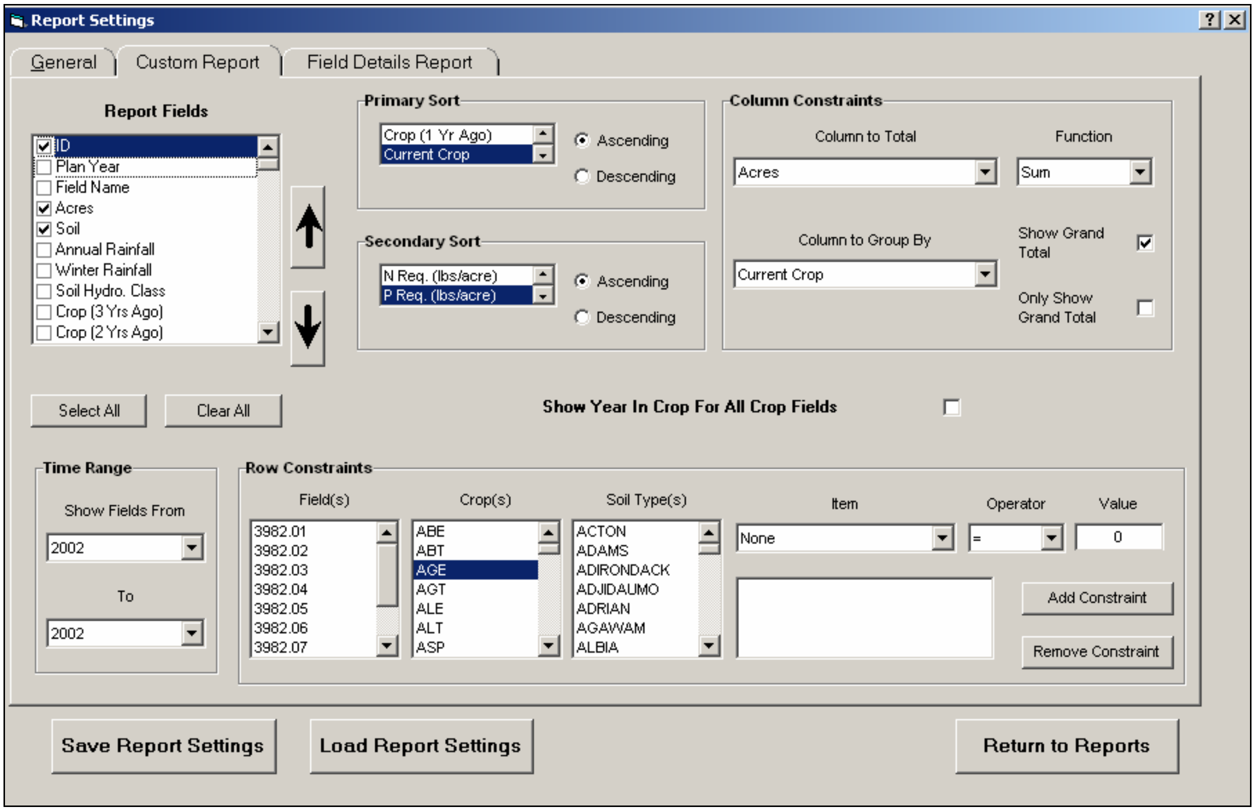


Figure 15.35

Click on "Save Report Settings", name the report template, "Starter Fertilizer Selection Aid", and save it in a file appropriate for your Cropware file management scheme (i.e. where it can be located again in the future!). Click on "Return to Reports" to view the new report, as shown in Figure 15.36.

Custom Report

ID	Acres	Soil	Current Crop	N Req. (lbs/acre)	P Req. (lbs/acre)	K Req. (lbs/acre)	Comments
3982.06	16.5	LANGFORD	AGE	0	10	20	
	16.50						
3982.02	28.4	HOWARD	COS	85	0	0	
3982.05	17.9	BATH	COS	51	20	0	
3982.07	25.6	HOWARD	COS	109	25	0	
628.10	17.1	CHAGRIN	COS	93	30	0	
	89.00						
TOTAL	105.50						

Figure 15.36

As a note, if you check the "Show Year in Crop For All Crop Fields" as in Figure 15.37, then crop code data, such as in the "Current Crop" column in Figure 15.36, above, will be coupled with the year in crop within the rotation (i.e. COS1, AGT4, etc.).

Figure 15.37

Once printed, use the "Comments" column to write in the N-P_2O_5-K_2O fertilizer material of choice and the initial rate (lbs/acre) of application to satisfy the portion of the total nutrient requirement appropriate for starter fertilizer (refer to the Nitrogen, Phosphorus, and Potassium management sections for guidance, here). Based on your notes, choose starter fertilizer materials and rates on the Allocation screen. Now you're in a position to allocate manure and/or additional fertilizers to satisfy the remaining nutrient balance. You may also want to refine your initial starter fertilizer choices at this point.

Creating Custom Reports Using Row Constraints: The most basic use of the Row Constraint function is to build queries in order to subset the farm data. For example, to determine which fields in Plan Year 2002 have a Dissolved Phosphorus (PI-DP) Index of greater than 50, then **perform the following:**

1) **Reset the Report Fields to only include Field ID, Plan Year, Acres, Current Crop, and PI-DP.**
2) **Reset the Primary and Secondary Sorts to None.**
3) **Reset the "Column to Total" in the Column Constraints to None.**
4) **Set the "Time Range" to Show Fields From 2002 to 2002, so as to only analyze the 2002 Plan Year.**
5) **De-select any crops highlighted in the Crops row constraint.**
6) **Select PI-DP from the Item menu.**
7) **Select > from the Operator menu.**
8) **Enter 50 into the Value menu.**
9) **Click "Add Constraint".**
10) **Click Return to Reports.**

See Figure 15.38 for the set-up and Figure 15.39 for the resulting report.

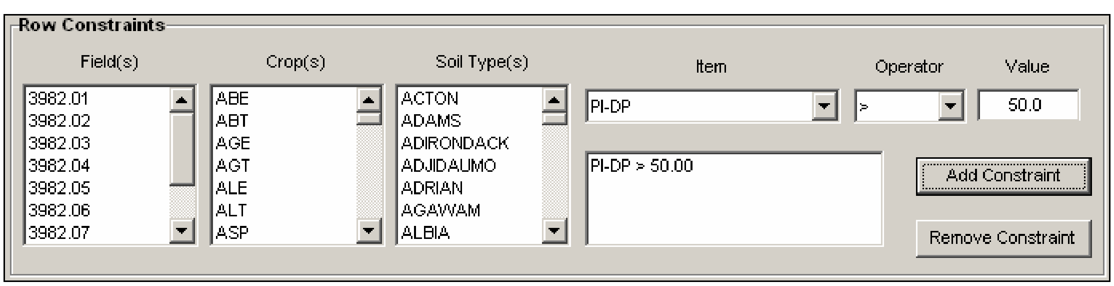


Figure 15.38

Custom Report

ID	Plan Year	Acres	Current Crop	PI-DP
3982.03	2002	24.7	AGT	52

Figure 15.39

Continue to experiment with creating and saving Custom Reports to assist you in planning, implementation, and evaluation of the nutrient management plan.

Reports – Crop, Livestock, and Nutrient Index Summary

56. *Crop, Livestock, and Nutrient Index Summary:* The Crop Summary component of this report provides absolute acreages and proportions of the different crops grown on the land base for the existing plan years. The Livestock Summary and Nutrient Index Summary components are helpful for quantifying changes on the farm overtime, such as increased stocking rate or farm weighted Phosphorus Index values.

Reports – Crop Plan Summary

57. *Crop Plan Summary Report:* The Crop Plan Summary Report provides the acreages of crops for the current plan year, 3 years prior, and 10 years to follow. This report is a summary of the crop rotations of individual fields defined on the Fields—Crop Data screen. Toggling between the Fields—Crop Data screen and the Crop Plan Summary report can aid in crop rotation development during the planning process. Cropware does not couple yield and dry matter measurements with the acreages of various crops. Such information can be coupled with this report to assess whether the current crop rotation plan will provide the necessary quantities of specific crops to meet herd feed requirements, while reducing soil erosion and nutrient loss.

Reports – Nutrient Balance

58. *Nutrient Balance Report:* The purpose of this report is to give the farmer and planner a broad view of the plant, soil and manure nutrient balance of the whole farm for the current and future plan years. Changes in herd numbers, feeding management, land area, crop rotation, manure application method, manure storage, fertilizer use, etc. will impact a farm's nutrient balance over time. This report can help quantify some of those impacts and help plan a progressive future direction.

Reports – Nutrient Management Plan

59. *Nutrient Management Plan:* The Nutrient Management Plan report is a summary of the within field nutrient balance for the current Plan Year. It provides similar information as

found on the Allocation screen, but is reported in a more concise manner. The report is useful for nutrient planning discussions between the farmer and the planner, because it clearly displays nutrient credits as well as how the crop nutrient requirement will be met (or not) by the application of manure and fertilizer nutrients. The reporting of the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index across all the farm fields also provides a clear picture of where additional resources may need to be focused.

Reports – Manure Analysis, Collection, and Storage

60. *Manure Analysis, Collection, and Storage:* The purpose of this report is to give a summary of the manure nutrient composition, quantity, and storage capacity for each waste source. The Manure Nutrient Analysis component is populated by the latest manure analysis for the given manure system. The Annual Nutrient Collection component reports the total annual amount of nitrogen, phosphorus, and potassium collected by a given manure system. The Waste Storage component compares the existing waste storage capacity with the annual amount of manure produced by the source, resulting in the number of months of storage available.

Reports – Manure Analyses

61. *Manure Analyses:* This report lists all of the manure analyses entered into the Manure screen. Farms with manure storage systems often couple historic manure analyses with the estimated quantity in storage to determine the manure allocation plan, because quick tests for manure nutrient composition and immediate allocation planning are not currently feasible options. This concise summary of a farm's manure analyses is helpful in calculating long-term, farm-specific average manure nutrient compositions.

Reports – Fertilizer and Manure Management Summary

62. *Fertilizer and Manure Management Summary:* The Fertilizer and Manure Management Report shows a summary of fertilizer and manure information for all of the fields. In addition to fertilizer and manure application rates, lime requirement and the latest soil sample date are also shown. The lime requirement is calculated to 100% ENV and assumes that no lime has been applied since the last soil test date.

Reports – Fertilizer Shopping List

63. *Fertilizer Shopping List:* The Fertilizer Shopping List is simply a list of the total quantity of each fertilizer used in the current year plan. This report can be used to plan fertilizer purchases or re-evaluate the fertilizer selection. For instance, if the supplier had inadequate inventory of a given fertilizer blend, you may choose to not use that blend and, instead, purchase a different fertilizer for those fields. You can also track fertilizer material costs over the plan years.

Reports – Field Details Report

64. *Field Details Report:* Depending on the preferences of the farmer and/or planner, the Field Details Report can be used as recipe for the nutrient management of a field for the current Plan Year. A one-page report is generated for each field, providing a comprehensive summary of nutrient management inputs and recommendations for the particular field. **To view the report, check the Field Details Report within the “Select Reports” menu and click “View Report”. On the following screen, click “Settings”. Click the “Field Details Report” tab and check the fields of interest. Click “Return to Reports” to review the Field Details Reports for the chosen fields.**

16. Cropware 2.0 Grazing Farm Tutorial

16.1 Cropware 2.0 Grazing Farm Tutorial Introduction

Developing a Plan for a Farm with Pasture

In this tutorial, you will learn how to develop a nutrient management plan for a farm with a pasture using Cropware. The tutorial will provide all the data and direction necessary to build the plan from scratch, but if you would prefer to progress through the tutorial with a completed plan for the Grazing Farm, a "Cropware 2.0 Grazing Farm Tutorial.mdb" file can be loaded into Cropware from the Cropware CD or downloaded from the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu). As another alternative, if you'd like to create the nutrient management plan using only the farm data without any instruction, you can access the basic data in the "Grazing Farm Tutorial (Data only).xls" file from the Cropware CD or the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu).

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16.2 Basic Nutrient Management Planning Flow

Before launching into the nutrient management plan tutorial, it's helpful to look at the big picture. Figure 16.1 below outlines the basic steps involved in nutrient management planning, including characterizing sources of manure and information about the farm fields, using that information to develop agronomic and environmental nutrient guidelines (performed by Cropware), allocating manure and fertilizer to meet crop and environmental goals (this step is often iterative), and generating a plan for implementation and evaluation. It may be helpful to refer back to this flow as you progress through the nutrient management planning process with Cropware.

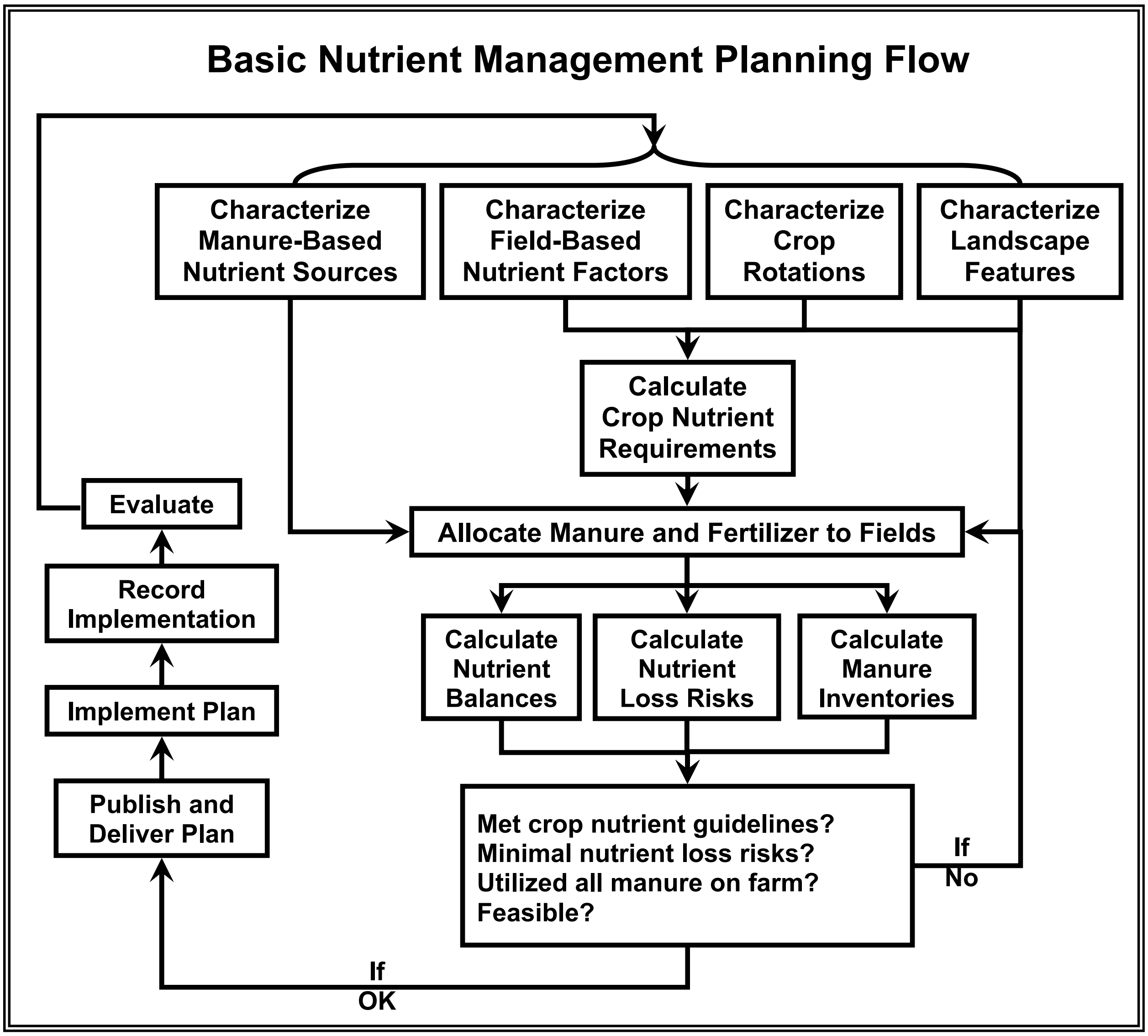


Figure 16.1

16.3 GETTING STARTED

1. *Creating the Plan:* If this is the first time you have opened Cropware, a "No Plan in Memory" alert will be displayed. Click OK. Without a plan in memory, you must click on the File menu and select either New Plan or Load Plan. To create a new plan from scratch with the information provided in this tutorial, click on New Plan, name the plan Grazing Tutorial, and click on Save. Or, to load an existing plan, click on Load Plan, select "Cropware 2.0 Grazing Farm Tutorial.mdb" from the Cropware CD or the Nutrient Management Spear Program website (http://nmsp.css.cornell.edu), and click on Open.

   As an alternative, if you've created the Grazing Farm Tutorial with Cropware 1.0, you may convert that file to the version 2.0 format according to the following instructions: click on Tools; select "Convert Version 1.0 Plan Files to Current Version"; select the "Grazing Tutorial Completed.cpw" file to convert and hit Open; next, name the converted file "Cropware 2.0 Grazing Farm Tutorial.mdb"; and click Save. The previous plan file has been converted to the Cropware 2.0 format and is ready for use.

2. *Saving the Plan:* You will want to save your plan as you populate it with the information provided in the tutorial. Click on the File menu and select Save to save the plan with its current name and folder or choose Save As to change the file name, folder, and/or drive. While in the File menu, you will also notice Auto-Save Plan on Exit option. This option can be selected and de-selected depending on whether you want the plan to be automatically saved when exiting Cropware.

3. *Exiting and Resuming a Cropware Session at a Later Time:* You may want to work through the tutorial during multiple sessions. For safety, save the plan before exiting, unless you've made changes since your last save that you would prefer not to be included in the plan. To exit the program, click on the File Menu, select Exit, and strike OK within the Confirm Exit box. Regardless your choice of Auto-Save options, upon exiting Cropware, a "Cropware Default Settings File.def" will be created in the Cropware folder on your hard drive. The default settings file will direct Cropware to bring up your last plan the next time you start the program, thereby eliminating the need to load the plan, as described in Step 1.

4. *Moving around the Program:* Take a minute to familiarize yourself with the flow of the program.

   Drop-Down Menus

   File: Allows the management of program files as described in Steps 1 through 3.

   Go To…: Provides an alternative method of moving to the various screens relative to clicking on one of the series of buttons below the drop-down menus.

   Tools: Allows the management of future plan years, the importation of soil test data via electronic download, and the conversion of Cropware 1.0 plan files to the Cropware 2.0 format.

Reports: Provides an alternative method of moving directly to a chosen report relative to clicking on the Reports button.

Help: Provides a standard help system describing the use of Cropware, the nutrient management concepts driving the software, as well as a What's This? contact sensitive help system that allows you to click on a point of interest to display information about the item. The Help system is in .PDF format and requires Adobe Acrobat Reader (a free download from www.adobe.com) to be installed.

Planning Buttons: The Planning Buttons lead you from left to right through screens that assist you in characterizing the farm, developing the strategic nutrient management plan, and creating tactical work orders and summary reports. As a note, you must create a manure source on the Manure screen in order to have full use of the screens accessed by the buttons to the right of the Manure button.

Tree: Provides an alternative method of moving among the rotation, fertilizer, plan year, manure source, and field options within a given plan. The tree can be hidden to allow larger views of program screens.

Contacts: Input screen for basic farm and planner contact info and first plan year definition.

Options: Input screen for the plan-wide definition of the first month of the plan year and the default manure application field access per crop.

Rotations: Crop rotation library. Allows you to define the list of crop rotations that will be available for application to individual fields in the Fields screen.

Fertilizers: Fertilizer library. Allows you to define the list of fertilizers that will be available for application to individual fields in the Fields screen.

Manure: Input screen for 1) characterizing the total annual quantity and nutrient content of the manure from each manure source on a farm and 2) defining the manure storage capacity associated with each manure source.

Spreaders: Input screen for the defining the capacity of each manure spreader on a farm.

Fields: Input screen for characterizing each farm field in terms of, for example, soil type, soil nutrient analysis, crop rotation, past and future manure use, fertilizer use, and Phosphorus Index factors.

Allocation: Allows for the allocation of manures and fertilizers to meet agronomic and environmental goals on a field-by-field basis while fully utilizing the manure available for application from all manure sources across the landbase.

Calendar: Allows for the distribution of the manure selected for application on the Allocation screen for each field on a monthly basis within the plan year. Phosphorus Index timings may also be updated based on the monthly allocations of manure. Also, calculates end-of-month manure inventories for each manure source, so that storage capacities (if any) are not exceeded by manure supply.

Work Order: Input screen for the development of manure application work orders for a selected month, manure source, manure spreader, and application rate based on the temporal allocation of manure from the Calendar screen. Also allows for the recording and reporting of manure application activities on a monthly basis for each field.
Reports: Provides pre-designed reports and user-defined, custom reports for communication and documentation of the nutrient management plan.

16.4 CONTACTS SCREEN

5. *Defining Contacts:* **Enter the following information about the farm, planner, and first plan year.**

Table 16.1

Click in….	Enter the following
Producer Name	Grace D. Paddock
Farm Name	The Pasture Farm
Address	27 Breakwire Road
City	Greenville
State	New York
Zip Code	11111
Phone	333-333-3333
FAX	333-333-3333
E-Mail	Paddock@pasturefarm.com
Watershed	Susquehanna
County	Cortland
Township	Harford
Planner Name	Russell Low
Company	CNMP ASAP
Address	10 Recycling Way
City	Cleanville
State	New York
Zip Code	10000
Phone	777-777-7777
FAX	777-777-7777
E-Mail	cnmp@cnmpasap.com
First Plan Year	2002

The Watershed designation is purely a record and not utilized by Cropware. The County and Township designations link the farm-wide plan to a database of site-specific precipitation data for basic manure storage sizing (county precipitation data) and Nitrogen Leaching Index (township precipitation data) determinations. The county and township can be changed on a field-by-field basis in the Fields—Field Data screen for more accurate determination of the Nitrogen Leaching Index. The First Plan Year defines the starting plan year and sets a base for building future plan years. Once the First Plan Year is defined, you'll add subsequent plan years with the Create New Plan Year function within the Tools drop-down menu.

Save plan.

16.5 Options Screen

6. *Defining First Month of the Plan Year:* Click on the down arrow to view the list of months. **Select October.** By selecting October, you are defining the plan year as beginning October 1 and ending September 30. October will be the beginning month displayed on the manure application Calendar screen. You may want to change this definition for the plans that you will create depending on your growing season and plan communication style.

7. *Defining the Default Monthly Field Access as a Function of Current Crop:* This section defines which months a particular crop is open for the application of manure. For example, on many farms a corn field is only accessible for manure applications before planting and after harvest. **Click on the down arrow next to Crop and find COS, the crop code for corn silage (as a note, striking the "C" or "COS" until COS is highlighted may ease your search and is a function found in all of Cropware's drop-down menus).** Cropware's default settings define the period when manure can be physically applied to a COS field as from Oct-Apr. Therefore, this is the default accessibility period for COS for the entire plan. As you'll see later, the accessibility definition can be changed on a field-by-field basis in the Fields—Manure Use screen to accommodate soils with varying trafficability, different planting times, labor and machinery constraints, etc. The accessibility definition results in the shading of months closed to spreading in the Calendar screen, thereby assisting in the temporal allocation of manure.

   Now, select PIT, the code for intensively managed pasture, from the crop drop-down menu. By clicking on the "Allow Manure Application All Months" button, the accessibility is changed accordingly from the default (all of the "Manure Application" buttons are selected).

   Next, by clicking on the "No Spreading Any Month" button you'll notice the crop is now closed to manure applications (all of the "No Spreading" buttons are selected).

   Finally, re-define the accessibility period for PIT by clicking on the months of April through October in the "Manure Application" row.

   Next, re-define the accessibility period for ALE to allow manure applications only from October through March, i.e. you're allowing manure applications before the new seeding, but not after.
   Save plan.

16.6 Rotations Screen

8. *Reviewing Default List of Crop Rotations:* The list of default crop rotations may be modified by creating new rotations or deleting existing rotations. The list of rotations will be utilized in the Fields—Crop Data screen in order to couple a particular field with a specific crop rotation. **Click on the down arrow next to Rotation Name and scroll down the list of default rotations.** By clicking on a particular default rotation, you'll see the individual crops comprising the rotation within the Rotation Crops box.

9. *Creating a New Rotation:* You will likely want to add more rotations in the rotation library for later use in the Fields screen. **Click on the "Create New Rotation" button and name the new rotation, 4 Clover/Grass – 3 Corn Silage. Click OK. Now populate the rotation with individual crops. Click on CGE within the Perennial Crops – Establishment menu and notice CGE appears in the "Rotation Crops" box. Next click on CGT in the Perennial Crops – Established menu three times. Now you've described a rotation containing four years of Clover/Grass. Click on COS three times in the Annual Crops Menu. Now the rotation should look like the following.**

   Table 16.2

Yr 1: CGE
Yr 2: CGT
Yr 3: CGT
Yr 4: CGT
Yr 5: COS
Yr 6: COS
Yr 7: COS

   If you made a mistake in the order, you can change the order of the individual crops by highlighting a particular crop and moving it up or down within the rotation by clicking on the appropriate arrow to the right of the Rotation Crops box.

10. *Deleting a Rotation:* **If you made a mistake and inputted an incorrect crop code or an incorrect number of a certain crop code, you must delete the crop rotation and start over. You will not be using the 4 Clover/Grass – 3 Corn Silage rotation in the tutorial, so delete the rotation by highlighting it in the Rotation Name menu and clicking the "Delete Current Rotation" button. Click OK to confirm the deletion and voila!** As a note, you will not be allowed to delete a rotation from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the rotation is currently utilized upon the attempted deletion.

    Save plan.

16.7 FERTILIZERS SCREEN

11. *Reviewing Default List of Fertilizers:* The list of default crop fertilizers may be modified by creating new fertilizers or deleting existing fertilizers. The list of fertilizers will be utilized in the Fields—Fertilizers screen and the Allocation screen in order to couple a particular field with specific fertilizers. **Scroll down the list of default fertilizers in the Fertilizer menu.** By clicking on a particular default fertilizer, you'll see the following details about the fertilizer: cost (no costs have been entered for the default list of fertilizers), dry or liquid consistency, density (if liquid), and nutrient concentration (%).

12. *Creating a New Fertilizer:* You will likely want to add more fertilizers in the fertilizer library for later use in the Fields screen and the Allocation Screen. **Click on the "Add Fertilizer" button and name the fertilizer, Corn Starter #1. Click OK. With Corn Starter #1 highlighted in the Fertilizer Menu, characterize the fertilizer as follows:**

    Table 16.3

Click in….	Enter the following
Solid or Liquid	Liquid
Density	11.0
Cost	$1.51/gal
N (%)	20
P_2O_5 (%)	10
K_2O (%)	0
B (%)	0
Fe (%)	0
Mg (%)	0
Mn (%)	0
Zn (%)	0
S (%)	0

    Save plan.

13. *Deleting a Fertilizer:* **You will not be using the fertilizer named "Corn Starter #1" in the tutorial, so delete the fertilizer by highlighting it in the Fertilizer menu and clicking the "Remove Fertilizer" button. Click OK to confirm the deletion.** As a note, you will not be allowed to delete a fertilizer from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the fertilizer is currently utilized upon the attempted deletion.

14. *Reset to Default Fertilizers:* If you'd like to return the list of fertilizers in the Fertilizer menu to the original default list packaged with Cropware, **click on "Reset to Default Fertilizers", as the default list is used for the tutorial.**

    Save plan.

16.8 MANURE SCREENS

Manure Screen – General Information

15. *Manure Screen:* To create a nutrient management plan, you will need to determine both the quantity and composition of manure to be allocated to crop land. To aid in this effort, the Manure screen is divided into three tabs: Manure Source Data, Manure Analyses, and Manure Storage.

    As a note, at least one waste source must be created before any field information can be entered in the Fields screens; otherwise, a message requesting the creation of a waste source will appear. The waste source is any manure or other waste handling system where the nutrients or waste are produced and must be accounted for. Examples of waste sources are "daily spread", "silage leachate", "bedded pack", "earthen storage system", "pasture", etc.

16. *Creating a Waste Source:* In this tutorial, you'll be working with three sources of waste on a dairy farm: waste from the Main Barn (containing lactating and dry cows and milking center waste), manure that is deposited on the pasture system (from the lactating cow and dry cow groups only), and manure from the Heifer Barn (containing young stock).**Click "Add Source", type Main Barn, and hit OK. Next, click "Add Source" again, type Pasture, and hit OK. Finally, click "Add Source" again, type Heifer Barn, and hit OK.** You should be able to toggle between the three manure sources using the arrow buttons or the down arrow next to the Choose Waste Source drop-down menu. In order to enter or change data for a particular waste source, it must be selected in the Choose Waste Source menu. If you make a mistake and wish to delete a source, click the "Delete Source" button and confirm, but don't do this for the tutorial. As a note, you will not be allowed to delete a manure source from the list if it is utilized elsewhere in the plan; Cropware will provide a list of all the fields where the source is currently utilized upon the attempted deletion.

Manure Screen – Manure Source Data Tab

17. *Entering Information in the Manure Source Data Tab:* **Select Main Barn in the Choose Waste Source drop-down menu. Within the Manure Source Data tab, enter the following information about the Main Barn system.**

Table 16.4

Click in….	Enter the following
Waste Source Units	Gallons
Manure Density	8.34 lbs/gal
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Select Pasture in the Choose Waste Source menu. Within the Manure Source Data tab, enter the following information about the <u>Pasture</u> system.

Table 16.5

Click in….	**Enter the following**
Waste Source Units	Gallons
Manure Density	8.34 lbs/gal
Animal Units	Set to ZERO upon leaving the Manure screen
Choose Species	Dairy Cattle

Save plan.

Select Heifer Barn in the Choose Waste Source menu. Within the Manure Source Data tab, enter the following information about the <u>Heifer Barn</u> system.

Table 16.6

Click in….	**Enter the following**
Waste Source Units	Tons
Manure Density	N/A
Animal Units	N/A (Calculated later)
Choose Species	Dairy Cattle

Save plan.

18. *Estimate Waste Available for Application in the Plan Year:* The quantity of "Annual Waste Available for Application" is not a user entry but is calculated and displayed by the program, where:

"Amount at Start of Plan Year"
plus "Amount Added to System Annually"
less "Amount Exported from System Annually"
equals "Annual Waste Available for Application

See Figure 16.2 below.

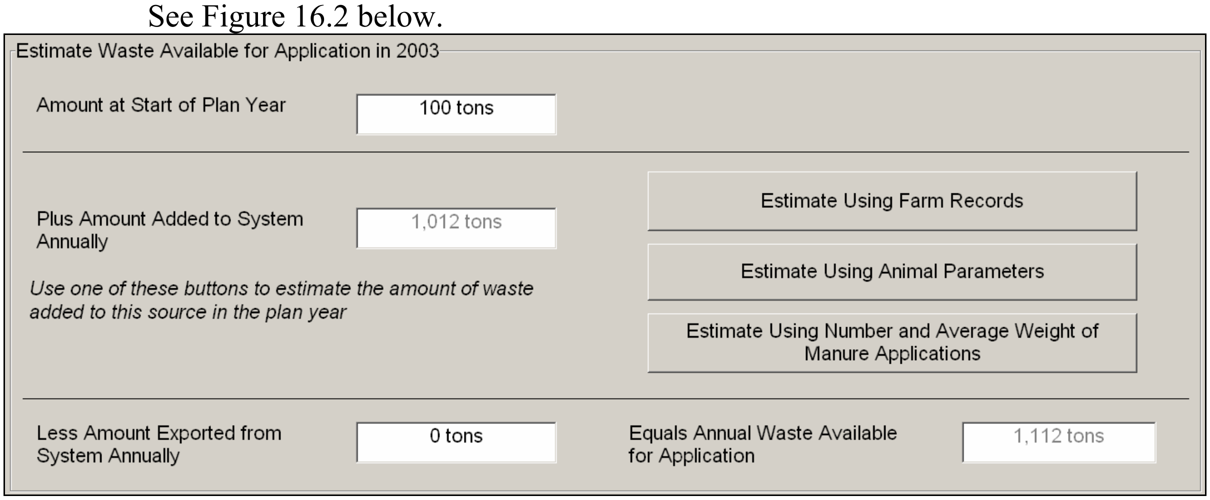


Figure 16.2

Amount at Start of Plan Year: **This tutorial focuses on a farm with manure storage capacity associated with the Main Barn and Heifer Barn waste sources. The Pasture waste source represents the amount of manure deposited on pasture, so manure carry-over is not applicable. Enter the following data based on farm records.**

Table 16.7

Waste Source	Amount at Start of Plan Year
Main Barn	100,000 gallons
Pasture	0
Heifer Barn	100 tons

As a note, when a new plan year is created the "Amount at start of plan year" is set as the manure available for application less the amount of manure allocated to crop land (i.e. last plan year's "Manure Balance" from the Allocation screen) or, in other words, it's the un-applied manure carried over from the previous plan year. However, if you use the manure spreading Calendar screen to plan the manure allocation through the year, the ending inventory amount in the last month may be a better estimate of the "Amount at start of plan year" than the program set value. In that case, you can manually enter the correct beginning inventory quantity here.

Amount Added to System Annually: In Cropware, you have the option of choosing one of three ways to estimate the amount of waste added to a waste system annually.

1. Estimate Amount Added Using Farm Records, or
2. Estimate Using Animal Parameters, or
3. Estimate Using Number and Average Weight of Manure Applications.

Again, refer to Figure 16.2 above.

Estimate Amount Added Using Farm Records: **Select Heifer Barn from the Choose Waste Source drop-down menu and click on the "Estimate Amount Using Farm Records" button. Enter 500 tons and click OK. You have just directly defined the amount of waste produced annually for the Heifer Barn.**

Estimate Using Animal Parameters: **Now consider a case where manure production records don't exist. Continuing with the Heifer Barn, click on "Estimate Using Animal Parameters" to gain experience with another estimation method.** A data entry screen will displayed as in Figure 16.3 below.

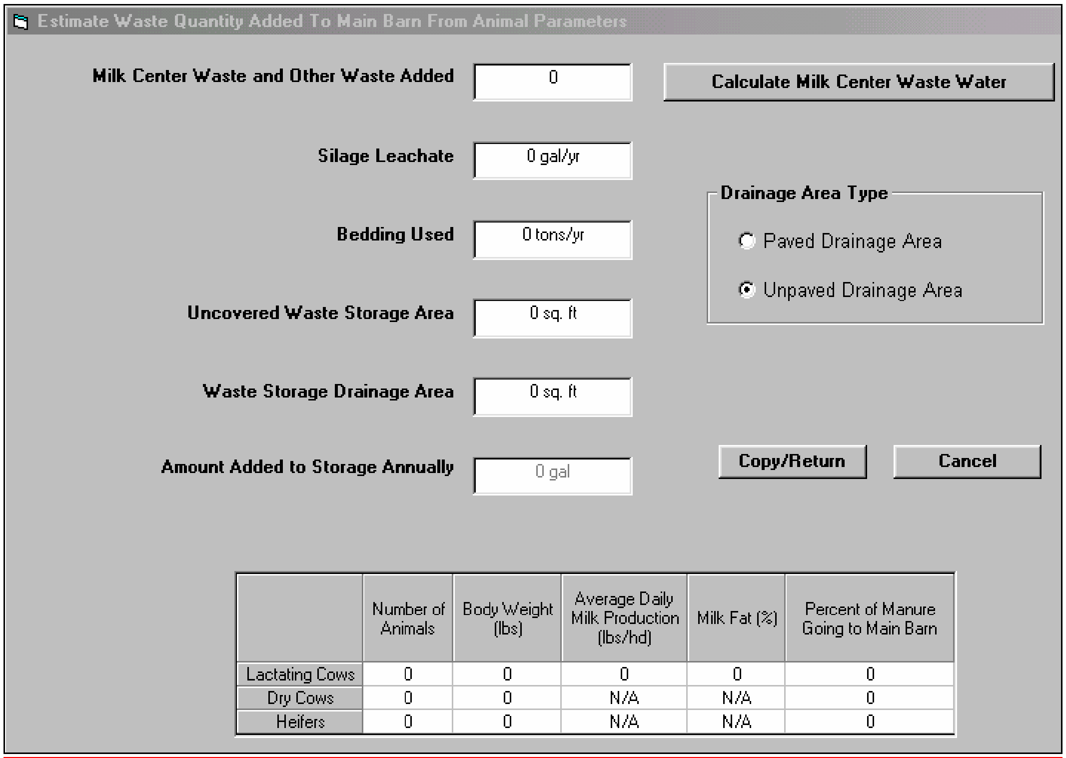


Figure 16.3

From Figure 16.3 you can see the factors considered in this estimation method. Starting from the top, to calculate Milk Center Waste and Other Waste Added you can enter a value directly into the cell from records or click on "Calculate Milk Center Waste Water" to display a screen for estimating milk center waste volumes. **No milking center waste is added to the Heifer Barn manure, so click Cancel to return to the previous screen.**

Returning to the previous screen, shown in Figure 16.4 below, allows the entry of recorded or estimated values for the full range of wastes potentially generated on a farm.

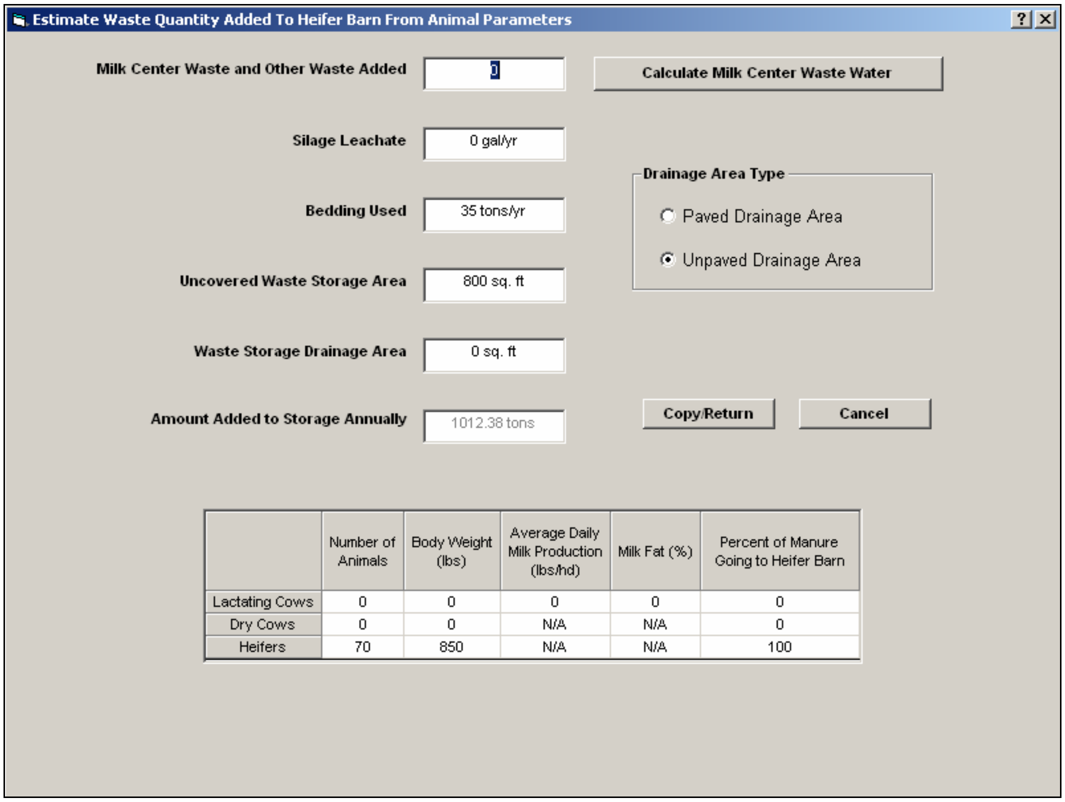


Figure 16.4

Silage Leachate: Estimated from farm records.
Bedding Used: Estimated from farm records or daily bedding use recommendations. **Enter 35 tons/yr.**
Uncovered Waste Storage Area: Measured from designs or in the field. **Enter 800 sq.ft.**
Waste Storage Drainage Area: Represents any area that drains into the waste system. Measured from plans, maps, or in the field.
Drainage Area Type: Paved drainage areas will contribute a greater volume of runoff than unpaved areas. Assess in the field.
Animal Parameters: Herd records. **Enter 70 heifers with an average weight of 850 lbs.** The animals in the Heifer Barn are not grazed, so all of their manure will be collected and mechanically applied to fields. Therefore, **enter 100% for the "Percent of Manure Going to the Heifer Barn"**.

As a note, this method of estimating manure production can be applied to pasture situations through the following steps: 1) adjust the "Percent of Manure Going to the barn" to estimate the total percentage of manure collected in the facility (i.e. not deposited on pasture), 2) create a new waste source to represent the manure directly deposited on pasture by the animals when not in the barn (e.g. call it "pasture"), 3) enter the same animal characteristics as you did for the barn, but this time enter the remainder of the "Percent of Manure Going to the barn" (e.g. if 75% was used for the barn, 25% would be used for the pasture), 4) be sure to exclude all other wastes (e.g. milk house, bedding, etc.) from the calculation, and 5) replace the animal unit calculation for the pasture waste source on the Manure Source Data screen with a zero value in order to not double count animals. We'll work through an actual example of another, more records-based method of determining manure quantities on pasture in the next section.

Click on Copy/Return and notice that 1,012 tons now populates the "Amount Added to System Annually" cell. As a note, the waste quantity estimation method used most recently will always populate the "Amount Added to System Annually" cell. **Use the 1,012 ton estimation for the Heifer Barn.** Note the Animal Units cell has been populated with 60 as a result of entering the animal parameter information.

Save plan.

Estimate Using Number and Average Weight of Manure Applications: The final listed method offered in Cropware for waste quantity estimation is based on the number of manure spreader loads hauled from the system coupled with the average weight or capacity of each spreader load. We will also use this section to help determine the amount of manure deposited by animals within the barn and on pasture.**Select the Main Barn from the "Choose Waste Source" drop-down menu and click on the "Estimate Using Number and Average Weight of Manure Applications" button. If you haven't characterized any spreaders yet, you'll encounter a "No Spreaders Defined" pop-up box. Click Yes to define a spreader.** The Spreaders screen that appears is the same screen represented by the Spreaders button positioned across the top of the Cropware interface. **Click "Create Spreader", enter Tank as the spreader name, click OK, and a screen similar to Figure 16.5 should appear.**

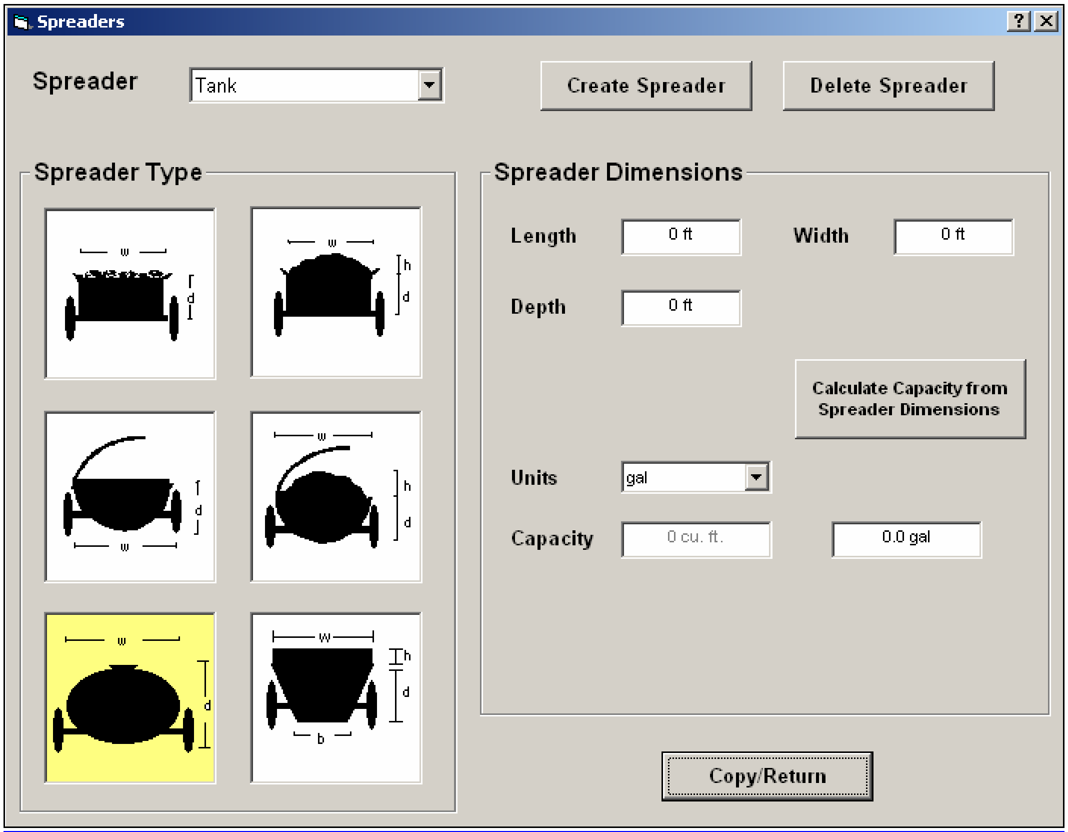


Figure 16.5

Choosing Spreader Type and Determining Spreader Capacity: Cropware allows you to define spreader capacity by entering the dimensions of the spreader (Spreader Dimensions) or by entering the weight or volume of the spreader directly based on field measurements. Regardless of the method, Spreader Capacity is stored by Cropware in cubic feet and converted to gallons or tons depending on the units and density of the waste currently selected in the "Choose Waste Source" drop-down menu. **Toggle through the 6 spreader options in the "Spreader Type" menu and notice the change in Spreader Dimension options.** The "Calculate Capacity from Spreader Dimensions" button signals Cropware to compute the Spreader capacity from entered dimensions. **For the tutorial, highlight the symbol for the tank-style spreader in the lower-left corner of Figure 16.5 above and enter the Capacity for the Box spreader directly into the rightmost "Capacity" cell based on Table 16.8 below.**

Table 16.8

Spreader ID	Capacity
Tank	3500 gal

Click on Copy/Return and you should return to the "Estimate Using Number and Average Weight of Manure Applications", as shown in Figure 16.6.

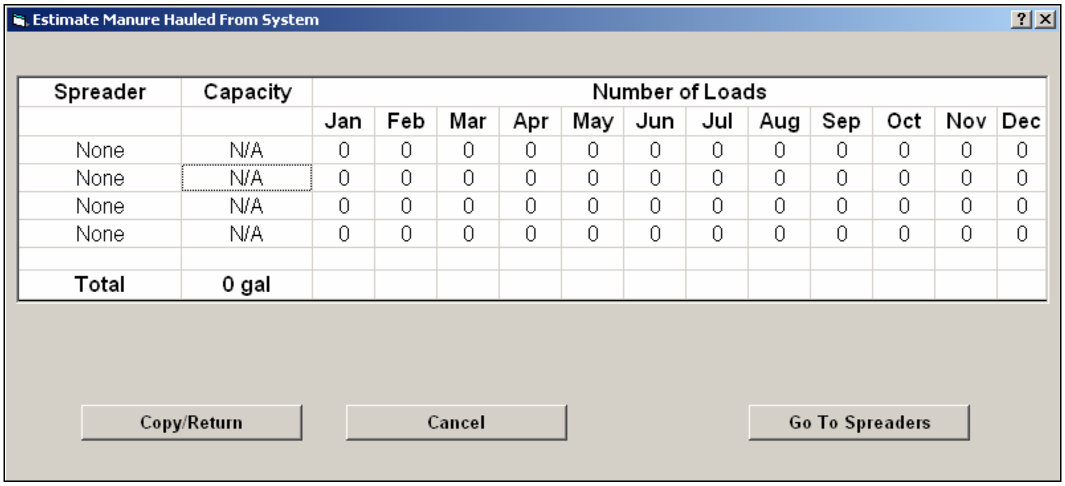


Figure 16.6

The "Estimate Manure Hauled from System" screen depicted in Figure 16.6 allows you to select the recently defined Box spreader, or up to four spreaders total, from the Spreader drop-down menus. **Click in the "Spreader" column, select the Tank spreader, and click on another cell in the grid. The 3,500 gallon capacity entered on the Spreaders screen will appear in the Capacity column.** At this point, you are set to enter the number of loads applied per month with the Tank spreader over the course of a year from the Main Barn. The number of loads will be multiplied by the volume of the spreader and recorded in the Total cell. **Enter the number of loads according to the manure application history in Table 16.9.**

Table 16.9

	Number of Loads											
Spreader	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Tank	25	26	25	23	15	17	19	19	15	19	24	25

The Main Barn has generated approximately 250 loads of manure per year according to the farm records, resulting in a total manure quantity estimation of approximately 889,000 gallons. **Click on Copy/Return and you'll notice that the ~889,000 gallon value now populates the "Amount Added to System Annually" cell on the Manure Source Data tab.**

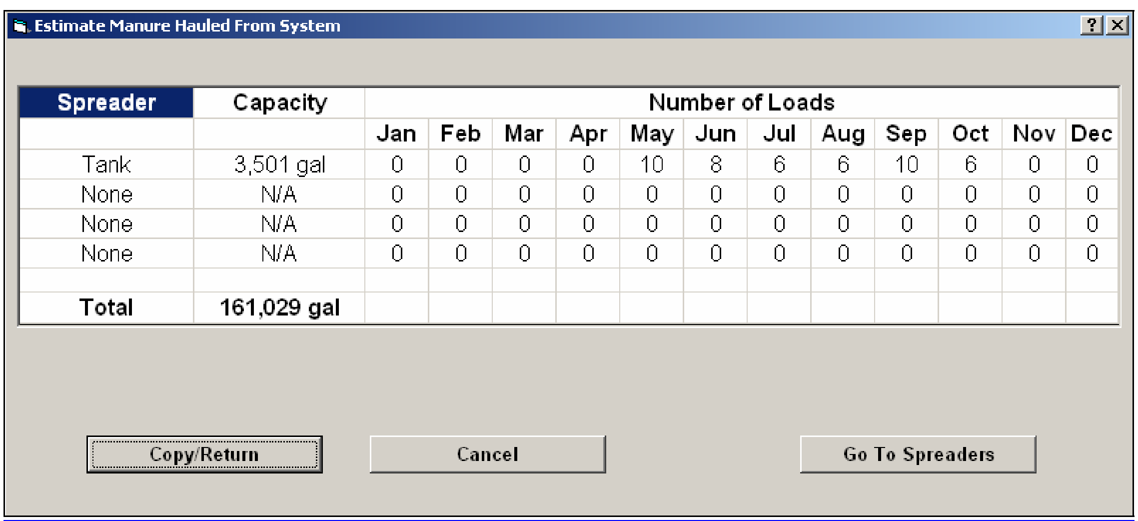
Since the animals from the Main Barn spend time both in the Main Barn and on Pasture, we must now estimate how much manure from the Main Barn animals is deposited directly on pasture. As described above, one could estimate this using the "Estimate Using Animal Parameters" tool. **If good spreading records exist for a facility, though, the amount of manure deposited on pasture can also be estimated using the "Estimate Using Number and Average Weight of Manure Applications" method, as follows.**

1) **Record the number of loads hauled with a spreader from the Main Barn during the grazing months (e.g. May – October) <u>and</u> during the non-grazing months (e.g. November – April), as shown in Table 16.9.**
2) **Average the number of loads per month across the <u>non-grazing</u> months (average = 25 loads per month).**
3) **Subtract the number of loads for each grazing month from the average number of loads for the non-grazing months in order to estimate the manure deposited directly by grazing animals throughout the grazing period, see Table 16.10 below.**

Table 16.10

	Number of Loads					
Loads	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Average Number of Loads Hauled during Non-Grazing Period	25	25	25	25	25	25
Actual Loads Hauled during Grazing Period	15	17	19	19	15	19
Difference (i.e. the "loads" deposited by animals on pasture)	10	8	6	6	10	6

4) **Switch to the "Pasture" manure source, choose "Estimate Using Number and Average Weight of Manure Applications", select the Tank spreader, and enter the difference in manure loads into the corresponding months of the worksheet, as in Figure 16.7 below.**



Spreader	Capacity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tank	3,501 gal	0	0	0	0	10	8	6	6	10	6	0	0
None	N/A	0	0	0	0	0	0	0	0	0	0	0	0
None	N/A	0	0	0	0	0	0	0	0	0	0	0	0
None	N/A	0	0	0	0	0	0	0	0	0	0	0	0
Total	161,029 gal												

Figure 16.7

5) **You have now estimated the amount of manure deposited directly on pasture by the animals (i.e. 161,029 as in Figure 16.7 above). The load information will be converted into gallons of manure on the Calendar screen.**

Estimating manure deposition by grazing animals is not a clear cut calculation. The method above is subject to error due to seasonal differences in bedding, manure production, herd numbers, etc. Nonetheless, it does provide an estimate based on the fairly straightforward records of hauled manure.

As a note, it's possible to calculate the number of animal units contributing to a given waste system without using the "Estimate Using Animal Parameters" method of determining waste quantity. Select the Main Barn system in the Choose Waste Source menu and click on "Estimate Using Animal Parameters". Enter the animal parameters from Table 16.11 below into the grid.

Table 16.11

Animal Type	Number	Body Wt.	Milk Prod.	Milk Fat	% Going to Main Barn
Lactating Cows	95	1350	65	3.2	N/A
Dry Cows	13	1400	N/A	N/A	N/A

Click Copy/Return and you'll notice that 146 animal units now populate the Animal Units cell. Because "Estimate Using Animal Parameters" was the last manure quantity estimation method used, the Amount Added to System Annually cell now reads 0 gallons! Have no fear, **click on the "Estimate Using Number and Average Weight of Manure Applications" button again and hit Copy/Return.** Now both the waste quantity based on number and weight of loads and the animal units are displayed for the Main Barn. A report of the animal units per acre exists in the "Crop, Livestock, and Nutrient Index Summary". In order to correctly account for the all animal units on the farm in this report, the animal units must be entered or calculated on the Manure screen.

Save plan.

Amount Exported from System Annually: You can enter the amount of manure exported from the farm and, therefore, not intended for application to the farm's land base. **No manure is exported from the farm for the tutorial.**

Manure Screen – Manure Analyses Tab

19. *Entering Information in the Manure Analyses Tab:* Once you've described the quantity of manure on the farm, you must characterize the nutrient content of the manure from each Waste Source. The quantity of manure will be paired with the nutrient content to calculate the total amount of nitrogen (ammonium-N and organic-N), phosphorus, and potassium available from manure for recycling back through the farm's crops, then animals, and so on. Manure analyses can be entered and deleted. The list of available

manure analyses exists in the "Test Description" drop-down menu for each Waste Source and is accessible from Fields—Manure Use screen, Fields—Past Manure Use screen, and the Allocation screen once you begin allocating manure to the crop land. In addition, a listing of the all of the entered manure analysis details is created in the "Manure Analyses" report and the most recent manure analysis for each source is presented in the "Manure Analysis and Collection" report. **Click on the "Test Description" down arrow and notice that currently only the Default Dairy Cattle analysis populates the list.**

Select Main Barn from the "Choose Waste Source" menu, click on the "Add Test" button, enter a Test Description name, hit OK, and repeat for the following list of manure Test Descriptions from Table 16.12.

Table 16.12

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002

Once the Test Description names are entered, click in the test attribute cells and enter the data from Table 16.13 for each of the Test Descriptions. As a note, entering Ammonia N and Organic N will automatically populate the Total N cell by addition.

Table 16.13

Test Description	Main Barn 2000	Main Barn 2001	Main Barn 2002
Ammonia N %	0.17	0.2	0.18
Organic N %	0.18	0.21	0.19
P_2O_5 Equivalent %	0.15	0.18	0.16
K_2O Equivalent %	0.26	0.23	0.3
Total Solids %	6.0	6.5	6.5
Manure Analysis Date	8-19-99	8-15-00	5-15-01

As a note, the nutrients are entered as percentages from your manure analysis report. Should you lack such data, to compute nutrient percentages from lbs of nutrient per ton:

4 lbs organic N/ton = 4 lbs/2000 lbs = 0.002 or 0.2%

or to compute nutrient percentages from lbs of nutrient per 1000 gal:

12 lbs organic N/1000 gal = (12 lbs/1000 gal) / (8.34 lbs/gal) = 0.0014 or 0.14%

Save plan.

Next, repeat the preceding steps for the Pasture manure with the data in Table 16.14. The pasture manure analyses are based on manure samples taken from the barn floor.

Table 16.14

Test Description	Pasture 2000	Pasture 2001	Pasture 2002
Ammonia N %	0.28	0.3	0.29
Organic N %	0.25	0.27	0.26
P_2O_5 Equivalent %	0.24	0.21	0.25
K_2O Equivalent %	0.58	0.53	0.57
Total Solids %	10.0	9.0	10.0
Manure Analysis Date	6-20-99	6-12-00	6-25-01

Finally, repeat the preceding steps for the Heifer Barn with the data in Table 16.15.

Table 16.15

Test Description	Heifer Barn 2000	Heifer Barn 2001	Heifer Barn 2002
Ammonia N %	0.27	0.17	0.25
Organic N %	0.31	0.33	0.35
P_2O_5 Equivalent %	0.23	0.17	0.25
K_2O Equivalent %	0.44	0.43	0.40
Total Solids %	18.0	16.0	18.0
Manure Analysis Date	8-19-99	8-15-00	5-15-01

Save plan.

Manure Screen – Manure Storage Tab

20. *Entering Information in the Manure Storage Tab:* For each waste source, the storage capacity (if any) can be entered or calculated. This function is for planning, not design purposes. This is not a required input, but is necessary if you want to compare waste storage capacity to storage requirements and calculate months of storage duration in the "Manure Analysis, Collection, and Storage Report". In addition, if a waste storage is associated with a Waste Source, it's helpful to quantify its capacity for comparison with Ending Monthly manure Inventories in the Calendar screen. Are the end of the month manure inventories less than your storage capacity?…hope so!

    Select Main Barn in the "Choose Waste Source" menu and click on the "Calculate Capacity from Structure" button. The Calculate Waste Storage Capacity screen will appear and offer three choices of waste storage configurations. **Select the Rectangular Storage option by clicking anywhere on the image. Enter the dimensions of the system according to Figure 16.8 below.**

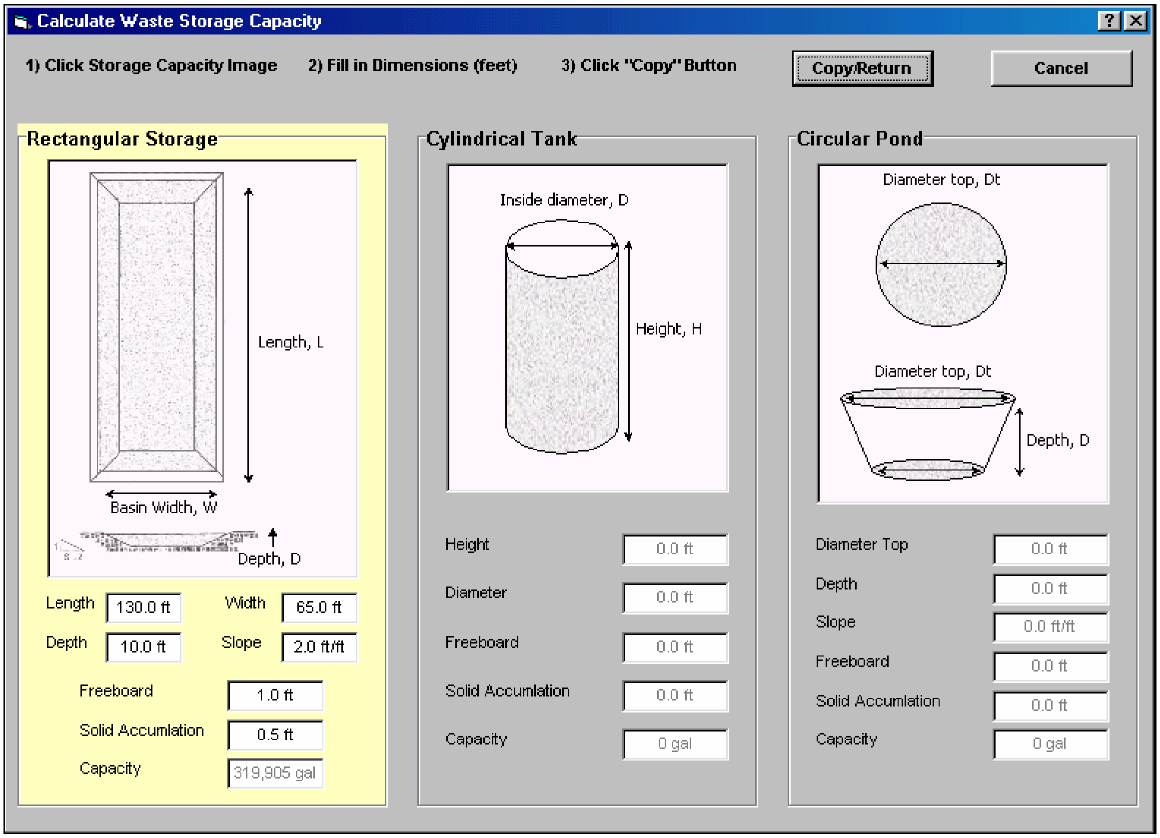


Figure 16.8

As a note, the slope is Run/Rise. **When finished, click Copy/Return and the calculated capacity (319,905 gallons) will be displayed in the "Waste Storage Capacity" cell of the Manure Storage tab.**

Next, select Heifer Barn in the "Choose Waste Source" drop-down menu and click on the "Calculate Capacity from Structure" button. Select the Rectangular Storage Option and enter the dimensions of the system according the Figure 16.9 below. As a note, the Heifer Barn storage is a walled stacking pad, so the slope is zero.

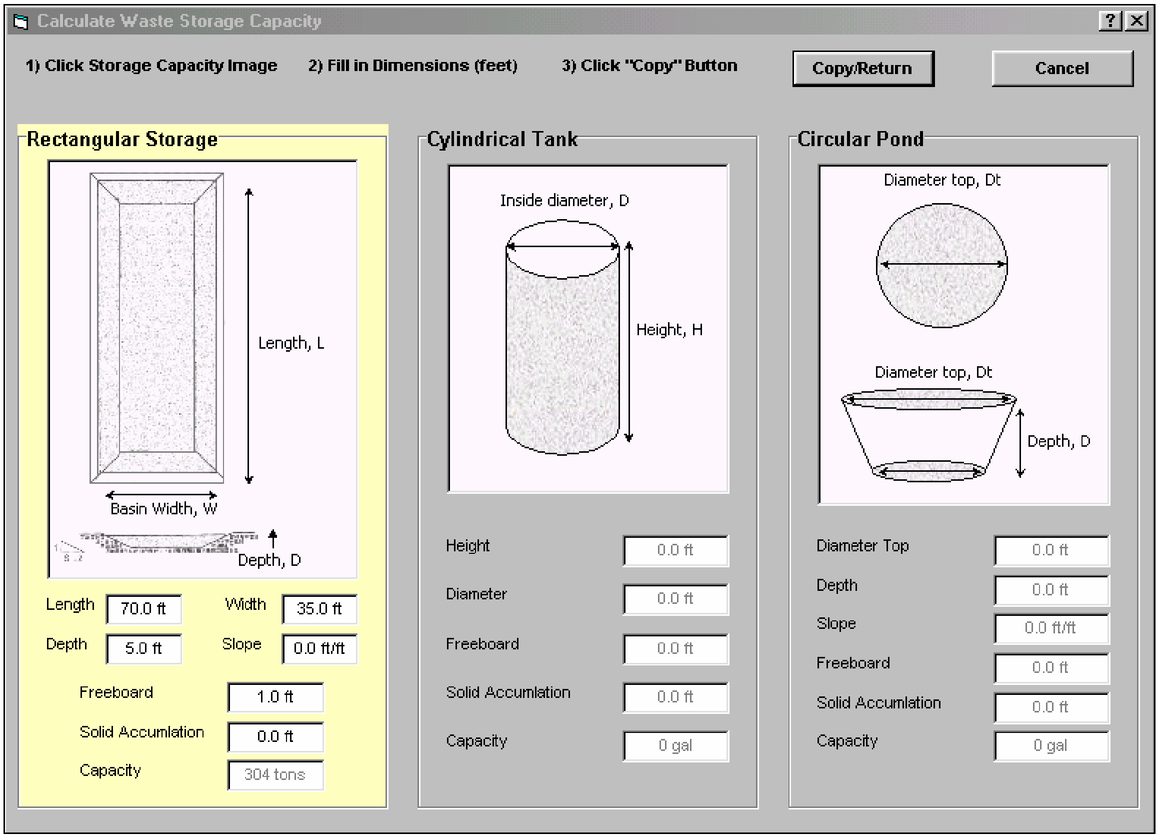


Figure 16.9

When finished, click Copy/Return and the calculated capacity (304 tons) will be displayed in the Waste Storage Capacity cell of the Manure Storage screen.

Manure storage does not apply to the Pasture source, as this source accounts for the manure deposited directly to pasture only.

Save plan.

16.9 Spreaders Screen

21. *Spreaders:* Manure spreader capacity is entered on this screen. The capacity can be entered directly or calculated by the program from the size and shape of the spreader. The computed capacity applies only to the current manure source as the value computed will change as a function of the density of the manure being spread and the units selected.

22. *Create a new Spreader:* **Click on the "Spreaders" tab and hit the "Create Spreader" button. A box spreader has yet to be defined, so enter "Box" as the name and click OK. Highlight the Box image in the lower left corner and enter the capacity according to Figure 16.10 below.**

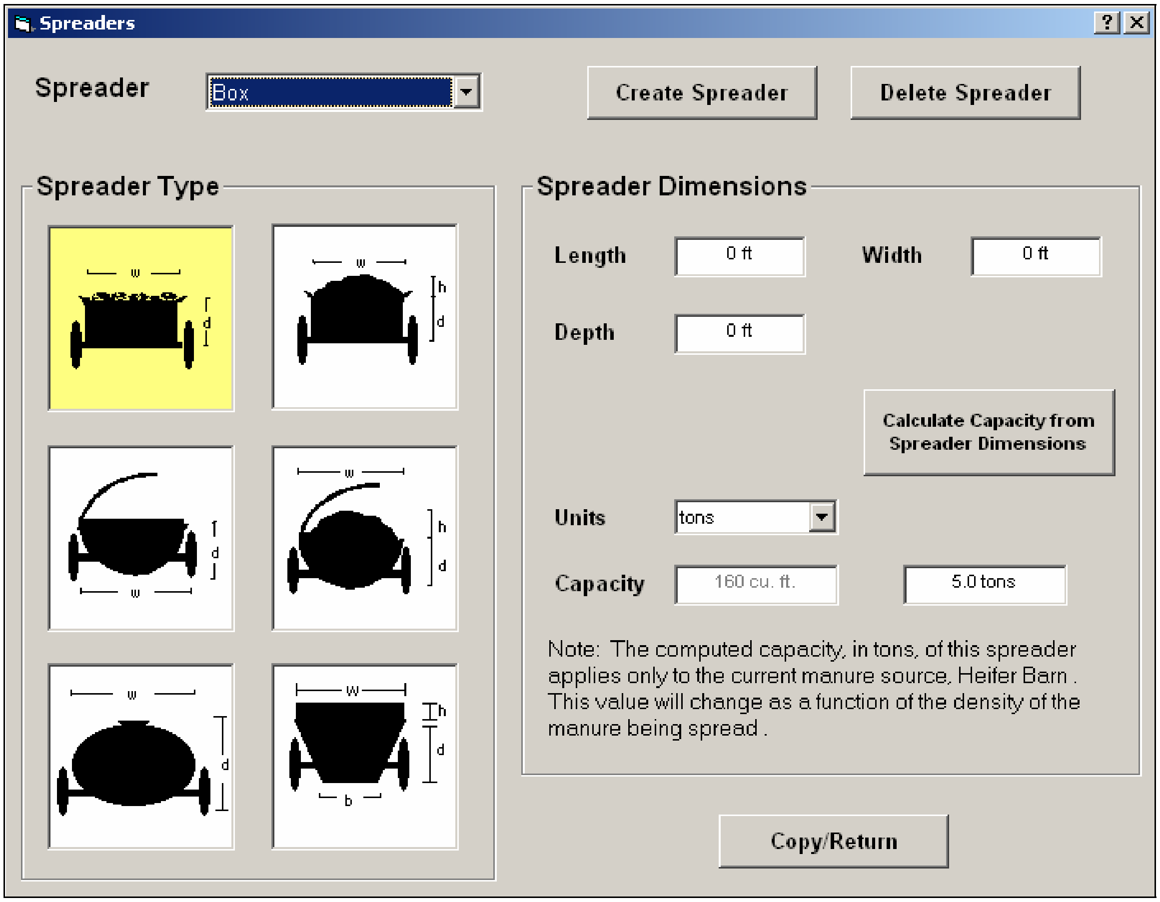


Figure 16.10

Click on Copy/Return. Now both the Box spreader and the Tank spreader have been defined and will be available for developing manure application work orders from the Work Order screen.

Save plan.

16.10 FIELDS SCREENS

Field Screens – General Information

23. *Create a Field:* The first step in characterizing a farm field is to create a field and name it. **Click on "Create Field", enter the Field ID, click OK, and repeat the process for the following list of fields.** As a note, the Field ID should be the Farm Service Agency tract and field number, according to the following example format: 3982.1A (where 3982 = Tract ID, 1 = Field ID, and A = Strip ID, if present).

Table 16.16

Field ID
3982.01
3982.02
3982.03
3982.04
3982.05
3982.06
3982.07
3982.08
3982.09
628.10

Once created, the list of Field ID's will populate the "Field ID" drop down menu. You can select a field by highlighting it in the drop-down menu or by using the left or right arrow. The newly created fields will also appear under the Fields limb of the Tree (if not currently displayed, activate the tree by clicking on the Tree button). You can navigate among different fields using either the Field ID menu or the Tree.

Save plan.

24. *Copy Field:* If you have a group of similar fields, perhaps in terms of soil type, crop rotation, manure history, etc., you may wish to fully create and populate a representative field and copy it repeatedly depending on the number of similar fields. This can minimize data entry time by reducing the number of redundant keystrokes. The copy function will not be used in tutorial, but to get a feel for it, **select field 628.10 within the "Field ID" menu and click "Copy Field". Enter 628.10A as a field ID for the copy of 628.10 and hit OK. Repeat this process, but now enter 628.10B.** As a result, Field 628.10A and Field 628.10B have both been added to the list of fields in the Field ID menu. This could be a common change as fields are divided into smaller management units for production and/or environmental conservation purposes. On an actual plan, you would adjust the acreage of each "sub-field" to reflect the area of each management unit.

25. *Re-Order Fields:* Now let's re-order Field 628.10A and Field 628.10B above the original Field 628.10 in the list. **Click "Re-Order Fields", highlight 628.10A, and click the UP**

arrow once. Repeat this for 628.10B. Both of the "sub-fields" should appear above the original 628.10. Hit OK when finished re-ordering the fields.

26. *Delete Field:* Field 628.10A and Field 628.10B will not be used in the tutorial, so **select field 628.10A within the "Field ID" menu, click on "Delete Field", and hit OK on the warning screen. Repeat for Field 628.10B.** Field 628.10A and Field 628.10B will no longer be listed in the Field ID menu.

Field Screens – Field Data Tab

27. *Field Data:* The Field Data screen is designed for characterizing the following field attributes.

Field Name	Soil Name	Artificial Drainage
Acres	Present or Past Sod	Corn Yield Potential
County	Tillage Depth	Highly Erodible Land
Township		

28. *Enter Field Data:* **Enter the following data into the Field Data screen:**

Table 16.17

Field ID	Field Name	Acres	County	Town-ship	Soil Name	Present or Past Sod	Tillage Depth	Artificial Drainage	Corn Yield Potential	HEL
3982.01	1	19.6	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.02	2	28.4	Cortland	Harford	Howard	50+% Leg	7-9 Inches	None	Use CU	N
3982.03	3	24.7	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	None	Use CU	N
3982.04	4	18.2	Cortland	Harford	Howard	26-50% Leg.	7-9 Inches	Adeq	Use CU	N
3982.05	5	17.9	Cortland	Harford	Bath	1-25% Leg	7-9 Inches	Adeq	Use CU	Y
3982.06	6	16.5	Cortland	Harford	Langford	1-25% Leg	7-9 Inches	None	Use CU	N
3982.07	7	25.6	Cortland	Harford	Langford	100% Grass	7-9 Inches	None	Use CU	N
3982.08	8	7.0	Cortland	Harford	Valois	100% Grass	7-9 Inches	None	Use CU	Y
3982.09	9	26.9	Cortland	Harford	Erie	100% Grass	7-9 Inches	None	Use CU	N
628.10	10	8.5	Cortland	Harford	Chagrin	100% Grass	7-9 Inches	None	Use CU	N

Save Plan.

Field Screens – Soil Test Tab

29. *Soil Test:* The Soil Test Data screen is designed for characterizing the following field attributes.

Lab ID	P	Fe
Extraction Method	K	Mn
Sample Date	Al	Zn
pH	Ca	Organic Matter
Exchange Acidity	Mg	Pre Side-Dress N Test (PSNT)

30. *Enter Soil Test Data:* **Enter the following data into the Soil Test screen:**

Table 16.18

Field ID	Lab ID	Extraction Method	Sample Date	pH	Exch. Acidity	P	K	Al	Ca
3982.01	CNAL	Morgan	4/11/01	6.6		77	360	25	4210
3982.02	CNAL	Morgan	4/11/01	6.5		46	335	23	3470
3982.03	CNAL	Morgan	3/30/00	6.6		27	325	34	4470
3982.04	CNAL	Morgan	4/11/01	6.7		7	280	31	3950
3982.05	CNAL	Morgan	4/11/01	6.4		11	245	60	3400
3982.06	CNAL	Morgan	4/11/01	6.5		8	310	21	3790
3982.07	CNAL	Morgan	4/11/01	6.1		15	235	21	3350
3982.08	CNAL	Morgan	11/1/99	5.8	13	5	110	106	2190
3982.09	CNAL	Morgan	11/30/99	6.2		25	100	41	4230
628.10	CNAL	Morgan	4/11/01	6.0	14	13	215	52	2780

Table 16.19

Field ID	Mg	Fe	Mn	Zn	Organic Matter	PSNT
3982.01	620	3	19	2.6	4.1	
3982.02	450	1	9	2.3	4.4	
3982.03	635	3	18	3.3	3.9	
3982.04	705	3	21	2.9	4.6	
3982.05	520	6	19	1.8	4.3	
3982.06	610	1	11	2.5	4.0	
3982.07	640	1	9	1.5	4.6	
3982.08	250	21	32	1.8	5.4	
3982.09	620	4	22	2.7	4.8	
628.10	420	5	25	1.2	4.5	

Save plan.

Field Screens -- Crop Data Tab

31. *Crop Data:* The crop history and planned rotation for each field is entered on the Crop Data tab. The rotations that you made in the Rotations screen are used to quickly setup the planned rotation for each field. Any changes made to a rotation in the Crop Data screen impact the rotation for the field only and do not change the stored, user-defined rotations.

    The crop data from the past three crop years is used in the nutrient requirement equations. If a sod crop has been plowed down or killed during the past three years, the organic nitrogen will become available to the plants through mineralization. The amount of nitrogen available is a function of the amount of legume in the stand and the years since plow down, as defined by the user-selected cropping sequence on the Crop Data screen.

    In addition, for planning purposes, the Crop Data screen can be used in combination with the "Crop, Livestock, and Nutrient Index Summary" report and the "Crop Summary Report" to assess the acres of each crop across the entire farm for the plan year and over the course of the rotation, respectively.

32. *Selecting a Pre-Defined Crop Rotation:* **Click on the down arrow in the "Rotation" menu and select the desired rotation to fill the year fields with the rotation crop codes.**

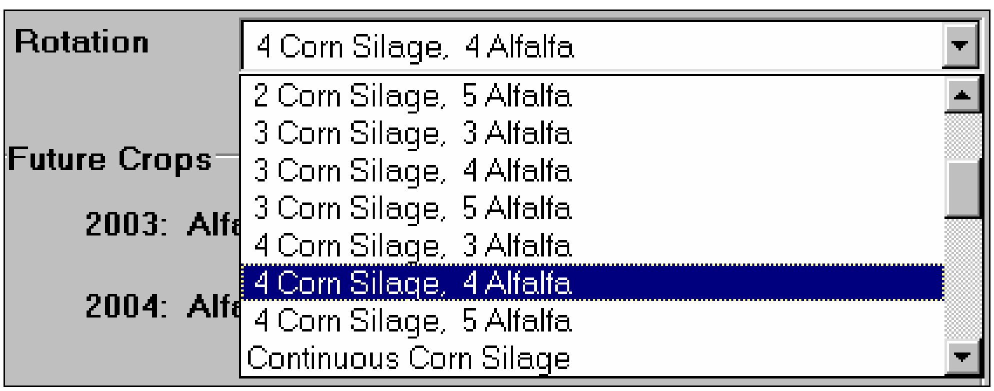


Figure 16.11

For field 3982.01, select the 4 Corn Silage, 4 Alfalfa rotation according to Table 16.20, below. Click OK to accept the rotation change. Repeat this progression for the remaining fields.

Table 16.20

Field ID	Rotation Goal
3982.01	4 Corn Silage, 4 Alfalfa
3982.02	4 Corn Silage, 4 Alfalfa
3982.03	4 Corn Silage, 4 Alfalfa
3982.04	4 Corn Silage, 4 Alfalfa
3982.05	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.06	4 Corn Silage, 4 Alfalfa-Grass Mix
3982.07	Pasture Rotationally Grazed
3982.08	Pasture Rotationally Grazed
3982.09	Pasture Rotationally Grazed
628.10	Continuous Intensively Managed Grass

Save plan.

33. *Temporally Aligning a Crop Rotation:* Notice how the pre-defined rotation populated the rotation planning cells for field 3982.01 as shown in Figure 16.12.

34.

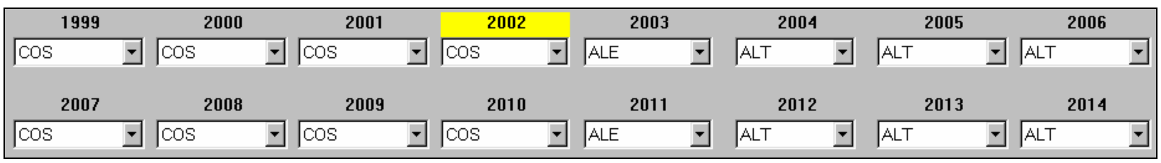


Figure 16.12

For field 3982.01, compare the sequence of crops within the rotation from Figure 16.12 to the true sequence of the rotation plan in Table 16.21.

Table 16.21

Field ID	1999	2000	2001	2002	2003	2004	2005	2006
3982.01	COS	ALE	ALT	ALT	ALT	COS	COS	COS

Notice that the initial crop sequence in the Cropware rotation displays COS for the current year (highlighted in Figure 16.12), but the true crop rotation plan (Table 16.21) specifies that 2002 should be in 3rd year alfalfa, that is ALT, preceded by ALT in 2001 and ALE in 2000. **In order to align the sequence of crops within a rotation correctly with the plan years, you can roll the entire rotation sequence forward or backward through the years. To do this, click on the year label above any rotation planning cell that matches the true crop's position in the rotation for the current plan year (i.e. any year with 3rd year alfalfa). The crop code for the year you click will become the crop for the yellow-highlighted, current plan year. So, considering Figure 16.12, clicking on 2005 or 2013 will roll the entire rotation around, resulting in correct alignment of the rotation with the past and future plan years, while maintaining the sequence of crops within the rotation. It's still a 4 Corn Silage, 4 Alfalfa rotation (Figure 16.13) over time!**

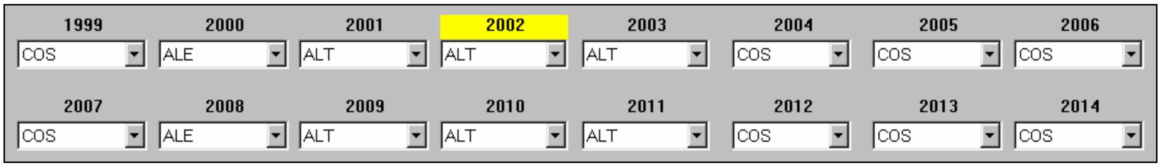


Figure 16.13

Now, correctly align the rotations for the remaining fields according to the rotation plan in Table 16.22.

Table 16.22

Field ID	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
3982.02	ALT	ALT	ALT	COS	COS	COS	COS	ALE
3982.03	COS	COS	COS	ALE	ALT	ALT	ALT	COS
3982.04	ALT	COS	COS	COS	COS	ALE	ALT	ALT
3982.05	AGE	AGT	AGT	AGT	COS	COS	COS	COS
3982.06	COS	COS	COS	COS	AGE	AGT	AGT	AGT
3982.07	PIT	PIT	PIT	PIT	PIT	PIT	PIT	PIT
3982.08	PIT	PIT	PIT	PIT	PIT	PIT	PIT	PIT
3982.09	PIT	PIT	PIT	PIT	PIT	PIT	PIT	PIT
628.10	GIT	GIT	GIT	GIT	GIT	GIT	GIT	GIT

Save plan.

35. *Changing Crops within a Rotation:* You can also edit the rotation for each field by clicking on the down arrow key next to the crop code in each year of the rotation and changing the crop code. In order to maintain the rotation sequence in future years, though, you'll need to change the crop code for each subsequent year in a similar manner.

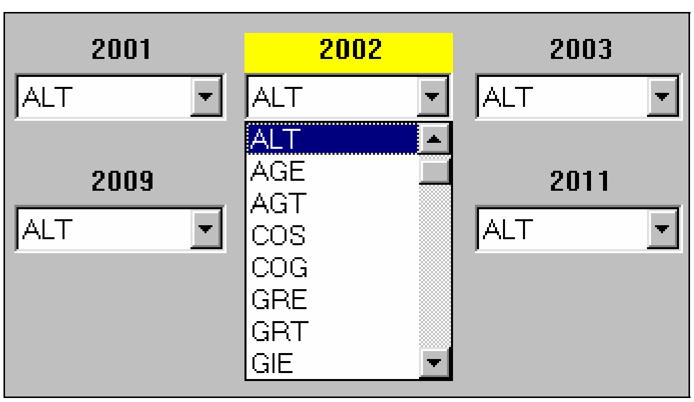


Figure 16.14

36. *Inserting or Removing Crops within a Rotation:* If the sequence of crops within a pre-defined rotation from the Rotation drop-down menu cannot be maintained precisely over time, you can choose to insert or remove a crop from the rotation without altering the crop sequence of the rotation in future plan years. **Select field 3982.05 in the Field ID menu.** After reviewing the crop rotation plan for 2002, you fear that not enough acres of corn silage were planned to meet the herd forage requirements. The pre-defined, long-term crop rotation plan for 2002 should be altered, such that field 3982.05 will be plowed and planted to COS instead of managing another year of AGT. The farmer plans to resume the pre-defined crop sequence (i.e. 4 Corn Silage, 4 Alfalfa-Grass Mix) after 2002, so you must remove the AGT crop from the rotation for 2002. **Click on the "Remove Crop" button, select 2002 from the "Year" drop-down menu, and hit OK. Compare the pre-defined rotation sequence in Figure 16.15 with the updated sequence in Figure 16.16.**

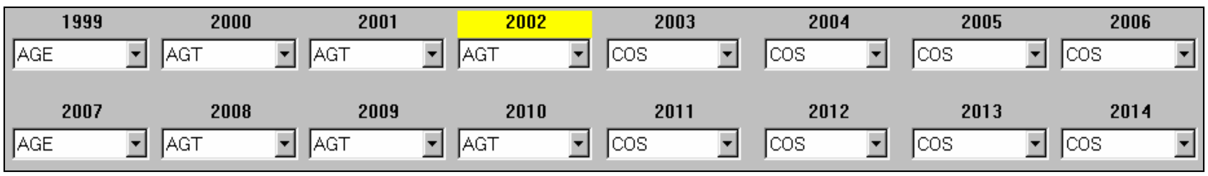


Figure 16.15

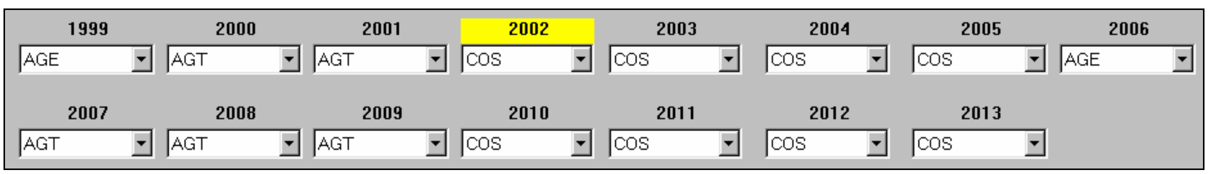


Figure 16.16

Now, after a talk with the herd nutritionist, you realize that plenty of corn silage will be produced relative to herd demand with the original crop plan for 2002, so **click on the "Insert Crop" button, select "2002", select "AGT" from the Year menu, and hit OK. The rotation for Field 3982.5 should mirror Figure 16.15 again.**

Save plan.

Field Screens – Manure Use Tab

37. *Manure Use:* In the Manure Use screen, you can enter information about the planned manure applications for the current plan year. **The screen is designed to accommodate two manure application events per field per plan year, as distinguished by Primary Application and Secondary Application.**

38. *Entering Current Year Data:* The following outlines the Manure Use screen for the Primary Application and the Secondary Application.

Manure Source and Test Description: **Click on the drop-down menus to view the lists of manure Source Names and manure Test Descriptions, originally entered on the Manure Screen. These data can also be selected for a given field on the Allocation Screen.** So, unless you know that manure from a particular source will be applied to a particular field based on your knowledge of the field or the planned crop (see the Crop Summary portion of the Manure Use screen), it's often more efficient to **select this information on the Allocation screen. Use this method for the tutorial.** The Manure Source and Test are coupled with the rate of manure application from the Allocation screen in the Phosphorus Index calculation.

Timing: The months of the year during which manure will be applied. The manure application timing is utilized in the Phosphorus Index calculation. In some cases, perhaps based on the planned crop, you'll know when manure will be applied to a field at this stage of the planning process. Otherwise, the Timing of application should be defined after the manure has been temporally allocated in the Calendar screen. As a default setting, manure application timings are set to "Feb-Apr" as this represents the highest risk timing in the Phosphorus Index. This default setting is a good starting point for allocating manure on the Allocation screen, because it represents a conservative approach. **Don't define the Timing for the tutorial at this point. Instead, return to the Manure Use screen to define the Timing of application after completion of the Calendar screen.**

Application Method: The selection of an Application Method depends on the manure source chosen for a field, the amount of manure storage for the given source, the equipment and labor resources, the crop, the risk of runoff and/or leaching, etc. With experience on a given farm, you may be able to initially select the application method per field at this stage in the planning process, but you will likely find it necessary to confirm the application method after planning manure applications across the land base in the Allocation screen and the Calendar screen. It's often helpful to toggle among the Fields—Manure Use, Allocation, and Calendar screens through the planning process. **For the tutorial, utilize the "Top Dress or Incorporated After 5 Days" option initially.** The method of manure application is utilized in the Phosphorus Index calculation and ammonia conservation determination.

Hydrologic Sensitivity Description: Enter comments on hydrologically sensitive areas for a given field. This is only used as a comment space by Cropware. **Enter the following.**

Table 16.23

Field ID	Hydrologic Sensitivity Description (Primary Application)	Hydrologic Sensitivity Description (Secondary Application)
3982.01		
3982.02		
3982.03	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP	AVOID APPLICATION IN GRASSED WATERWAY & FILTER STRIP
3982.04		
3982.05	AVOID APPLICATION IN WET POCKET--NE CORNER	AVOID APPLICATION IN WET POCKET--NE CORNER
3982.06		
3982.07		
3982.08		
3982.09		
628.10	AVOID APPLICATION IN FILTER STRIP	AVOID APPLICATION IN FILTER STRIP

Priority Nutrient: **Use Nitrogen as the Priority Nutrient for all fields in the tutorial.**

Field Access: In the Options screen, you defined the time period available for manure applications based on crop. Having defined the crop for the plan year in the Crop Data screen, Cropware now displays the months available for spreading on the "Field Access" button. At this point, you can change the manure application access periods from the default settings on a field-by-field basis. **Select field 3982.06 in the "Field ID" menu and notice the default field accessibility, based on the definition for COS in the Options screen.**

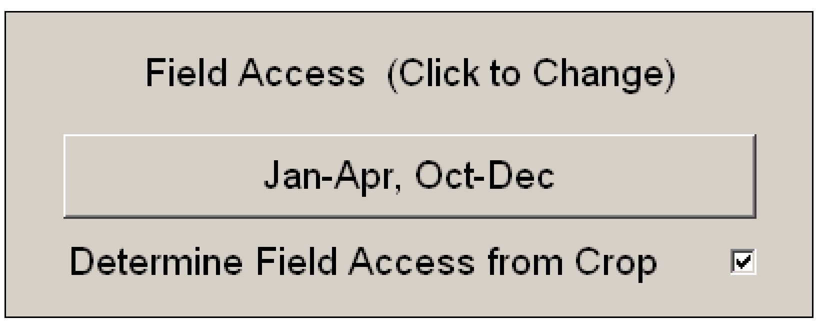


Figure 16.17

Click on the checkbox next to "Determine Field Access from Crop" to de-select this option. Click on the "Field Access" button to define the field accessibility for this field specifically. By clicking in Manure Application row, allow manure applications on this field from Oct-May and hit Return.

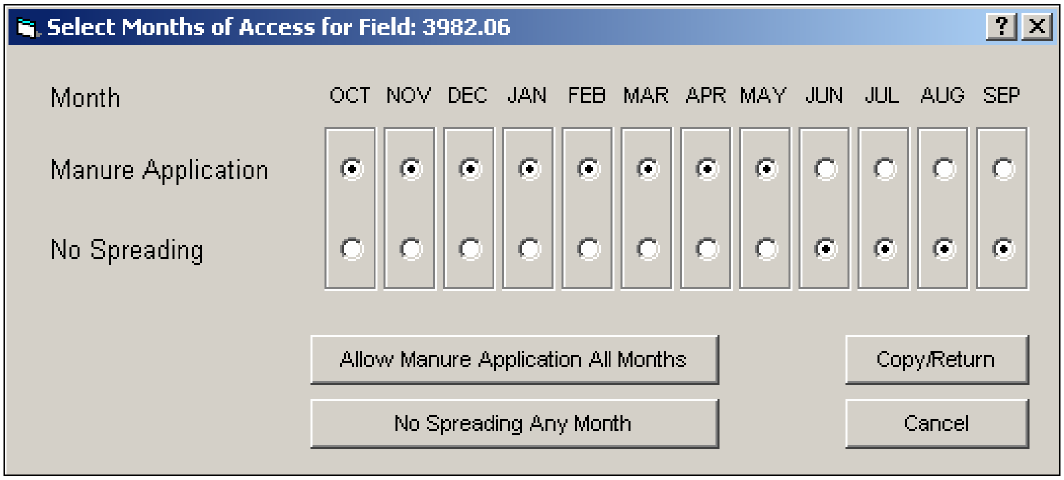


Figure 16.18

"Oct-May" will appear on the Field Access button now and the shaded, no-spreading period on the Calendar screen will reflect this change. **Select the "Determine Access from Crop" checkbox to return field 3982.06 to its original accessibility status, as in Figure 16.17 above.**

Save plan.

Field Screens – Past Manure Use Tab

39. *Enter Past Manure Use Data:* Past manure application data are used to determine the residual nitrogen available from the last two years of manure application activity for the plan year's crop nitrogen requirement. **Enter the Manure Source, associated historic Test Description, and the Quantity Applied per acre on a given field for both two years ago and last year according to the Table 16.24.**

Table 16.24

	Last Year				2 Years Ago			
Field ID	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)	Application	Manure Source	Manure Analysis ID	Quantity Applied (ton/acre or gal/acre)
3982.01	Primary	Main Barn	Main 2001	5000	Primary	Main Barn	Main 2000	5000
	Secondary				Secondary			
3982.02	Primary				Primary			
	Secondary				Secondary			
3982.03	Primary	Main Barn	Main 2001	17000	Primary	Main Barn	Main 2000	8500
	Secondary				Secondary			
3982.04	Primary	Main Barn	Main 2001	4000	Primary	Heifer Barn	Heifer 2000	15
	Secondary				Secondary			
3982.05	Primary	Main Barn	Main 2001	6000	Primary	Main Barn	Main 2000	6000
	Secondary				Secondary			
3982.06	Primary	Main Barn	Main 2001	8500	Primary	Main Barn	Main 2000	8500
	Secondary				Secondary			
3982.07	Primary	Pasture	Pasture 2001	2000	Primary	Pasture	Pasture 2000	2000
	Secondary	Main Barn	Main 2001	6000	Secondary	Main Barn	Main 2000	6000
3982.08	Primary	Pasture	Pasture 2001	2000	Primary	Pasture	Pasture 2000	2000
	Secondary	Main Barn	Main 2001	4000	Secondary	Main Barn	Main 2000	6000
3982.09	Primary	Pasture	Pasture 2001	2000	Primary	Pasture	Pasture 2000	2000
	Secondary	Main Barn	Main 2001	4000	Secondary	Main Barn	Main 2000	6000
628.10	Primary	Main Barn	Main 2001	10000	Primary	Main Barn	Main 2000	10000
	Secondary				Secondary			

Save plan.

Manure applications planned in the previous two plan years on the Allocation screen will be carried forward to the Fields—Past Manure Use screen in the newly created plan year to save data entry effort. Please check these “planned” quantities with the actual records of manure application and update where necessary.

Field Screens – Fertilizers Tab

40. *Fertilizers:* On this tab, you can enter up to four fertilizers to be applied to this field in the plan year. You'll be selecting fertilizers from the list housed on the Fertilizers library screen.

41. *Entering Fertilizer Application Data:*

Fertilizer Name: As in the Manure Use screen, you'll be choosing soil fertility amendments for application in the Allocation screen. In some cases, perhaps depending on crop (notice the crop summary on the bottom of the Fertilizers screen), knowledge of past management, etc., you'll know what fertilizer material(s) a particular field should receive. **In most cases, though, fertilizer selection should be made on the Allocation Screen, where the crop nutrient requirement can be assessed.**

Planned Application Rate: **Wait to select the application rate on the Allocation screen while you're balancing the field's nutrient requirements.** The rate of fertilizer application is used in the Phosphorus Index calculation.

Timing: If a Fertilizer Name is not chosen, you won't be able to input a Timing. If fertilizer has been chosen, depending on the crop and your knowledge of the field, you may be able to assume a timing of application on the Fields—Fertilizers tab before consulting the Allocation screen. Regardless of whether a fertilizer material and rate are chosen on the Allocation screen or the "Fields—Fertilizer" tab, the timing of application will need to be selected from the "Field—Fertilizer" tab. The timing of fertilizer application is used in the Phosphorus Index calculation.

Application Method: If a Fertilizer Name is not chosen, you won't be able to input an Application Method. If fertilizer has been chosen, depending on the crop, your knowledge of field management, etc., you may be able to assume an application method at this point. Otherwise, you can toggle back to the Fields—Fertilizers tab from the Allocation screen. The method of fertilizer application is used in the Phosphorus Index calculation.

Save plan.

Field Screens – Phosphorus Index Factors Tab

42. *Phosphorus Index Factors:* This tab collects information used with other entered data to rank the fields according to their risk of P losses via the Phosphorus Index. The following remaining information is necessary to calculate the Phosphorus Index: Soil Erosion – RUSLE (tons/acre), Proximate Waterbody Type, Predominant Flow Distance to Blue Line Stream or Equivalent, Soil Drainage Class, Flooding Frequency, and presence of Concentrated Flows.

43. *Entering Phosphorus Index Factors:* **Enter the remaining information necessary to calculate the Phosphorus Index from Table 16.25:**

Table 16.25

Field ID	Soil Erosion RUSLE	Watercourse (Intermittent or Perennial)	Flow Distance to Watercourse (ft)	Soil Drainage Class	Flooding Frequency	Concentrated Flows (Y/N)
3982.01	1.1	I	1500	MWD	Rare	N
3982.02	1.5	I	1300	MWD	Rare	Y
3982.03	1.5	I	65	MWD	Rare	N
3982.04	1.4	I	4500	MWD	Rare	Y
3982.05	1.0	I	110	WD	Rare	N
3982.06	1.7	P	1350	MWD	Rare	Y
3982.07	2.2	P	400	MWD	Rare	N
3982.08	1.0	P	130	WD	Rare	N
3982.09	1.0	P	1300	SPD	Rare	N
628.10	2.2	P	850	WD	Occas	N

Save plan.

16.11 Allocation Screen

Allocation Screen – General Information

44. *Allocation:* The Allocation Screen is the step in the nutrient management plan where the farm's spatial nutrient balance is created. Considering the crop nutrient requirements, available manure, and risk indices (Phosphorus Runoff Index and Nitrate Leaching Index), you'll assign the source and rate of manure applications and rates of fertilizer applications for each field on this screen. The table at the top of the screen titled Manure Summary shows the quantity of manure available for application, the current quantity allocated to the fields and the difference between the two for each manure source and for the whole farm. The Field Nutrient Balance table is where you balance the crop nutrient requirements for each field with nutrients from manure and fertilizer. All cells allowing data entry are shaded yellow. **Your basic goals in the Allocation screen are to optimally:**
    1. **Meet crop nutrient guidelines on a field-by-field basis by allocating manure and/or fertilizer at achievable rates on the farm.**
    2. **Allocate all of the farm's manure across the land base (otherwise you may need to reconsider the "Amount Exported from System Annually" option on the Manure screen).**

3. **Minimize the risk of nutrient losses via runoff, erosion, and leaching, as indicated by the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index, respectively.**

Refer to the Nitrogen, Phosphorus, and Potassium management units in the Help for a better understanding of the Nutrient Management concepts applied in Cropware.

Allocation Screen – Configuring the Allocation Screen

45. *Configuring the Allocation Screen:* You can change what information is displayed on the Allocation screen in order to best suit your nutrient balancing efforts. You'll likely develop your own preferences, but to get a feel for the screen, consider the following:

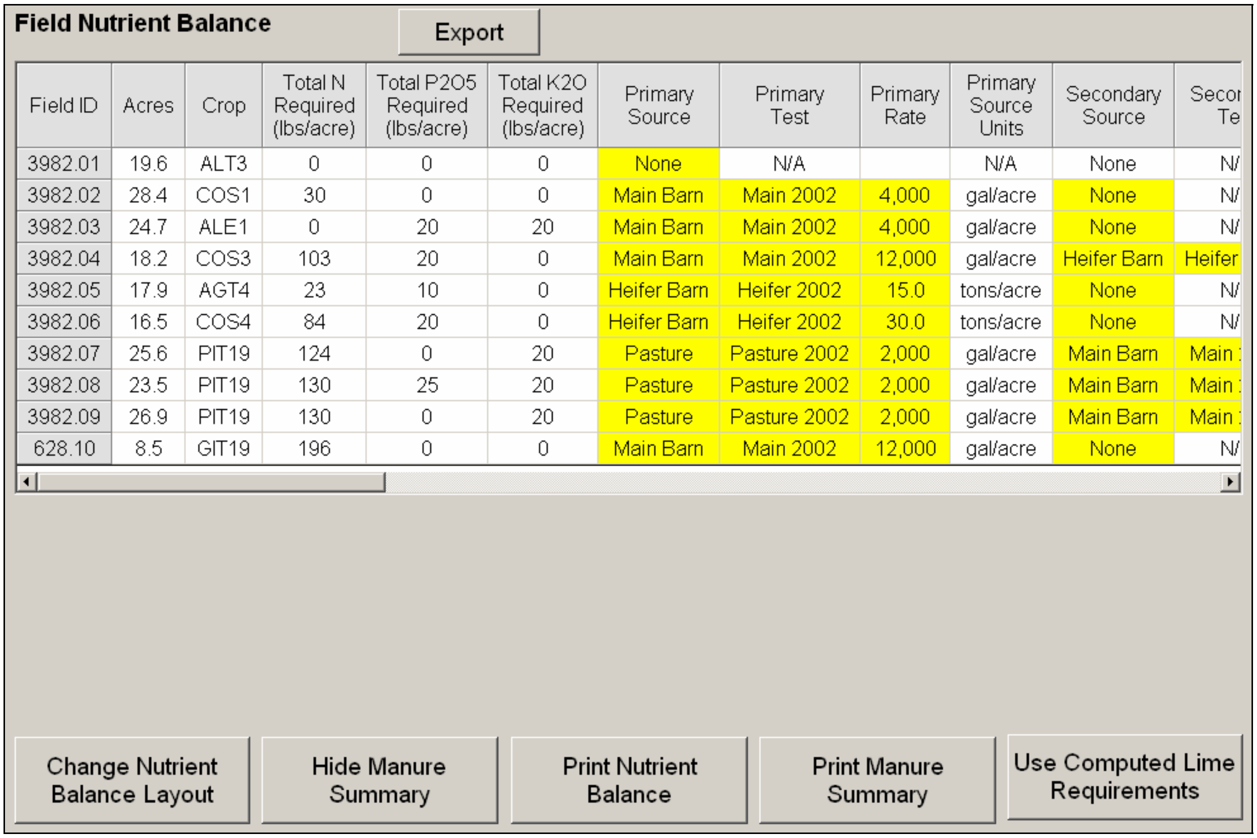
Manure Summary: The Manure Summary is helpful to consider while allocating manure in order to monitor manure inventories. The Manure Summary values will include changes made to the Field Nutrient Balance table when the "**Update NMP"** button is clicked. To have the Manure Summary updated after each entry, check the "Update NMP with Each Change" box. However, selecting this option will slow down the Allocation screen operation. **The Manure Summary can be hidden to expand the view of the Field Nutrient Balance table, by clicking on the "Hide Manure Summary" button. Try this. Then click on the "Show Manure Summary" button to re-display the Manure Summary, as in Figure 16.19 below.**

Manure Summary Export

	Total Tons	Total Gal	Main Barn	Pasture	Heifer Barn
Manure Available For Application	1112.00	1,150,300	989,254 gal	161,046 gal	1112.00 tons
Manure Allocated	945.50	1,040,000	888,000 gal	152,000 gal	945.50 tons
Manure Balance	166.50	110,300	101,254 gal	9,046 gal	166.50 tons

Figure 16.19

Field Nutrient Balance: On this screen you can decide the rate, source, and test of manure to be applied, the rate of up to four fertilizers to be applied, and whether any comments should be assigned to a given field (see teal input columns). All inputs should be entered on a "per acre" basis. To assist such decisions, you can choose the columns of data to view on the Field Nutrient Balance Table.



Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units	Secondary Source	Secor Te
3982.01	19.6	ALT3	0	0	0	None	N/A		N/A	None	N/
3982.02	28.4	COS1	30	0	0	Main Barn	Main 2002	4,000	gal/acre	None	N/
3982.03	24.7	ALE1	0	20	20	Main Barn	Main 2002	4,000	gal/acre	None	N/
3982.04	18.2	COS3	103	20	0	Main Barn	Main 2002	12,000	gal/acre	Heifer Barn	Heifer
3982.05	17.9	AGT4	23	10	0	Heifer Barn	Heifer 2002	15.0	tons/acre	None	N/
3982.06	16.5	COS4	84	20	0	Heifer Barn	Heifer 2002	30.0	tons/acre	None	N/
3982.07	25.6	PIT19	124	0	20	Pasture	Pasture 2002	2,000	gal/acre	Main Barn	Main
3982.08	23.5	PIT19	130	25	20	Pasture	Pasture 2002	2,000	gal/acre	Main Barn	Main
3982.09	26.9	PIT19	130	0	20	Pasture	Pasture 2002	2,000	gal/acre	Main Barn	Main
628.10	8.5	GIT19	196	0	0	Main Barn	Main 2002	12,000	gal/acre	None	N/

Figure 16.20

Click on the "Change Nutrient Balance Layout" button to show or hide columns on the table. Scroll through the pop-up box to see the options. To start with, choose the "Restore Defaults" to display the default set of data columns. Click OK. Scroll laterally within the Field Nutrient Balance to view all of the default data columns.

Click OK. Scroll laterally within the Field Nutrient Balance to view all of the recently added columns.

Next, right-click on the "Crop" column heading and choose "Sort by Ascending Order". This option will alpha-numerically sort the data in the selected column. This may be helpful if you'd like to, for instance, arrange all of the corn fields in a single view for nutrient allocation. The column order is returned to the default order, based on the Field ID, once you leave and return to the Allocation screen.

Allocation Screen – Allocating Manure and Fertilizer to Fields

46. *Allocating Manure and Fertilizer to Fields:* Based your characterizations of the farm fields and the quantities and nutrient contents of the farm manures, you are now ready to allocate manure and fertilizer nutrients to fields. **Find field 3982.04 in the "Field**

Nutrient Balance" table. Do the nutrient requirements match those in Figure 16.21 below?

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)
3982.01	19.6	ALT3	0	0	0
3982.02	28.4	COS1	30	0	0
3982.03	24.7	ALE1	0	20	20
3982.04	18.2	COS3	103	30	0
3982.05	17.9	AGT4	23	10	0
3982.06	16.5	COS4	84	25	0
3982.07	25.6	PIT19	124	0	20
3982.08	23.5	PIT19	130	25	20
3982.09	26.9	PIT19	130	0	20
628.10	8.5	GIT19	196	0	0

Figure 16.21

Now scroll to the right and notice the Nutrient Balance columns, as shown in Figure 16.22.

Field ID	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	0	0	0
3982.02	-30	0	0
3982.03	0	-20	-20
3982.04	-103	-30	0
3982.05	-23	-10	0
3982.06	-84	-25	0
3982.07	-124	0	-20
3982.08	-130	-25	-20
3982.09	-130	0	-20
628.10	-196	0	0

Figure 16.22

For N, P_2O_5 and K_2O, the difference between the sum of nutrients supplied by manure and fertilizer applications and the Total Nutrients Required is calculated in the Nutrient Balance columns. If the manure and fertilizer nutrient contributions are greater than nutrients required, the difference will be displayed in this column as a positive number. If the manure and fertilizer nutrient contributions are less than the nutrients required, the difference will be displayed in this column as a negative number. Because you haven't allocated any manure or fertilizer nutrients, yet, many balance values are negative. **Consult the Nutrient Balance columns as you allocate manure and fertilizer nutrients to a**

particular field. So how to satisfy the nutrient requirement for field 3982.04 with fertilizer and/or manure?

Fertilizer Allocation for Field 3982.04: Field 3982.04 will be planted to third year corn and requires 103 lbs/acre N, 30 lbs/acre P_2O_5, and no K_2O. According to current guides for starter fertilizer use, a response can almost always be seen from 10-30 lbs/acre of nitrogen fertilizer in the starter band. Next, if the phosphorus requirement is 20 lbs/acre of P_2O_5 or less (indicating a High or Very High soil test phosphorus classification), corn yields are not likely to respond to phosphorus in the starter band. If the P requirement exceeds 20 lbs/acre P_2O_5 (indicating a Medium to Very Low soil test phosphorus level from the Cornell Nutrient Analysis Lab), apply 20 lbs/acre P_2O_5 in the starter band and balance the remaining P_2O_5 requirement with manure. Visit the Nutrient Management Spear Program website for the latest research on Starter Phosphorus management (http://nmsp.css.cornell.edu/projects/starterp.asp). The potassium requirement can come from manure or fertilizer, banded or broadcast.

Therefore, select a starter fertilizer and rate for Fertilizer #1 on field 3982.04 that will supply ~10-30 lbs/acre N, ~20 lbs/acre P_2O_5, and 0 lbs/acre K_2O. To do this, scroll to the “Fertilizer #1 Name” column and select a starter fertilizer from the drop-down menu (remember that this list of fertilizers was created on the Fertilizers screen). Since this farmer can apply liquid starter fertilizers through the corn planter, choose 21-17-0. Next enter 9 gal/acre in the “Fertilizer #1 Rate” column for field 3982.04, as shown in Figure 16.23 below.

Field ID	Fertilizer #1 Name	Fertilizer #1 Formulation (N:P:K)	Fertilizer #1 Rate	Fertilizer #1 Units	N Balance (lbs/acre)	P2O5 Balance (lbs/acre)	K2O Balance (lbs/acre)
3982.01	None	N/A	N/A	N/A	0	0	0
3982.02	None	N/A	N/A	N/A	-30	0	0
3982.03	None	N/A	N/A	N/A	0	-20	-20
3982.04	21-17-0	21:17:0	9	gal/acre	-82	-13	0
3982.05	None	N/A	N/A	N/A	-23	-10	0
3982.06	None	N/A	N/A	N/A	-84	-25	0
3982.07	None	N/A	N/A	N/A	-124	0	-20
3982.08	None	N/A	N/A	N/A	-130	-25	-20
3982.09	None	N/A	N/A	N/A	-130	0	-20
628.10	None	N/A	N/A	N/A	-196	0	0

Figure 16.23

Notice that the “N Balance” and “P_2O_5 Balance” have decreased to -82 lbs/acre and –13 lbs/acre, respectively.

As a note, rates for liquid fertilizers should be entered in gal/acre. The Density value entered on the Fertilizers library screen is then used to calculate the lbs/acre of N, P_2O_5, and K_2O supplied by the given volume of liquid fertilizer in the following manner:

N: (9 gal/acre) x (11.3 lbs/gal) x (21%N) = 21 lbs/acre N
P_2O_5: (9 gal/acre) x (11.3 lbs/gal) x (17% P_2O_5) = 17 lbs/acre P_2O_5
K_2O: (9 gal/acre) x (11.3 lbs/gal) x (0% K_2O) = 0 lbs/acre K_2O

Now toggle to the Fields—Fertilizers screen and select "May-Aug" for the Timing and "Subsurface Banded" for the Application Method as shown in Figure 16.24 below. This will complete the Phosphorus Index inputs for this fertilizer application.

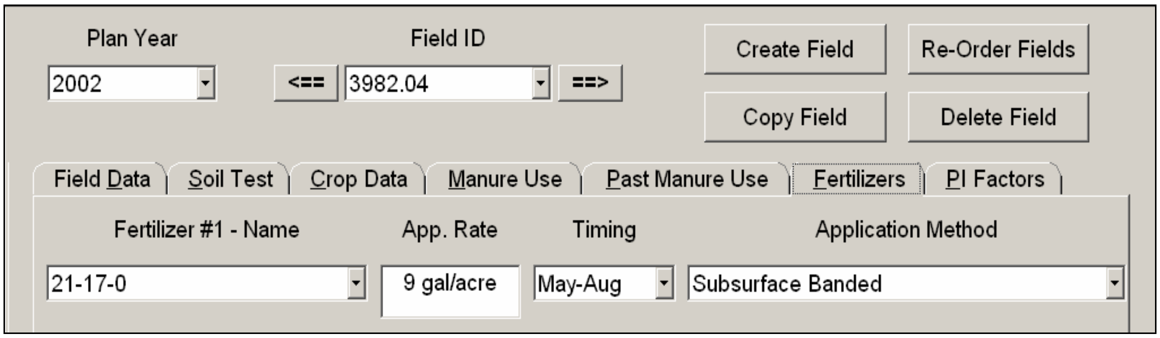


Figure 16.24

Manure Allocation for Field 3982.04: Depending on manure quantities and environmental risk indices, the remainder of the nutrient requirement may be supplied by manure. Cropware 2.0 enables the user to choose up to two manure applications per field per plan year. For instance, the user can plan two applications each from a different source, application method, timing, and/or rate. This operates under the assumption that each application covers the entire field. Planning with two manure sources enables the plan to better reflect field operations and more site-specifically define applications relative to the conservation of ammonia-N in manure and the Phosphorus Index.

As an example of one option for allocating manure to field 3982.04, scroll all the way to the left to view the "manure" columns. Click in the common "Primary Source" cell for field 3982.04 and select the Main Barn from the drop-down list. Next, select the Main 2002 Manure Test and enter a rate of 12,000 gallons/acre, as shown on Figure 16.25.

Field ID	Acres	Crop	Total N Required (lbs/acre)	Total P2O5 Required (lbs/acre)	Total K2O Required (lbs/acre)	Primary Source	Primary Test	Primary Rate	Primary Source Units
3982.01	19.6	ALT3	0	0	0	None	N/A		N/A
3982.02	28.4	COS1	30	0	0	None	N/A		N/A
3982.03	24.7	ALE1	0	20	20	None	N/A		N/A
3982.04	18.2	COS3	103	30	0	Main Barn	Main 2002	12,000	gal/acre
3982.05	17.9	AGT4	23	10	0	None	N/A		N/A
3982.06	16.5	COS4	84	25	0	None	N/A		N/A
3982.07	25.6	PIT19	124	0	20	None	N/A		N/A
3982.08	23.5	PIT19	130	25	20	None	N/A		N/A
3982.09	26.9	PIT19	130	0	20	None	N/A		N/A
628.10	8.5	GIT19	196	0	0	None	N/A		N/A

Figure 16.25

After choosing the starter fertilizer and 12,000 gallons/acre of Main Barn manure, field 3982.04 still requires 15 lbs of N to meet the crop requirement (see "N Balance" column). **Click into the "Secondary Source" column for field 3982.04 and enter an amount of Heifer Barn manure until the N Balance is roughly zero.**

How much did you allocate?…10 tons/acre.
What is the P_2O_5 balance?…197 lbs/acre.
How about the K_2O balance?…380 lbs/acre. Why such an imbalance?
The rate(s) of manure application(s) entered on the Allocation screen is used in the Phosphorus Index ratings. What are the Phosphorus Index scores now?

Click on the "Update NMP" button to update the manure inventories for the Heifer Barn and Main Barn. The allocation of 12,000 gallons/acre from the Main Barn and 10 tons/acre form the Heifer Barn to field 3982.04 (18.2 acres) amounts to 218,400 gallons of Main Barn manure and 182 tons of Heifer Barn manure.

Fertilizer and Manure Allocation for the Entire Farm: You've now balanced one field. **Realizing that the nutrient management plan requires an integration of all fields and all manure sources, enter the following manure and fertilizer data from Table 16.26 into the Allocation Screen.** Keep an eye on the changes in the Manure Balance, Nutrient Balances, the Phosphorus Index ratings, and whether the application is appropriate relative to the Nitrate Leaching Index. As you choose what manure to apply to what fields, you also may want to keep in mind the number of months of storage for a given manure source, the window when a field is open for manure application, the consistency of the manure, the number of different application rates practical on the farm, and any equipment or labor constraints that may favor one manure over another on a particular field. For example, liquid manures often interfere less with the re-growth of hayfields than solid manures, or a manure source with little storage capacity may need to be applied across a variety of fields so as to allow spreading opportunities throughout the year, or the number of recommended application rates may not be currently achievable on the farm, or it may be more cost effective to haul a more nutrient dense manure a greater distance.

Table 16.26

	Manure				Fertilizer			
Field ID	Manure Application	Manure Source	Manure Test	Manure Rate (/acre)	Fertilizer #1 Name	Fertilizer #1 Rate (/acre)	Fertilizer #2 Name	Fertilizer #2 Rate (/acre)
3982.01	Primary Secondary							
3982.02	Primary Secondary	Main Barn	Main 2002	4000 gal	UAN*	6 gal		
3982.03	Primary Secondary	Main Barn	Main 2002	4000 gal	6-24-24	85 lbs		
3982.04	Primary Secondary	Main Barn Heifer Barn	Main 2002 Heifer 2002	12000 gal 10 ton	21-17-0	9 gal		
3982.05	Primary Secondary	Heifer Barn	Heifer 2002	15 ton				
3982.06	Primary Secondary	Heifer Barn	Heifer 2002	30 ton	21-17-0	9 gal		
3982.07	Primary Secondary	Pasture Main Barn	Pasture 2002 Main 2002	2000 gal 6000 gal	Urea	100 lbs	Urea	100 lbs
3982.08	Primary Secondary	Pasture Main Barn	Pasture 2002 Main 2002	2000 gal 4000 gal	Urea	100 lbs	Urea	100 lbs
3982.09	Primary Secondary	Pasture Main Barn	Pasture 2002 Main 2002	2000 gal 4000 gal	Urea	100 lbs	Urea	100 lbs
628.10	Primary Secondary	Main Barn	Main 2002	12000 gal	Urea	215 lbs		

*Note: UAN = Urea Ammonium Nitrate

Notice the changes in nutrient balances and Phosphorus Index ratings resulting from the additions of manure and fertilizer to the plan.

Focusing on the pasture paddocks (fields 3982.07, 3982.08, and 3982.09), notice how the two manure sources, Pasture and Main Barn, and fertilizers were used in concert to help satisfy the nutrient needs of the paddocks. This was accomplished through the following steps.

1. Determine the total Manure Available for Application from the Pasture source (e.g. 161,046 gallons as calculated on the Manure screen).
2. Calculate the application rate, assuming that the Pasture manure is deposited evenly by the grazing animals across all of the paddocks.
    a. Divide the total Manure Available for Application by the number of acres in pasture (e.g. 161,046 / (25.6 acres + 23.5 acres + 26.9 acres) = ~2000 gal/acre.
3. Enter the calculated application rate for the paddocks on the Allocation screen as the Primary Application.
4. Use the Secondary Application to plan additional manure applications, this time with manure spreaders not grazing animals, from other manure sources on the farm.
5. Finally, plan "top-dressed" fertilizer applications as needed to satisfy the pasture nutrient guidelines with Fertilizer #1, Fertilizer #2, etc.

Click on the "Update NMP" button to update the manure inventories for the Main Barn, Pasture, and Heifer Barn sources. Notice the resulting Manure Summary, shown below in Figure 16.26. The Manure Balance is 101,254 gallons for the Main Barn, 9,046 gallons (essentially zero) for Pasture, and 166.5 tons for the Heifer Barn. This is a typical manure surplus for this farm and will be carried over to the Amount at Start of Plan Year for the next Plan Year, 2003. The surpluses are possible, because the amounts are within the capacities of the Main Barn and Heifer Barn manure storages, 320,000 gallons and 300 tons, respectively. The Pasture balance should be approximately zero, because it is not associated with a manure storage system.

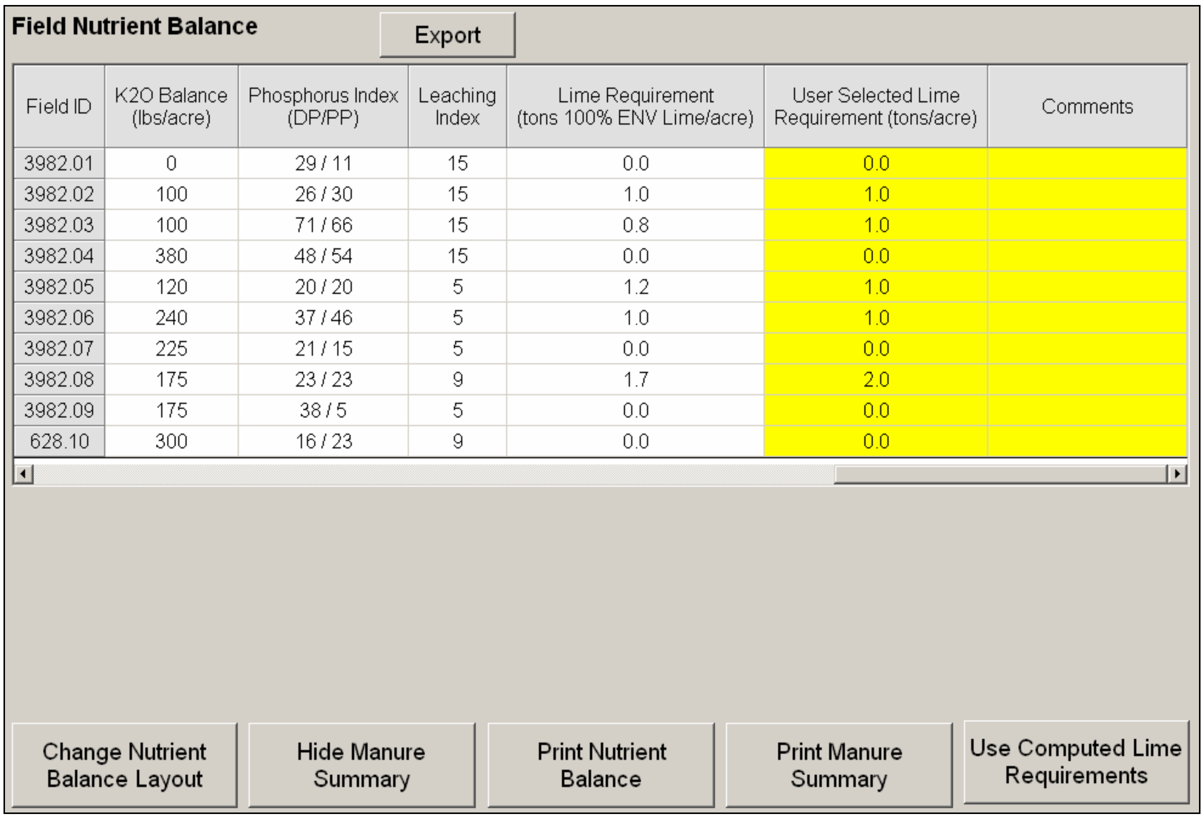
Manure Summary Export

	Total Tons	Total Gal	Main Barn	Pasture	Heifer Barn
Manure Available For Application	1112.00	1,150,300	989,254 gal	161,046 gal	1112.00 tons
Manure Allocated	945.50	1,040,000	888,000 gal	152,000 gal	945.50 tons
Manure Balance	166.50	110,300	101,254 gal	9,046 gal	166.50 tons

Figure 16.26

You can print the Manure Summary or Nutrient Balance with the appropriate "Print" button on the lower right portion of the Allocation Screen. Similarly, each grid can be exported to an .rtf file (compatible with Microsoft Word®) by clicking on the appropriate "Export" button.

47. *Allocating Lime to Fields:* Lime guidelines, based on crop, current soil test, soil type, and tillage depth, are provided on the Allocation screen as well. The lime requirement is not modeled between soil samples, but instead based on the actual soil analysis. **Scroll to the far right on the Allocation screen and notice the "Lime Requirement" and "User Selected Lime Requirement" columns.** Computed lime guidelines for 100% ENV lime are provided in the "Lime Requirement" column. The user must choose the rate of 100% ENV lime to be applied for the current plan year in the "User Selected Lime Requirement" column. This can be accomplished by entering lime guidelines directly in the column or by clicking the "Use Computed Lime Requirement" button in the lower left corner of the screen. **Enter the User Selected Lime Requirements as shown in Figure 16.27, below.**



Field ID	K2O Balance (lbs/acre)	Phosphorus Index (DP/PP)	Leaching Index	Lime Requirement (tons 100% ENV Lime/acre)	User Selected Lime Requirement (tons/acre)	Comments
3982.01	0	29 / 11	15	0.0	0.0	
3982.02	100	26 / 30	15	1.0	1.0	
3982.03	100	71 / 66	15	0.8	1.0	
3982.04	380	48 / 54	15	0.0	0.0	
3982.05	120	20 / 20	5	1.2	1.0	
3982.06	240	37 / 46	5	1.0	1.0	
3982.07	225	21 / 15	5	0.0	0.0	
3982.08	175	23 / 23	9	1.7	2.0	
3982.09	175	38 / 5	5	0.0	0.0	
628.10	300	16 / 23	9	0.0	0.0	

Figure 16.27

48. *Allocation Screen What If's:* So much of the balancing done on the Allocation screen depends on your definition of manure sources and fields from the previous screens. Take a moment to assess the effects of individual inputs on the nutrient management plan developed in this tutorial.

Effect of % Legume in Sod on Crop N Requirement: **Considering field 3982.04, notice the "Total N Requirement" (103 lbs/acre) for the 3rd year corn field on the Allocation screen. Toggle to field 3982.04 on the Fields—Field Data screen and change the "Past or Present Sod" input from "26-50% Legume" to 100% Grass". Flip to the Allocation screen and note the new Total N Requirement.** Any difference? If so, why? **Now switch to the "Fields—Crop**

Data" screen and change field 3982.04 to a 4th year COS field. Toggle back to the Allocation screen, note the Total N Requirement, and switch back to the "Fields—Field Data". Change the "Past or Present Sod" input back to "26-50% Legume" and toggle back to the Total N Requirement column on the Allocation screen. Any difference? Explain. **Go to the "Fields—Crop Data" screen and return field 3982.04 to 3rd year COS in 2002.**

Effect of Soil Test P Level on Crop P_2O_5 Requirement: **Continuing with field 3982.04, switch the "Soil Test P" value on the Fields—Soil Test screen to 3 lbs/acre P and toggle to the Allocation screen to assess the "Total P Requirement". Repeat this progression for the following Soil Test P values: 15, 25, 45, and, finally, return back to the original 7 lbs/acre.**

Effect of Years Since Sod on Crop N Requirement: **Continuing with field 3982.04, move to the Fields—Crop Data screen. Click on 2000, such that the crop rotation sequence rolls, making 2002 1st year COS after ALT. Toggle to the Allocation screen and assess the new "Total N Requirement".** Any difference? If so, why?

Effect of Manure Application Method on Application Rate to Satisfy Crop N requirement: **Continuing with field 3982.04, go to the "Fields—Crop Data screen" and roll the crop rotation sequence back to the original setting, making 2002 3rd year COS after ALT. Now, switch to the Fields—Manure Use screen and make sure the Primary Application Method is "Top Dress or Incorporated After 5 Days". Go to the Allocation screen and note the "N Balance (lbs/acre)". Toggle back to the Fields—Manure Use screen and switch the Primary Application Method to "Spring Incorporation Within 1 Day". Go to the Allocation screen and note the "N Balance (lbs/acre)" now.** *Any difference? If so, why?*

Effect of Manure Application Method on Phosphorus Index Rating: **Continuing with field 3982.04, while in the Allocation screen, note the Phosphorus Index ratings (DP and PP). Now, go to the Fields—Manure Use screen and change the Primary Application Method back to "Top Dress or Incorporated After 5 Days". Toggle back to the Allocation screen and note the updated Phosphorus Index ratings (DP and PP).** Any difference? If so, why?

Effect of Manure Application Timing on Phosphorus Index Rating: **Continuing with field 3982.04, go to the Fields—Manure Use screen and set the Primary Application Timing to "May-Aug". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP). Now, go back to the "Fields—Manure Use" screen and change current Application Timing to "Feb-Apr". Switch to the Allocation screen and note the Phosphorus Index ratings (DP and PP).** Any difference? If so, why?

16.12 Calendar Screen

Calendar Screen – General Information

49. *Calendar:* The Calendar screen acts as a worksheet to budget the timing of manure applications across the Plan Year. An important consideration in the development of a nutrient management plan is determining whether the applications of manure planned on the Allocation screen are feasible given temporal constraints. For example, the plan may call for the bulk of the manure to be spread on corn fields. But, it may not be possible to carry out the plan because there is not enough labor, machinery, or manure storage available to spread all the manure between corn harvest and planting. Or, the quantity of manure required by the plan may not be available when the field is accessible. To plan for these contingencies, Cropware provides a Calendar with a running manure inventory to plan the timing of manure applications for each month of the year.

Calendar Screen – Temporally Planning Manure Applications with the Calendar

50. *Temporally Planning Manure Applications with the Calendar:* A calendar worksheet is created for all manure sources on the farm for each plan year as well as for individual manure sources. **Enter the Calendar screen. Your basic goals in the Calendar screen are to allocate the "Planned Quantity" of manure per field (*not* per acre) across un-shaded months, such that:**
    1. **The "Quantity Difference" per field is zero.**
    2. **The "Ending manure Inventory" per month is greater than or equal to zero, but less than the manure storage capacity (if any) associated with the selected manure source.**
    3. **The "Phosphorus Index" ratings are best minimized.**

    All of the variables above can be adjusted on the Calendar screen. See Figure 16.28 for the basic layout of the Calendar screen.

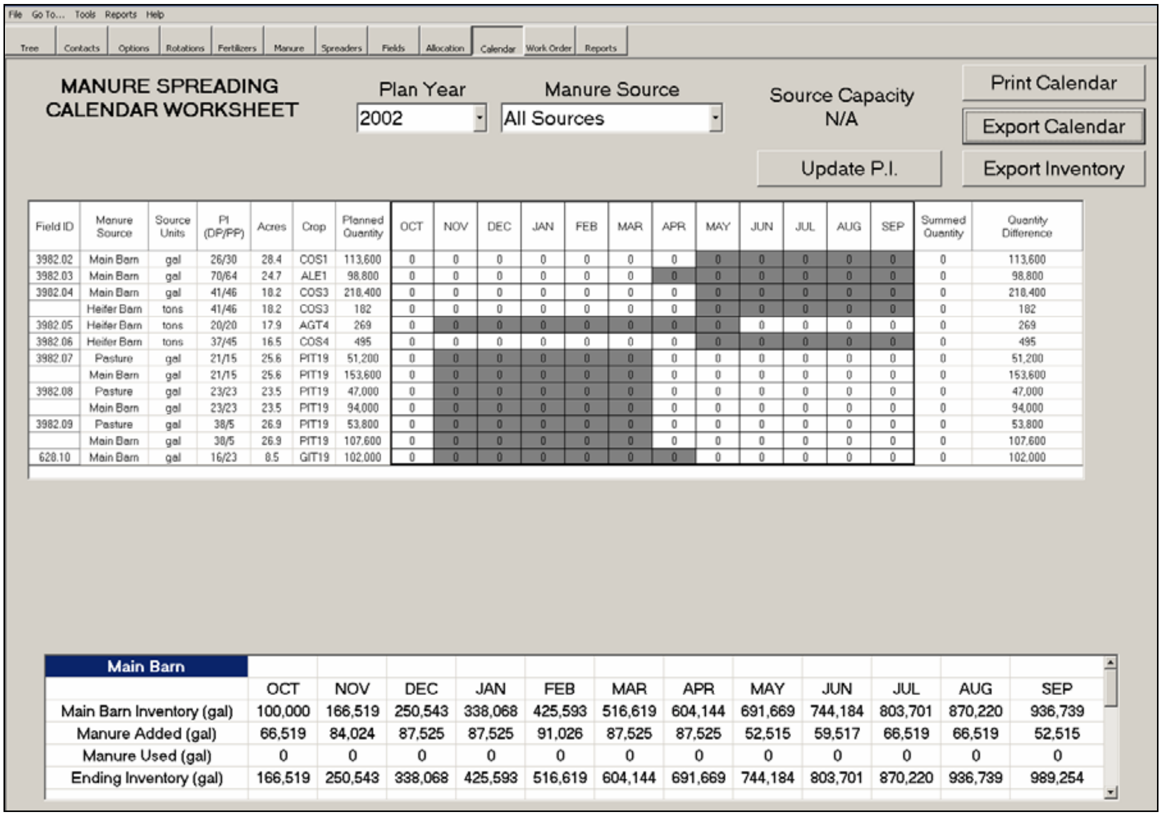


Figure 16.28

Considerations When Using the Calendar with a Grazing Farm: The manure inventory grid at the bottom of the screen is scrollable to show the running manure inventories for all sources on the farm. The quantities in the "Manure Added" row of the inventory grid can be adjusted on a monthly basis to reflect different amounts of manure produced by the manure source throughout the year, for instance on a grazing farm. As with the Main Barn and the Pasture manure sources, the total amounts of manure produced annually were estimated using the "Estimate Using Number and Average Weight of Manure Applications" method on the "Manure—Manure Source Data screen. The monthly records of manure spreader loads established that less manure was collected in the Main Barn during the grazing season and, subsequently, more manure was available for direct deposit on the Pasture system during the grazing season. Such variation in monthly manure availability is reflected in the Manure Added row, as in Figures 16.29 and 16.30.

Main Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Main Barn Inventory (gal)	100,000	166,519	250,543	338,068	425,593	516,619	604,144	691,669	744,184	803,701	870,220	936,739
Manure Added (gal)	66,519	84,024	87,525	87,525	91,026	87,525	87,525	52,515	59,517	66,519	66,519	52,515
Manure Used (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Ending Inventory (gal)	166,519	250,543	338,068	425,593	516,619	604,144	691,669	744,184	803,701	870,220	936,739	989,254

Figure 16.29

Pasture												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Pasture Inventory (gal)	0	21,006	21,006	21,006	21,006	21,006	21,006	21,006	56,016	84,024	105,030	126,036
Manure Added (gal)	21,006	0	0	0	0	0	0	35,010	28,008	21,006	21,006	35,010
Manure Used (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Ending Inventory (gal)	21,006	21,006	21,006	21,006	21,006	21,006	21,006	56,016	84,024	105,030	126,036	161,046

Figure 16.30

If manure production is not characterized as varying on a monthly basis on the Manure—Manure Source Data screen, then the total annual manure production value is divided equally across the 12 months of the plan year. This is demonstrated by the Heifer Barn manure source in the tutorial (Figure 16.31). Such default values can be changed in the "Manure Added" row, with the balance of the annual manure production kept in the last month of the plan year (September in the case above).

Heifer Barn												
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	100	184	268	352	436	520	604	688	772	856	940	1024
Manure Added (tons)	84	84	84	84	84	84	84	84	84	84	84	84
Manure Used (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Ending Inventory (tons)	184	268	352	436	520	604	688	772	856	940	1,024	1,108

Figure 16.31

Quantity Difference and Ending Monthly Manure Inventory Considerations: **Find the Calendar row for field 3982.06 in Figure 16.28, above. You'll notice that the "Planned Quantity" of manure for this field is 496 tons from the Heifer Barn. Next, scroll to the Heifer Barn in the manure inventory grid at the bottom of the screen. Find the "Ending Inventory" for October, the first month of the plan year as defined on the Options screen; you should see 184 tons. This end-of-the-month inventory is comprised of the Heifer Barn Inventory plus the Manure Added during October less the Manure Used during October. Note the 100 ton "Heifer Barn Inventory" at the beginning of October.** This quantity was carried over from the last plan year, as defined in the "Manure Balance" cell on the Allocation Screen for the last plan year and then the "Amount at Start of Plan Year" cell on the Manure screen for the current plan year. **Begin populating the Calendar screen by entering the following amounts of manure according to Table 16.27 below.**

Table 16.27

Field ID	OCT (gal)	NOV (gal)	DEC (gal)	JAN (gal)	FEB (gal)
3982.06	184	84	84	84	59

Remember that the total storage capacity for the Heifer system as defined on the Manure screen, is approximately 300 tons. **For the months of October through February, are the Ending Inventories all roughly less than 300 tons? Has the entire Planned Quantity of manure been allocated for the field (i.e., is the Quantity Difference approximately zero)?**

Complete the Calendar with the following allocations.

Table 16.28

Field ID	Manure Source	Source Units	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
3982.02	Main Barn	gal	0	0	85,668	27,932	0	0	0	0	0	0	0	0
3982.03	Main Barn	gal	0	98,800	0	0	0	0	0	0	0	0	0	0
3982.04	Main Barn	gal	0	0	0	0	0	0	218,400	0	0	0	0	0
	Heifer Barn	tons	0	0	0	0	0	0	182	0	0	0	0	0
3982.05	Heifer Barn	tons	0	0	0	0	0	0	0	0	0	0	269	0
3982.06	Heifer Barn	tons	184	84	84	84	59	0	0	0	0	0	0	0
3982.07	Pasture	gal	21,006	0	0	0	0	0	0	0	0	0	4,230	25,964
	Main Barn	gal	153,600	0	0	0	0	0	0	0	0	0	0	0
3982.08	Pasture	gal	0	0	0	0	0	0	0	25,994	0	4,230	16,776	0
	Main Barn	gal	0	0	0	0	0	0	0	0	0	0	94,000	0
3982.09	Pasture	gal	0	0	0	0	0	0	0	9,016	28,008	16,776	0	0
	Main Barn	gal	0	0	0	0	0	0	0	0	0	0	107,600	0
628.10	Main Barn	gal	0	0	0	0	0	0	0	0	51,000	51,000	0	0

Once entered, notice that the "Quantity Difference" for each field is nearly zero. Also, note the "Ending Inventories" for each manure source in the Figure 16.32, below. Is the Ending Inventory for the Main Barn within the storage capacity (i.e. 320,000 gallons)? For the Heifer Barn (i.e 300 tons)? For Pasture (i.e. no storage because this represents manure that is directly deposited on pastures by grazing animals)?

Main Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Main Barn Inventory (gal)	100,000	12,919	-1,857	0	59,593	150,619	238,144	107,269	159,784	168,301	183,820	48,739
Manure Added (gal)	66,519	84,024	87,525	87,525	91,026	87,525	87,525	52,515	59,517	66,519	66,519	52,515
Manure Used (gal)	153,600	98,800	85,668	27,932	0	0	218,400	0	51,000	51,000	201,600	0
Ending Inventory (gal)	12,919	-1,857	0	59,593	150,619	238,144	107,269	159,784	168,301	183,820	48,739	101,254
Pasture	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Pasture Inventory (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Manure Added (gal)	21,006	0	0	0	0	0	0	35,010	28,008	21,006	21,006	35,010
Manure Used (gal)	21,006	0	0	0	0	0	0	35,010	28,008	21,006	21,006	25,964
Ending Inventory (gal)	0	0	0	0	0	0	0	0	0	0	0	9,046
Heifer Barn	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Heifer Barn Inventory (tons)	100	0	0	0	0	25	109	11	95	179	263	78
Manure Added (tons)	84	84	84	84	84	84	84	84	84	84	84	84
Manure Used (tons)	184	84	84	84	59	0	182	0	0	0	269	0
Ending Inventory (tons)	0	0	0	0	25	109	11	95	179	263	78	162

Figure 16.32

The Calendar screen is helpful in assessing the feasibility of the manure management plan, thereby highlighting opportunities to change the system for more flexibility and efficiency, in terms of both production and environmental management.

Calendar Screen – Phosphorus Index Considerations

51. *Phosphorus Index Considerations:* The more temporally specific plan developed in the Calendar screen can be used to update the "Timing" variable for manure applications for the Phosphorus Index. **By clicking on the "Update P.I." button and confirming that you want to change the manure application timing setting for all of the fields, you'll be setting the manure application "Timing" on the Fields—Manure Use screen to correspond with the timings set on the Calendar screen. Based on this change, the Phosphorus Index ratings displayed on both the Allocation and Calendar screens will be updated.**

    The manure application timing for the Phosphorus Index is defined for each application (i.e. primary, secondary) within the following four periods, representing the lowest to highest risk of phosphorus loss: "May-Aug", "Sep-Oct", "Nov-Jan", and "Feb-Apr". If a timing defined on the Calendar screen spans two or more periods, Cropware will define the timing for the application to the range of months that represents the highest risk according to the Phosphorus Index. If two manure application events are planned for a field, the timing will be defined for each application and combined to calculate a single Dissolved Phosphorus Index rating and Particulate Phosphorus Index Rating for the entire field.

    After clicking the Update P.I. button, the following timings in Table 16.29 should now be present on the Fields—Manure Use screen.

Table 16.29

Field ID	Primary Application Timing	Secondary Application Timing
3982.01	Choose any -- No manure applied	Choose any -- No manure applied
3982.02	Nov-Jan	Choose any -- No manure applied
3982.03	Nov-Jan	Choose any -- No manure applied
3982.04	Feb-Apr	Feb-Apr
3982.05	May-Aug	Choose any -- No manure applied
3982.06	Feb-Apr	Choose any -- No manure applied
3982.07	Sep-Oct	Sep-Oct
3982.08	May-Aug	May-Aug
3982.09	May-Aug	May-Aug
628.10	May-Aug	Choose any -- No manure applied

You will also likely need to update the manure "Application Method" after completing the Calendar screen. The manure "Application Method" is used in the Phosphorus Index calculations and should be appropriate for the Timing of the planned manure application. Within the same Timing period, you may also wish to alter the Application Method to impact ammonia-N conservation and/or Phosphorus Index ratings. The manure Application Method can only be changed on the Fields—Manure Use screen. **Change the "Application Method" in the Fields—Manure use tab to the following.**

Table 16.30

Field ID	Primary Application Method	Secondary Application Method
3982.01	Choose any -- No manure applied	Choose any -- No manure applied
3982.02	Surf. App. on Frozen or Sat. Ground	Choose any -- No manure applied
3982.03	Surf. App. on Frozen or Sat. Ground	Choose any -- No manure applied
3982.04	Top Dress/Incorp. After 5 Days	Top Dress/Incorp. After 5 Days
3982.05	Top Dress/Incorp. After 5 Days	Choose any -- No manure applied
3982.06	Surf. App. on Frozen or Sat. Ground	Choose any -- No manure applied
3982.07	Top Dress/Incorp. After 5 Days	Top Dress/Incorp. After 5 Days
3982.08	Top Dress/Incorp. After 5 Days	Top Dress/Incorp. After 5 Days
3982.09	Top Dress/Incorp. After 5 Days	Top Dress/Incorp. After 5 Days
628.10	Top Dress/Incorp. After 5 Days	Choose any -- No manure applied

Congratulations! You just completed the first iteration of Nutrient Management Planning with Cropware….but there's more! Up to this point

in the tutorial, the Phosphorus Index has been calculated with initial estimations of manure application timing, and method. Once the Calendar screen is completed and the manure application timing and method data are updated in the Fields—Manure Use screens, you can assess a more realistic Phosphorus Index rating on the Allocation screen. Go to the Allocation screen and scroll to the Phosphorus Index column. Compare both the Dissolved Phosphorus (DP) Index ratings and the Particulate Phosphorus (PP) Index ratings with the Phosphorus Index ranking rubric in Table 16.31. The higher ranking of the two indices will determine the necessary management.

Table 16.31

Phosphorus Index Rating	Site Vulnerability	Management
< 50	Low	N based management
50 - 74	Medium	N based management with BMPs
75 - 99	High	P applications to crop removal
≥ 100	Very High	No P_2O_5 fertilizer or manure application

The current plan is balanced on nitrogen, so any fields in the High or Very High ranking will require either 1) switching to phosphorus crop removal planning or no phosphorus application at all, respectively, or 2) changing field management to reduce the ranking to at least the Medium risk category. Such changes could include reducing manure and fertilizer P application rates, improving P application timing and methods, establishing within-field buffers to increase the flow distance to the nearest watercourse, adopting a different crop rotation or field configuration to reduce soil erosion, addressing a concentrated flow, etc. As you can imagine, such changes will result in a different use of manure and fertilizer relative to the first iteration, so a second iteration through the Allocation screen, Calendar screen, Fields screen, and back to the Allocation screen is necessary to update the plan (as illustrated in Figure 16.1).The first iteration of the tutorial resulted in all low and medium ranked fields, so move on to the Work Orders screen to create detailed manure application instructions and records.

16.13 Work Order Screen

Work Order Screen – General Information

52. *Work Order:* This screen is used to produce a "work order" for the person(s) applying manure. It allows you to create a tactical plan of how many loads to apply per field per month per spreader based on the completed Calendar screen. The Work Order itself, once printed, provides space for recording the number of loads actually spread and any relevant comments from the field. Once the completed Work Order is returned to the farm office, the number of loads applied can be entered to create a Manure Application Report for the farm.

Work Order Screen – Creating a Work Order

53. *Creating a Basic Work Order:* **Enter the data in Figure 16.33 to the Work Order screen.**

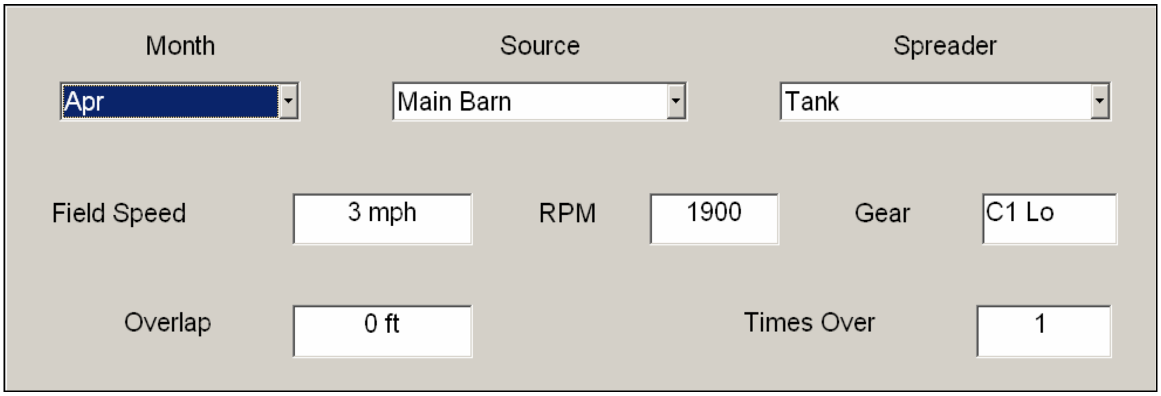
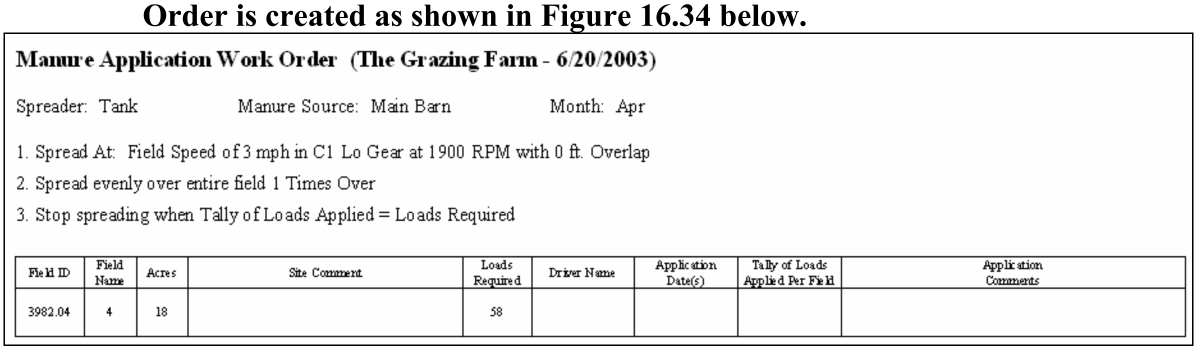


Figure 16.33

Spreader settings, such as Field Speed, RPM, Gear, Overlap, and Times Over can be determined by calibrating the spreader. For the month of April, field 3982.04 is the only field scheduled to receive manure from the Main Barn, based on your work in the Calendar screen.

Overlap or Times Over: To determine the amount of Overlap or, similarly, the number of Times to apply manure Over the entire field, keep in mind the calibrated rate of the spreader and the planned rate per acre from the Allocation screen. For instance, assume that the Tank spreader settings entered in Figure 16.33 above result in a rate of 6,000 gal/acre, according to your calibration activities. The planned rate/acre for field 3982.04 is 12,000 gallons, so the Tank spreader would need to apply manure two Times Over the field to achieve the planned rate. For this example, though, assume that the Tank spreader *is* calibrated for 12,000 gallons/acre, so the Times Over should be 1.

Check the "Select" box to add field 3982.04 to the Work Order and add any "Site Comments". Click on "View Work Order" and a printable Work Order is created as shown in Figure 16.34 below.



Manure Application Work Order (The Grazing Farm - 6/20/2003)

Spreader: Tank Manure Source: Main Barn Month: Apr

1. Spread At: Field Speed of 3 mph in C1 Lo Gear at 1900 RPM with 0 ft. Overlap
2. Spread evenly over entire field 1 Times Over
3. Stop spreading when Tally of Loads Applied = Loads Required

Field ID	Field Name	Acres	Site Comment	Loads Required	Driver Name	Application Date(s)	Tally of Loads Applied Per Field	Application Comments
3982.04	4	18		58				

Figure 16.34

Multiple Spreaders Applying Manure to a Single Field the Same Month: Two methods exist.

1) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. Create and Print a Work Order for each spreader, outlining the spreader settings. Then multiply the "Loads Required" by the proportion of the manure handled by that spreader and manually write in the corrected Loads Required number on the printed Work Order.
2) If multiple spreaders are used to apply manure to the same field within a single month, divide the total amount of manure scheduled for application to the field that month among the number of spreaders. To be safe, use the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized specifically for creating Work Orders. Next, go to the Calendar screen and find the field and month of interest within a given manure source. For each spreader, multiply the total quantity of manure allocated for the field during that month by the proportion of the manure to be applied by the particular spreader. Don't be concerned about the impact of such a change on the allocation screen. Go to the Work Order screen and select the "Month", "Manure Source", and "Spreader". The "Monthly Planned Quantity" has now been updated based on your changes for that spreader in the Calendar screen. Check the "Select" box and print the work order. Repeat entire process for the remaining spreaders, unless the you assume that each spreader will apply the same proportion of the Monthly Planned Quantity, in which case you can simply select another spreader from the Spreader drop-down menu and print a Work Order.

Single Spreader Applying Manure to Different Fields with Different Spreader Settings in the Same Month: If a single spreader is used with multiple spreader settings within the same month, a Work Order for each spreader setting should be created. Choose the Month, Manure Source, and Spreader. Select the spreader settings necessary to achieve the desired rate of application, as determined by your calibration activities. Check the Select box for those fields to receive manure with the chosen spreader settings. View the Work Order and Print. Then change the spreader settings and repeat for fields requiring different rates.

Creating a Report of the Number of Loads Required for an Entire Plan Year Across All Fields: Some planners and producers will prefer to create a report of the number of loads required for a given spreader for the entire plan year across all fields receiving manure from a particular manure source. To accomplish this, choose the Save Plan As function in the File drop-down menu to save the original plan to a renamed version utilized for the creating this specific report. Switch to the Calendar screen and sum all of the manure applications across the entire plan year for each manure source. Enter the totals per field into a single month column, for example October. Toggle to the Work Order screen. Select the month in which the annual totals were entered, October in this example. Select the Manure

Source, Spreader, and spreader settings, if applicable to this somewhat coarse work order. Check the Select box for all of the fields and View the Work Order and Print. The month, October in this case, does not apply as this is a report for the entire plan year, so it can be manually blocked-out on the printed report. This process can be repeated for all manure sources and spreaders.

Work Order Screen – Creating a Manure Application Report

54. *Creating the Manure Application Report:* Once the person applying the manure has returned the completed Work Order, the tally of loads can be used to create a record of manure applications per month on a field-by-field basis for the Plan Year. **For example, assume that the Tank spreader was used to apply 58 loads to field 3982.04 in April, per the Work Order in Figure 16.34 above. Multiply the number of loads applied (58) by the capacity per load (3500 gal found on the *Spreaders screen). The resulting total is 203,000 gallons. Return to the Work Order screen and choose April, Main Barn, and Tank. Check the "Done" box to signal that manure applications are finished on field 3982.04 for the month and enter 203,000 gallons into the teal-shaded "Quantity Applied" column. A running total of the amount of manure applied to field 3982.04 in April with the Tank spreader is kept in the "Total Quantity Applied" column. Click on "View Manure Application Report". You'll notice that 203,000 gallons of manure have been recorded for field 3982.04 in April.**

16.14 REPORTS

Reports – Cover Page

55. *Cover Page Report:* **Go the Reports screen and check the "Cover Page" box. Click on "View Report" and Print.**

Reports – Custom Report

56. *Custom Report:* Use the Custom Report option to create reports to your specifications. **De-select the "Cover Page" box and check the "Custom Report" box. Click on "View Report, "Settings", and the "Custom Report" tab. Gain experience in building custom reports by working through the following examples.**

Create a Simple Recipe for Implementation: **Click Clear All under "Report Fields" and check the following items:**

Field ID, Acres, Current Crop, Fertilizer #1 Name, Fertilizer #1 Units, Fertilizer #1 Rate, and Fertilizer #1 Applied.

"Highlight Fertilizer #1 Rate" and using the large Up arrow, shift the highlighted item up the list or above "Fertilizer #1 Units". This changes the

column order of items from left to right across the Custom Report. Re-check the "Fertilizer #1 Rate", if necessary.

Save Report Settings: Once you've created a useful Custom Report, you can save it as a template for use with other nutrient management plans on other farms. The selected data columns, sorts, queries, formats, etc. will be maintained, but the data for the report will be pulled from the plan currently loaded in Cropware. **Click Save Report Settings, keep the directory as My Documents, and name the file: Fertilizer #1 Applications. Hit Save.**

Load Report Settings: **Click on Settings and within the Custom Report Tab click on the Load Report Settings button. Select the file named: Fertilizer #1 Applications.set and hit Open.** You should see your originally selected report options on the Custom Report Settings screen. **Click on Return to Reports to view the report.**

Click "Return to Reports" to view the Custom Report, as below in Figure 16.35.

Custom Report

ID	Acres	Current Crop	Fert. #1 Name	Fert. #1 Rate/acre	Fert. #1 Units	Fert. #1 Applied
3982.01	19.6	ALT	None	0	N/A	0
3982.02	28.4	COS	Urea Ammonium Nitrate	6	gal	170
3982.03	24.7	ALE	6-24-24	85	lbs	2,100
3982.04	18.2	COS	21-17-0	9	gal	164
3982.05	17.9	AGT	None	0	N/A	1
3982.06	16.5	COS	21-17-0	9	gal	149
3982.07	25.6	PIT	Urea	100	lbs	2,560
3982.08	23.5	PIT	Urea	100	lbs	2,350
3982.09	26.9	PIT	Urea	100	lbs	2,690
628.10	8.5	GIT	Urea	215	lbs	1,828

Figure 16.35

Export Report: **Click Export Report to save the report as a Rich Text File (.rtf) in your chosen directory.**

Print Report: **Click on the Printer icon above the report.**

Create a Custom Report Using the Primary and Secondary Sorts, Column Constraints, and Row Constraints: **Click on "Settings" and the "Custom Report" tab.** For this report you'll consider the N, P_2O_5, and K_2O requirements for each field, grouped by crop and P_2O_5 requirement. This report is helpful for developing an initial starter fertilizer plan. **Click on "Clear All" under the Report Fields menu and select the following:**

Field ID, Acres, Current Crop, N Req. (lbs/acre), P Req. (lbs/acre), K Req. (lbs/acre), and Comments

In the Primary Sort menu, type "C" to find and select "Current Crop" and in the Secondary Sort, type "P" to find and select "P Req (lbs/acre)". Sort both in ascending order, resulting in a report with groupings by current crop and, within each crop, groupings of similar P_2O_5 requirements.

Next, in the Column Constraints section, we would like to total the acres for all fields that share the same crop and P_2O_5 requirement. **Select "Acres" from the "Column to Total" drop-down menu, "Sum" in the "Function" menu, and "Current Crop" from the "Column to Group By" menu.** Checking "Show Grand Total" will total the acres across all fields as well as sub-totals per the "Columns to Group By" selection, current crop in this case. If "Only Show Grand Total" is checked, the sub-totals will not appear. **Check "Show Grand Total". Finally, make sure that the "Time Range" in the lower left corner is set to "2002" to "2002" in order to capture only the current plan year.**

In the Row Constraints, we're interested in selecting only the fields that could require a starter fertilizer (i.e., those fields to be seeded or planted this year). For this farm, we have corn silage, alfalfa grass mixes, and alfalfa that could be planted/seeded during the plan year. Therefore, in the Crops Row Constraint column, click on the following crop codes, indicating: AGE, ALE, and COS. To deselect any crop, simply click on it a second time. **At this point, the settings should resemble the screen in Figure 16.36, below.**

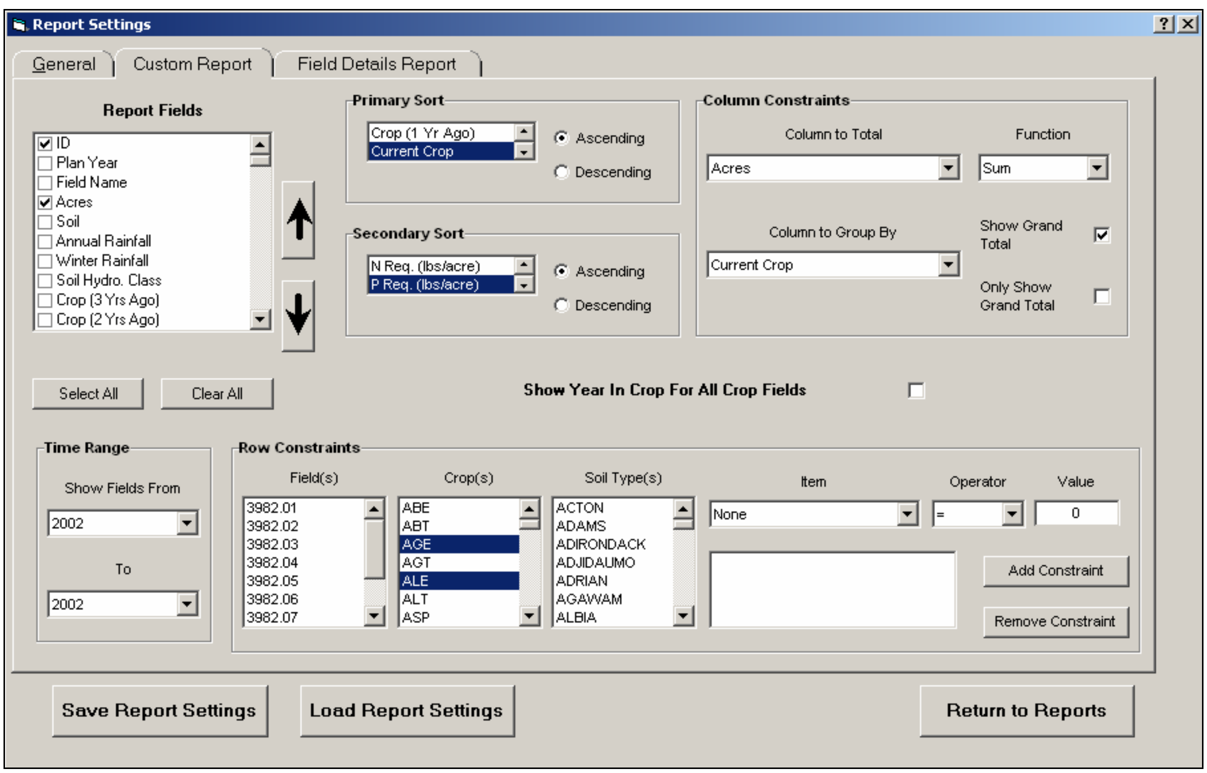


Figure 16.36

Click on Return to Reports and notice the report, shown below in Figure 16.37.

Custom Report

ID	Acres	Soil	Current Crop	N Req. (lbs/acre)	P Req. (lbs/acre)	K Req. (lbs/acre)	Comments
3982.03	24.7	HOWARD	ALE	0	20	20	
	24.70						
3982.02	28.4	HOWARD	COS	30	0	0	
3982.06	16.5	LANGFORD	COS	84	25	0	
3982.04	18.2	HOWARD	COS	103	30	0	
	63.10						
TOTAL	87.80						

Figure 16.37

As a note, if you check the "Show Year in Crop For All Crop Fields" as in Figure 16.38, then crop code data, such as in the "Current Crop" column in Figure 16.37 above, will be coupled with the year in crop within the rotation (i.e. COS1, ALT4, etc.).

Figure 16.38

Once printed, use the "Comments" column to write in the N-P_2O_5-K_2O fertilizer material of choice and the initial rate (lbs/acre) of application to satisfy the portion of the total nutrient requirement appropriate for starter fertilizer (refer to the Nitrogen, Phosphorus, and Potassium management sections for guidance, here). Based on your notes, choose starter fertilizer materials and rates on the Allocation Screen. Now you're in a position to allocate manure and/or additional fertilizers to satisfy the remaining nutrient balance. You may also want to refine your initial starter fertilizer choices at this point.

Creating Custom Reports Using Row Constraints: The most basic use of the Row Constraint function is to build queries in order to subset the farm data. For example, to determine which fields in Plan Year 2002 have a Dissolved Phosphorus (PI-DP) Index of greater than 50, then **perform the following:**

1) **Reset the Report Fields to only include Field ID, Plan Year, Acres, Current Crop, and PI-DP.**
2) **Reset the Primary and Secondary Sorts to None.**
3) **Reset the "Column to Total" in the Column Constraints to None.**
4) **Set the "Time Range" to Show Fields From 2002 to 2002, so as to only analyze the 2002 Plan Year.**
5) **De-select any crops highlighted in the Crops row constraint.**
6) **Select PI-DP from the Item menu.**

7) Select > from the Operator menu.
8) Enter 50 into the Value menu.
9) Click "Add Constraint".
10) Click Return to Reports.

See Figure 16.39 for the set-up and Figure 16.40 for the resulting report.

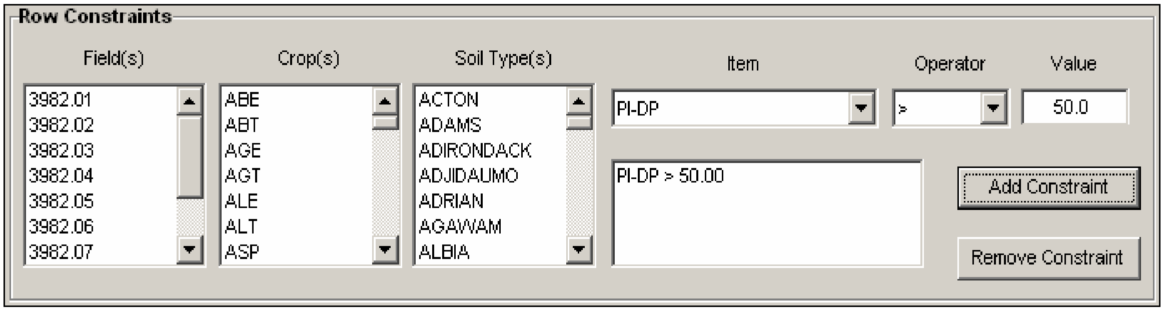


Figure16.39

Custom Report

ID	Plan Year	Acres	Current Crop	PI-DP
3982.03	2002	24.7	ALE	71

Figure 16.40

Continue to experiment with creating and saving Custom Reports to assist you in planning, implementation, and evaluation of the nutrient management plan.

Reports – Crop, Livestock, and Nutrient Index Summary

57. *Crop, Livestock, and Nutrient Index Summary:* The Crop Summary component of this report provides absolute acreages and proportions of the different crops grown on the land base for the existing plan years. The Livestock Summary and Nutrient Index Summary components are helpful for quantifying changes on the farm overtime, such as increased stocking rate or farm weighted Phosphorus Index values.

Reports – Crop Plan Summary

58. *Crop Plan Summary Report:* The Crop Plan Summary Report provides the acreages of crops for the current plan year, 3 years prior, and 10 years to follow. This report is a summary of the crop rotations of individual fields defined on the Fields—Crop Data screen. Toggling between the Fields—Crop Data screen and the Crop Plan Summary report can aid in crop rotation development during the planning process. Cropware does not couple yield and dry matter measurements with the acreages of various crops. Such

information can be coupled with this report to assess whether the current crop rotation plan will provide the necessary quantities of specific crops to meet herd feed requirements, while reducing soil erosion and nutrient loss.

Reports – Nutrient Balance

59. *Nutrient Balance Report:* The purpose of this report is to give the farmer and planner a broad view of the plant, soil and manure nutrient balance of the whole farm for the current and future plan years. Changes in herd numbers, feeding management, land area, crop rotation, manure application method, manure storage, fertilizer use, etc. will impact a farm's nutrient balance over time. This report can help quantify some of those impacts and help plan a progressive future direction.

Reports – Nutrient Management Plan

60. *Nutrient Management Plan:* The Nutrient Management Plan report is a summary of the within field nutrient balance for the current Plan Year. It provides similar information as found on the Allocation screen, but is reported in a more concise manner. The report is useful for nutrient planning discussions between the farmer and the planner, because it clearly displays nutrient credits as well as how the crop nutrient requirement will be met (or not) by the application of manure and fertilizer nutrients. The reporting of the Dissolved Phosphorus Index, the Particulate Phosphorus Index, and the Nitrogen Leaching Index across all the farm fields also provides a clear picture of where additional resources may need to be focused.

Reports – Manure Analysis, Collection, and Storage

61. *Manure Analysis, Collection, and Storage:* The purpose of this report is to give a summary of the manure nutrient composition, quantity, and storage capacity for each waste source. The Manure Nutrient Analysis component is populated by the latest manure analysis for the given manure system. The Annual Nutrient Collection component reports the total annual amount of nitrogen, phosphorus, and potassium collected by a given manure system. The Waste Storage component compares the existing waste storage capacity with the annual amount of manure produced by the source, resulting in the number of months of storage available.

Reports – Manure Analyses

62. *Manure Analyses:* This report lists all of the manure analyses entered into the Manure screen. Farms with manure storage systems often couple historic manure analyses with the estimated quantity in storage to determine the manure allocation plan, because quick tests for manure nutrient composition and immediate allocation planning are not currently feasible options. This concise summary of a farm's manure analyses is helpful in calculating long-term, farm-specific average manure nutrient compositions.

Reports – Fertilizer and Manure Management Summary

63. *Fertilizer and Manure Management Summary:* The Fertilizer and Manure Management Report shows a summary of fertilizer and manure information for all of the fields. In addition to fertilizer and manure application rates, lime requirement and the latest soil sample date are also shown. The lime requirement is calculated to 100% ENV and assumes that no lime has been applied since the last soil test date.

Reports – Fertilizer Shopping List

64. *Fertilizer Shopping List:* The Fertilizer Shopping List is simply a list of the total quantity of each fertilizer used in the current year plan. This report can be used to plan fertilizer purchases or re-evaluate the fertilizer selection. For instance, if the supplier had inadequate inventory of a given fertilizer blend, you may choose to not use that blend and, instead, purchase a different fertilizer for those fields. You can also track fertilizer material costs over the plan years.

Reports – Field Details Report

65. *Field Details Report:* Depending on the preferences of the farmer and/or planner, the Field Details Report can be used as recipe for the nutrient management of a field for the current Plan Year. A one-page report is generated for each field, providing a comprehensive summary of nutrient management inputs and recommendations for the particular field. **To view the report, check the Field Details Report within the "Select Reports" menu and click "View Report". On the following screen, click "Settings". Click the "Field Details Report" tab and check the fields of interest. Click "Return to Reports" to review the Field Details Reports for the chosen fields.**

17. CROPWARE TABLES

TABLE 17.1: CORNELL SOILS DATABASE.

HG = hydrologic group; D = drainage; SMG = soil management group; UDr = undrained; Dr = artificially drained. Drainage: V = very poorly drained, P = poorly drained, S = somewhat poorly drained, M = moderately well drained, W = well drained, E = excessively well drained. N uptake efficiency is the percent of the N added to this soil at side-dress time that is expected to be taken up by the plant. The soil N supply is the quantity of N that is expected to be taken up by the corn from the soil when adequate amounts of other nutrients are present but no N was added. Yield potentials for corn are given in bushels/acre on 85% dry matter basis. A yield of 100 bushels/acre equals a 17 tons/acre silage yield (35% dry matter). Yield potentials for alfalfa are in tons/acre and assume 88% dry matter. Yield potentials are the average yields expected under excellent management over a time period of 10 years. For soils with a hydrologic code that consists of more than one letter (e.g. “A/B”, “B/C”, “C/D”), its hydrologic code is determined by the presence or absence of adequate artificial drainage. If the field is artificially drained the hydrologic group moves to the first of the two classes. If the field is inadequately drained or not drained at all, the second of the two classes is assigned.

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential			
									Corn bu/acre		Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Acton	C	M	Rare/None	4	65	70	65	65	120	125	4.0	5.5
Adams	A	W	Rare/None	5	70	70	40	40	95	95	4.5	4.5
Adirondack	D	W	Rare/None	4	75	75	70	70	75	75	4.0	4.0
Adjidaumo	D	P	Frequent	1	55	60	65	75	75	105	2.5	3.5
Adrian	A/D	V	Rare/None	6	55	65	90	120	60	120	2.5	4.0
Agawam	B	W	Rare/None	4	75	75	65	65	140	140	6.0	6.0
Albia	C	S	Rare/None	3	60	65	60	70	100	120	3.5	4.5
Albrights	C	M	Rare/None	2	70	70	75	75	110	120	4.5	5.0
Alden	D	V	Rare/None	3	50	60	65	80	65	90	2.0	3.5
Allagash	B	W	Rare/None	5	75	75	65	65	105	105	5.0	5.0
Allard	B	W	Rare/None	3	75	75	70	70	135	135	6.0	6.0
Allendale	D	P	Rare/None	3	55	60	60	70	80	100	2.5	3.5
Allis	D	P	Rare/None	3	60	65	65	75	80	100	2.5	4.5
Alluvial Land	C	S	Rare/None	3	60	65	70	75	75	100	3.0	4.0
Almond	C	S	Rare/None	3	60	65	65	75	90	95	2.5	3.0
Alps	C	M	Rare/None	3	70	70	75	75	110	115	4.5	5.0
Altmar	B	M	Rare/None	5	65	70	50	60	100	115	4.5	5.0
Alton	A	W	Rare/None	5	75	75	65	65	125	125	5.5	5.5
Amboy	C	W	Rare/None	4	75	75	60	60	140	140	5.5	5.5
Amenia	B	M	Rare/None	4	70	70	65	65	135	140	5.0	5.5
Angola	C	S	Rare/None	2	60	65	70	80	95	110	3.0	4.5
Appleton	C	S	Rare/None	2	60	65	65	75	105	125	4.0	4.5
Arkport	B	W	Rare/None	4	75	75	50	50	125	125	5.5	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Armagh	D	P	Rare/None	2	55	60	70	80	80	100	2.5	4.0
Arnot	C/D	W	Rare/None	3	70	70	70	70	90	100	4.0	4.0
Ashville	D	V	Rare/None	3	50	55	65	75	75	95	3.0	3.5
Atherton	B	P	Rare/None	3	55	60	55	75	90	105	2.5	4.0
Atkins	D	V	Frequent	3	50	60	65	75	70	105	2.0	3.5
Atsion	C	P	Rare/None	5	60	65	60	70	70	95	3.0	4.5
Au Gres	B	S	Rare/None	5	55	65	60	65	90	100	3.0	4.5
Aurelie	D	P	Rare/None	3	55	60	70	80	75	95	2.0	2.5
Aurora	C	M	Rare/None	2	70	70	70	70	110	115	4.5	4.5
Barbour	B	W	Occasional	3	75	75	75	75	140	140	6.0	6.0
Barcelona	C	S	Rare/None	3	60	65	65	75	90	115	3.5	4.5
Barre	D	P	Rare/None	1	55	65	70	80	80	105	2.5	4.0
Bash	C	S	Frequent	3	60	65	65	75	105	130	5.0	5.5
Basher	B	M	Occasional	3	70	70	70	70	140	140	5.5	6.0
Bath	C	W	Rare/None	3	75	75	75	75	125	125	5.0	5.0
Becket	C	W	Rare/None	4	75	75	60	60	100	100	4.5	4.5
Becraft	B	M	Rare/None	3	70	70	75	75	150	150	5.5	6.0
Belgrade	B	M	Rare/None	3	70	70	80	80	140	145	5.5	6.0
Benson	D	E	Rare/None	4	70	70	65	65	80	80	4.0	4.0
Berkshire	B	W	Rare/None	5	75	75	65	65	125	125	5.5	5.5
Bernardston	C	W	Rare/None	4	75	75	65	65	135	135	5.5	5.5
Berrien	C	M	Rare/None	5	70	70	55	55	120	120	4.5	5.0
Berryland	B	V	Frequent	5	50	60	70	75	60	90	2.0	3.5
Beseman	A	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Bice	B	W	Rare/None	5	75	75	65	65	130	130	5.0	5.0
Biddeford	D	V	Rare/None	2	50	60	70	75	65	95	2.0	3.5
Birdsall	D	V	Rare/None	3	50	55	70	75	70	90	2.5	3.5
Blasdell	A	W	Rare/None	3	75	75	70	70	125	125	5.5	5.5
Bombay	B	M	Rare/None	4	70	70	65	65	135	135	5.0	5.5
Bonaparte	A	E	Rare/None	4	70	70	50	50	100	100	4.5	4.5
Bono	D	V	Rare/None	1	50	60	70	80	60	100	3.0	4.0
Boots	A	V	Rare/None	6	55	65	90	130	60	130	2.5	3.5
Borosaprists	A/D	V	Rare/None	6	55	65	90	140	60	150	2.0	3.5
Boynton	D	P	Rare/None	3	55	65	70	75	80	100	2.5	4.0
Braceville	C	M	Rare/None	4	70	70	75	75	115	120	4.0	5.0
Brayton	C	S	Rare/None	4	60	65	70	70	90	105	3.0	4.5
Bridge-hampton	B	W	Rare/None	3	70	70	70	70	150	150	6.0	6.0
Bridport	D	S	Rare/None	2	60	65	65	75	105	120	3.5	4.5
Briggs	A	W	Rare/None	4	75	75	60	60	100	100	5.0	5.0
Brinkerton	D	P	Rare/None	2	55	65	70	80	80	100	2.5	4.0
Broadalbin	C	M	Rare/None	4	75	75	65	65	130	130	5.5	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Brockport	D	S	Rare/None	1	60	65	70	80	95	120	4.0	4.5
Brookfield	B	W	Rare/None	3	75	75	75	75	130	130	5.0	5.0
Buckland	C	W	Rare/None	3	70	70	70	70	90	90	0.0	4.0
Bucksport	D	V	Rare/None	6	55	65	90	140	60	150	2.0	3.5
Budd	B	W	Rare/None	4	75	75	40	40	105	105	5.5	5.5
Burdett	C	S	Rare/None	2	60	65	70	80	100	120	4.0	4.5
Burnham	D	P	Rare/None	3	60	65	70	80	70	95	2.0	3.5
Busti	C	S	Rare/None	3	60	65	60	70	100	120	3.5	4.0
Buxton	C	M	Rare/None	2	70	70	70	70	120	120	5.0	5.5
Cambria	D	P	Rare/None	2	55	60	65	75	80	105	2.5	3.5
Cambridge	C	M	Rare/None	3	70	70	70	70	120	125	5.0	5.5
Camillus	B	W	Rare/None	3	70	70	75	75	120	125	5.0	5.0
Camroden	C	S	Rare/None	3	60	65	70	75	100	110	4.0	4.5
Canaan	C	E	Rare/None	4	70	70	65	65	75	75	4.5	4.5
Canaan-Rock Outcrop	C	E	Rare/None	4	70	70	65	65	75	75	4.5	4.5
Canadice	D	P	Rare/None	2	55	65	60	70	80	110	3.0	4.0
Canandaigua	D	P	Rare/None	3	55	65	70	80	90	110	2.5	4.0
Canaseraga	C	M	Rare/None	3	70	70	80	80	125	125	5.0	5.5
Canastota	C	M	Rare/None	2	70	70	75	75	120	125	4.5	5.0
Caneadea	D	S	Rare/None	2	60	65	65	75	105	120	4.0	4.5
Canfield	C	M	Rare/None	3	70	70	75	75	115	120	4.0	5.0
Canton	B	W	Rare/None	4	75	75	60	60	130	130	5.5	5.5
Carbondale	A	V	Rare/None	6	55	65	90	130	60	130	2.0	3.5
Carlisle	A/D	V	Rare/None	6	55	65	90	130	60	130	2.0	3.5
Carrollton	C	W	Rare/None	3	75	75	75	75	105	105	3.5	3.5
Carver	A	E	Rare/None	5	70	70	40	40	75	75	4.0	4.0
Carver-Plymouth	A	E	Rare/None	5	70	70	40	40	75	75	4.0	4.0
Castile	B	W	Rare/None	4	75	75	75	75	135	135	5.5	5.5
Cathro	A	V	Rare/None	6	55	65	90	140	60	150	2.5	3.5
Cathro-Greenwood	A	V	Rare/None	6	55	65	90	140	60	150	2.5	3.5
Cattaraugus	C	W	Rare/None	3	75	75	75	75	125	125	5.5	5.5
Cavode	C	S	Rare/None	2	60	65	70	75	105	120	3.5	4.5
Cayuga	C	W	Rare/None	2	70	70	75	75	135	135	5.5	5.5
Cazenovia	B	M	Rare/None	2	70	75	75	75	135	135	5.5	5.5
Ceresco	B	M	Rare/None	3	70	70	75	75	145	145	6.0	6.0
Chadakoin	B	W	Rare/None	3	75	75	75	75	130	130	5.5	5.5
Chagrin	B	W	Occasional	3	75	75	75	75	140	140	6.0	6.0
Champlain	A	E	Rare/None	5	70	70	50	50	75	75	3.5	3.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Charles	C	P	Frequent	3	55	60	70	80	75	90	2.0	3.0
Charlton	B	W	Rare/None	4	75	75	65	65	130	130	5.5	5.5
Chatfield (E)	B	E	Rare/None	4	70	70	50	50	100	100	4.5	4.5
Chatfield (We)	B	W	Rare/None	4	70	70	65	65	100	100	4.5	4.5
Chaumont	D	S	Rare/None	1	55	65	65	75	80	100	3.0	4.0
Chautauqua	C	M	Rare/None	3	70	70	75	75	125	125	5.0	5.0
Cheektowaga	D	P	Rare/None	5	55	65	55	75	80	105	3.0	4.0
Chenango	A	W	Rare/None	3	70	70	70	70	130	130	5.5	5.5
Cheshire	B	W	Rare/None	4	75	75	75	75	125	125	5.0	5.0
Chippeny	D	V	Rare/None	6	55	65	90	130	60	130	2.0	3.5
Chippewa	D	P	Rare/None	3	55	65	70	75	80	100	2.5	4.0
Churchville	D	S	Rare/None	2	60	65	70	80	105	120	3.0	4.5
Cicero	C	S	Rare/None	2	60	65	70	75	100	115	3.5	4.5
Clarkson	B	M	Rare/None	2	70	70	75	75	135	140	5.5	6.0
Claverack	C	M	Rare/None	4	70	70	70	70	120	120	5.5	5.5
Clymer	B	W	Rare/None	4	75	75	70	70	110	120	5.0	5.0
Cohoctah	B	P	Frequent	4	55	65	70	80	80	100	2.5	3.5
Collamer	C	M	Rare/None	3	70	70	75	75	140	140	5.5	6.0
Colonie	A	W	Rare/None	5	70	70	50	50	105	105	4.5	4.5
Colosse	A	E	Rare/None	4	70	70	50	50	70	70	4.5	4.5
Colrain	A	W	Rare/None	4	75	75	65	65	130	130	5.5	5.5
Colton	A	E	Rare/None	5	70	70	50	50	85	85	4.5	4.5
Colwood	D	P	Rare/None	3	55	65	70	80	90	110	2.5	4.0
Conesus	B	M	Rare/None	2	70	70	75	75	135	140	5.0	5.5
Conotton	A	W	Rare/None	3	75	75	70	70	125	125	5.5	5.5
Constable	A	W	Rare/None	5	70	70	50	50	75	75	4.5	4.5
Cook	D	V	Rare/None	5	50	60	70	80	70	90	2.5	3.5
Copake	B	W	Rare/None	4	75	75	65	65	135	135	6.0	6.0
Cornish	C	S	Occasional	3	60	65	65	75	95	110	3.5	4.5
Cosad	C	S	Rare/None	4	60	70	60	70	105	120	4.0	5.0
Cossayuna	C	W	Rare/None	4	75	75	65	65	135	135	5.5	5.5
Covert	A	M	Rare/None	4	70	70	60	60	115	120	5.0	5.5
Coveytown	C	S	Rare/None	4	65	70	65	75	90	110	3.0	4.5
Covington	D	P	Rare/None	1	55	60	70	75	75	95	2.5	3.5
Crary	C	M	Rare/None	4	65	70	60	70	110	120	4.0	4.5
Croghan	B	M	Rare/None	5	70	70	50	50	100	100	4.5	4.5
Culvers	C	M	Rare/None	3	70	70	75	75	115	125	4.5	5.0
Dalbo	C	M	Rare/None	3	70	70	75	75	95	115	4.5	4.5
Dalton	C	S	Rare/None	3	60	65	70	75	95	105	3.0	4.0
Danley	C	M	Rare/None	2	70	70	75	75	120	125	4.5	5.0
Dannemora	D	P	Rare/None	4	55	65	65	75	75	90	2.5	3.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Darien	C	S	Rare/None	2	60	65	70	75	100	115	3.5	4.5
Dawson	A	V	Rare/None	6	55	65	90	140	60	150	2.5	3.5
Deerfield	B	M	Rare/None	5	70	70	60	65	105	110	4.5	4.5
Deford	A	P	Rare/None	4	55	60	65	75	75	100	4.0	4.0
Dekalb	A	W	Rare/None	4	75	75	70	70	100	100	5.0	5.0
Depeyster	C	M	Rare/None	3	70	70	75	75	140	140	5.5	6.0
Deposit	B	M	Occasional	3	70	70	75	75	125	130	5.0	5.5
Derb	C	S	Rare/None	3	60	65	70	75	95	115	3.5	4.0
Dixmont	C	M	Rare/None	5	70	70	65	65	115	120	4.5	5.0
Dorval	A	V	Rare/None	6	55	65	90	140	60	150	2.0	3.5
Dover	B	W	Rare/None	4	75	75	70	70	125	125	5.5	5.5
Duane	B	M	Rare/None	4	70	70	60	60	95	95	4.0	4.5
Dunkirk	B	W	Rare/None	3	75	75	75	75	140	140	5.5	5.5
Dutchess	B	W	Rare/None	4	75	75	65	65	135	135	5.5	5.5
Duxbury	A	W	Rare/None	4	75	75	65	65	95	95	5.0	5.0
Edwards	B	V	Rare/None	6	55	65	90	130	60	130	2.5	3.5
Eel	B	M	Occasional	2	65	70	75	75	140	140	4.5	5.5
Eelweir	C	M	Rare/None	4	70	70	50	50	130	135	5.0	5.5
Elka	C	W	Rare/None	4	75	75	70	70	115	115	4.5	4.5
Ellery	D	P	Rare/None	3	55	65	70	75	80	100	2.5	4.0
Elmridge	C	M	Rare/None	5	70	70	60	60	135	135	4.5	5.5
Elmwood	C	M	Rare/None	4	70	70	60	60	130	130	4.5	5.0
Elnora	B	M	Rare/None	5	70	70	50	50	110	110	4.5	5.0
Empeyville	C	M	Rare/None	4	70	70	60	60	100	105	3.5	4.5
Enfield	B	W	Rare/None	3	75	75	75	75	150	150	5.5	5.5
Ensley	B	P	Rare/None	3	55	60	65	75	75	95	3.0	3.5
Erie	C	S	Rare/None	3	60	65	65	75	95	115	3.0	4.0
Ernest	C	W	Rare/None	3	75	75	75	75	75	75	4.0	4.0
Essex	C	W	Rare/None	5	75	75	70	70	95	95	4.5	4.5
Fahey	B	M	Rare/None	5	70	70	55	65	100	100	4.0	4.5
Farmington	C	W	Rare/None	3	75	75	65	65	90	90	4.0	4.0
Farnham	C	M	Rare/None	4	70	70	70	70	120	125	5.0	5.5
Fernlake	A	E	Rare/None	4	70	70	60	60	75	75	3.0	3.0
Flackville	C	M	Rare/None	4	70	70	70	70	120	120	5.5	5.5
Fonda	D	V	Rare/None	2	50	60	70	80	70	100	2.0	3.5
Franklinville	B	W	Rare/None	4	75	75	75	75	120	120	5.0	5.0
Fredon	C	S	Occasional	4	55	65	70	75	90	115	3.0	4.0
Freetown	D	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Fremont	C	S	Rare/None	2	60	65	65	75	100	110	3.0	4.5
Frenchtown	D	P	Rare/None	3	55	60	65	75	70	105	2.5	4.0
Frewsburg	C	S	Rare/None	3	60	65	65	75	80	95	3.0	4.0

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Fryeburg	B	W	Rare/None	3	75	75	70	70	95	95	4.0	4.0
Fulton	D	P	Rare/None	1	55	60	65	75	75	105	2.5	3.5
Gage	D	P	Rare/None	3	55	60	65	75	90	95	3.0	4.0
Galen	B	M	Rare/None	4	70	70	60	60	130	130	5.0	5.5
Galestown	A	E	Rare/None	5	70	70	40	40	90	90	4.0	4.0
Galoo	C	W	Rare/None	4	70	70	50	50	75	75	3.5	3.5
Galoo-Rock Outcrop	C	W	Rare/None	4	70	70	50	50	75	75	3.5	3.5
Galway	B	W	Rare/None	4	75	75	70	70	130	130	5.0	5.0
Genesee	B	W	Occasional	2	75	75	80	80	155	155	6.5	6.5
Georgia	C	M	Rare/None	4	70	70	75	75	135	140	5.0	5.5
Getzville	D	P	Rare/None	3	55	60	65	75	75	90	3.0	3.5
Gilpen	C	W	Rare/None	3	75	75	75	75	120	120	4.0	4.0
Gilpin	C	W	Rare/None	3	75	75	70	70	110	110	4.0	4.0
Glebe	C	W	Rare/None	4	70	70	70	70	75	75	3.0	3.0
Glebe-Saddleback	C	W	Rare/None	4	70	70	70	70	75	75	3.0	3.0
Glendora	A/D	W	Rare/None	4	75	75	70	70	75	75	3.0	3.0
Glenfield	B	V	Rare/None	3	50	60	65	75	90	110	2.5	3.5
Gloucester	A	E	Rare/None	4	70	70	50	50	120	120	4.5	4.5
Glover	D	E	Rare/None	4	70	70	60	60	90	90	3.5	3.5
Gougeville	A	V	Rare/None	5	50	60	65	75	75	100	2.0	4.0
Granby	A/D	P	Rare/None	5	55	60	60	65	75	100	2.0	3.5
Grattan	A	E	Rare/None	5	70	70	50	50	105	105	4.5	4.5
Greene	C	S	Rare/None	3	60	65	65	75	90	110	3.0	4.0
Greenwood	A	V	Rare/None	6	50	65	90	140	60	150	2.0	3.0
Grenville	B	W	Rare/None	4	75	75	75	75	140	140	5.5	5.5
Gretor	C	S	Rare/None	3	60	65	65	75	75	90	2.5	3.0
Groton	A	M	Rare/None	4	70	70	70	70	105	110	4.5	5.0
Groveton	A	W	Rare/None	4	70	70	65	65	95	95	4.0	5.0
Guff	D	P	Rare/None	1	50	55	60	75	75	90	2.5	3.0
Guffin	D	P	Rare/None	1	50	60	60	65	60	75	2.5	3.5
Gulf	B	P	Rare/None	4	55	60	65	75	75	90	2.5	3.5
Hadley	B	W	Rare/None	3	75	75	70	70	140	140	5.0	5.0
Haights	B	W	Rare/None	3	60	70	50	60	100	95	3.0	3.5
Haights-Gulf	B	P	Rare/None	3	60	70	50	60	95	100	3.0	3.5
Hailesboro	C	S	Rare/None	3	60	65	65	75	110	125	4.0	5.0
Halcott	C/D	W	Rare/None	2	70	70	75	75	75	80	3.0	3.5
Halsey	C/D	V	Rare/None	4	50	60	70	75	90	100	2.5	3.5
Hamlin	B	W	Occasional	2	75	75	80	80	155	155	6.5	6.5
Hamplain	B	W	Rare/None	2	75	75	80	80	150	150	5.5	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Hannawa	D	P	Rare/None	4	55	60	60	70	85	100	3.0	4.0
Hartland	B	W	Rare/None	4	75	75	75	75	155	155	6.0	6.0
Haven	B	W	Rare/None	4	75	75	65	65	150	150	6.0	6.0
Hawksnest	C/D	W	Rare/None	3	70	70	75	75	75	80	2.5	3.0
Hempstead	B	W	Rare/None	4	75	75	65	65	150	150	6.0	6.0
Henrietta	B	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Herkimer	B	M	Rare/None	3	70	70	75	75	130	130	5.5	6.0
Hermon	A	W	Rare/None	4	70	70	50	50	105	105	5.0	5.0
Hero	B	M	Rare/None	4	70	70	70	70	130	135	5.5	6.0
Heuvelton	C	M	Rare/None	2	70	70	75	75	115	135	4.5	5.5
Hilton	B	M	Rare/None	2	70	70	75	75	135	140	5.5	6.0
Hinckley	A	E	Rare/None	5	70	70	50	50	95	95	4.5	4.5
Hinesburg	C	W	Rare/None	4	75	75	60	60	105	105	5.5	5.5
Hogansburg	B	M	Rare/None	4	70	70	75	75	135	140	5.0	5.5
Hogback	C	M	Rare/None	5	75	75	50	50	75	75	4.0	4.0
Hogback-Ricker	C	M	Rare/None	5	75	75	50	50	75	75	4.0	4.0
Holderton	B	S	Occasional	3	60	65	65	75	105	115	4.0	4.5
Hollis	C	S	Rare/None	4	60	65	50	60	75	95	3.5	4.5
Holly	C/D	P	Frequent	2	55	60	60	75	70	95	2.5	3.5
Holyoke	C	W	Rare/None	3	70	70	70	70	75	75	4.0	4.0
Holyoke-Rock Outcrop	C	W	Rare/None	3	70	70	70	70	75	75	4.0	4.0
Homer	B	S	Rare/None	2	60	65	65	75	105	125	4.0	5.0
Honeoye	B	W	Rare/None	2	75	75	75	75	140	140	5.5	5.5
Hoosic	A	W	Rare/None	4	75	75	60	60	105	105	5.0	5.0
Hornell	D	S	Rare/None	2	65	70	70	75	95	105	3.0	4.0
Hornellsville	D	S	Rare/None	3	60	65	65	75	85	95	2.5	3.0
Houghtonville	C	W	Rare/None	5	75	75	65	65	105	105	4.5	4.5
Houghtonville-Rawson	C	W	Rare/None	5	75	75	65	65	105	105	4.5	4.5
Houseville	C	S	Rare/None	2	60	65	65	75	105	125	4.0	5.0
Howard	A	W	Rare/None	3	75	75	70	70	135	135	5.5	5.5
Hudson	C	M	Rare/None	2	70	70	80	80	135	135	5.0	5.5
Hulberton	C	S	Rare/None	2	60	65	70	80	105	125	4.0	4.5
Ilion	D	P	Rare/None	2	60	65	70	80	90	105	2.5	4.0
Insula	B	W	Rare/None	4	75	75	60	65	90	90	3.0	3.0
Ipswich	D	V	Frequent	6	50	65	90	99	60	130	2.5	3.5
Ira	C	M	Rare/None	4	70	70	65	65	115	120	4.5	5.0
Ischua	B	M	Rare/None	3	70	70	75	75	100	105	4.0	4.5
Ivory	C	S	Rare/None	2	60	65	65	75	90	100	2.5	3.0
Jebavy	A	P	Rare/None	5	55	60	60	70	75	95	3.0	4.0

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Joliet	D	P	Frequent	4	55	65	65	75	60	100	2.5	4.0
Junius	C	P	Rare/None	5	55	65	50	60	80	100	3.0	4.0
Kalurah	B	M	Rare/None	4	70	70	75	75	135	140	5.0	5.5
Kanona	D	S	Rare/None	2	55	65	60	70	77	95	2.5	3.5
Kars	A	W	Rare/None	4	70	70	65	65	125	125	5.5	5.5
Kearsarge	B	E	Rare/None	3	70	70	70	70	90	90	3.0	3.0
Kendaia	C	S	Rare/None	2	60	65	65	75	105	125	4.0	4.5
Kibbie	B	S	Rare/None	3	60	65	65	75	110	125	4.0	5.0
Kingsbury	D	S	Rare/None	1	60	65	65	75	95	110	3.5	4.5
Kinzua	B	W	Rare/None	3	75	75	75	75	130	130	4.5	4.5
Knicker-bocker	A	E	Rare/None	5	70	70	65	65	105	105	4.5	4.5
Lackawanna	C	W	Rare/None	3	75	75	75	75	125	125	5.5	5.5
Lagross	A	W	Rare/None	3	75	75	75	75	115	115	5.0	5.0
Lagross-Haights	A	W	Rare/None	3	75	75	75	75	115	115	5.0	5.0
Lairdsville	D	M	Rare/None	2	70	70	75	75	120	120	4.5	4.5
Lakemont	D	P	Rare/None	1	55	60	65	75	80	105	2.5	3.5
Lakewood	A	E	Rare/None	5	70	70	40	40	75	75	4.0	4.0
Lamson	B/D	P	Rare/None	4	55	65	65	75	75	110	2.5	4.0
Lanesboro	C	W	Rare/None	3	70	70	75	75	75	75	4.0	4.0
Langford	C	W	Rare/None	3	70	70	75	75	120	120	4.5	5.0
Lansing	B	W	Rare/None	2	75	75	75	75	140	140	5.5	5.5
Leck Kill	B	W	Rare/None	3	75	75	75	75	115	115	4.0	4.0
Leicester	C	P	Rare/None	4	55	65	65	75	75	105	2.5	3.5
Leon	C	P	Rare/None	5	60	65	60	70	70	95	3.0	4.5
Lewbath	C	W	Rare/None	3	75	75	75	75	95	95	4.5	4.5
Lewbeach	C	W	Rare/None	3	75	75	75	75	125	125	5.5	5.5
Leyden	C	M	Rare/None	2	70	70	75	75	120	125	4.5	5.0
Lima	B	M	Rare/None	2	70	70	75	75	135	140	5.0	5.5
Limerick	C	P	Frequent	3	55	65	70	75	80	115	3.0	4.5
Linden	B	W	Rare/None	4	75	75	75	75	135	135	6.0	6.0
Linlithgo	B	S	Occasional	3	65	65	70	75	105	115	3.5	4.5
Livingston	D	V	Rare/None	1	50	55	65	75	65	85	2.0	3.0
Lobdell	B	M	Occasional	3	65	70	75	75	135	135	4.5	5.5
Lockport	D	S	Rare/None	2	60	65	70	80	95	120	4.0	4.5
Lorain	D	P	Rare/None	1	55	60	60	70	80	100	3.0	4.0
Lordstown	C	W	Rare/None	3	75	75	70	70	105	105	4.5	4.5
Lovewell	B	M	Occasional	2	70	70	75	75	130	140	4.5	5.5
Lowville	B	W	Rare/None	4	75	75	75	75	135	135	5.0	5.0
Loxley	A	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Lucas	C	M	Rare/None	2	70	70	80	80	135	135	5.0	5.5
Ludlow	C	M	Rare/None	4	70	70	75	75	115	120	5.0	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Lupton	A	V	Rare/None	6	55	65	90	140	60	150	2.5	3.5
Lyman	C	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Lyman-Becket-Berkshire	C	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Lyme	C	P	Rare/None	5	55	65	60	70	75	100	2.5	4.0
Lyons	D	P	Rare/None	2	55	60	65	75	80	105	2.5	3.5
Machias	B	M	Rare/None	4	70	70	70	70	115	115	4.5	5.0
Macomber	C	W	Rare/None	4	75	75	75	75	85	85	3.5	3.5
Macomber-Taconic	C	W	Rare/None	4	75	75	75	75	85	85	3.5	3.5
Madalin	D	P	Rare/None	1	55	60	65	75	75	105	2.5	3.5
Madawaska	B	M	Rare/None	5	70	70	60	60	115	115	4.5	5.0
Madrid	B	W	Rare/None	4	75	75	65	65	135	135	5.5	5.5
Malone	C	S	Rare/None	4	60	65	65	75	105	125	3.5	4.5
Manahawkin	D	V	Frequent	6	55	65	90	130	60	130	2.5	3.5
Mandy	C	W	Rare/None	3	75	75	75	75	105	105	4.0	4.0
Manheim	C	S	Rare/None	2	60	65	65	75	105	125	3.5	4.5
Manhoning	D	S	Rare/None	2	60	65	65	75	90	115	3.0	4.5
Manlius	C	W	Rare/None	3	70	70	70	70	105	105	4.5	4.5
Mansfield	D	V	Rare/None	3	50	60	65	75	65	90	2.0	3.5
Maplecrest	B	W	Rare/None	2	75	75	75	75	130	130	5.5	5.5
Marcy	D	P	Rare/None	3	55	60	65	75	90	95	3.0	4.0
Mardin	C	M	Rare/None	3	70	70	75	75	115	120	4.5	5.0
Marilla	C	M	Rare/None	3	70	70	75	75	120	120	4.0	4.5
Markey	A/D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Marlow	C	W	Rare/None	4	75	75	60	60	120	120	5.0	5.0
Martisco	B	V	Frequent	6	50	65	90	120	60	120	2.5	3.5
Massena	C	S	Rare/None	4	60	65	65	75	105	125	3.5	4.5
Matoon	D	S	Rare/None	1	60	60	65	75	100	120	3.0	4.0
Matunuck	D	V	Frequent	6	50	65	90	130	60	130	2.5	3.0
Medihemists	A/D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Medina	B	W	Rare/None	3	75	75	75	75	130	130	5.0	5.0
Medomak	D	V	Frequent	3	50	55	65	75	60	80	2.0	2.5
Melrose	C	W	Rare/None	4	75	75	50	50	120	120	5.0	5.0
Menlo	D	P	Rare/None	4	55	60	60	70	80	95	2.5	3.5
Mentor	B	W	Rare/None	4	75	75	60	60	125	125	5.5	5.5
Merrimac	A	W	Rare/None	4	70	70	75	75	105	105	5.0	5.0
Middlebrook	C	M	Rare/None	3	70	70	75	75	105	110	4.0	4.5
Middlebrook-Mongaup	C	M	Rare/None	3	70	70	75	75	105	110	4.0	4.5
Middlebury	B	M	Occasional	3	65	70	75	75	135	135	4.5	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Millis	C	W	Rare/None	4	75	75	60	60	120	120	5.0	5.0
Millsite	C	W	Rare/None	4	70	70	65	65	100	100	4.5	4.5
Mineola	A	M	Rare/None	4	70	70	75	75	125	130	5.0	5.5
Miner	D	P	Rare/None	1	55	60	65	75	75	105	2.5	3.5
Mino	C	S	Rare/None	4	60	65	50	60	100	125	3.0	5.0
Minoa	C	S	Rare/None	4	60	65	50	60	100	125	3.0	5.0
Mohawk	B	W	Rare/None	2	70	70	75	75	140	140	5.5	5.5
Moira	C	M	Rare/None	4	70	70	70	70	100	110	4.0	5.0
Monadnock	B	W	Rare/None	4	75	75	60	60	95	95	3.5	3.5
Monarda	D	S	Rare/None	4	60	65	65	70	95	115	3.5	4.5
Mongaup	C	W	Rare/None	3	75	75	70	70	105	105	4.5	4.5
Montauk	C	W	Rare/None	4	70	70	65	65	135	135	5.0	5.0
Mooers	B	M	Rare/None	5	70	70	60	60	95	100	3.0	3.5
Morocco	C	P	Rare/None	4	55	65	60	65	90	115	3.0	4.0
Morris	C	S	Rare/None	3	60	65	65	75	95	105	3.5	4.5
Mosherville	C	S	Rare/None	4	60	65	60	70	100	125	3.5	4.5
Muck	D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Muck-Peat	D	V	Rare/None	6	55	65	90	130	60	150	2.5	3.5
Mundal	C	W	Rare/None	4	75	75	60	60	65	65	3.5	3.5
Mundalite	C	W	Rare/None	3	75	75	70	70	105	105	4.5	4.5
Mundalite-Rawsonville	C	W	Rare/None	3	75	75	70	70	105	105	4.5	4.5
Munson	D	S	Rare/None	2	60	65	65	75	105	120	3.5	4.5
Munuscong	B	P	Rare/None	4	55	65	60	65	60	95	2.0	3.5
Muskego	A/C	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Muskellunge	D	S	Rare/None	3	60	65	65	75	90	115	3.5	4.5
Napoleon	A	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Napoli	C	S	Rare/None	3	60	65	65	75	80	90	2.5	3.5
Nassau	C	E	Rare/None	4	70	70	50	50	85	85	4.0	4.0
Naumburg	C	S	Rare/None	5	55	65	60	65	90	100	3.0	4.5
Nehasne	B	W	Rare/None	4	75	75	70	70	130	130	5.0	5.0
Nellis	B	W	Rare/None	4	75	75	70	70	140	140	5.5	5.5
Neversink	D	P	Rare/None	4	55	60	60	70	75	90	2.0	3.5
Newfane	B	W	Rare/None	4	75	75	50	50	125	125	5.5	5.5
Newstead	C	S	Rare/None	4	55	65	60	70	95	115	3.5	4.5
Newton	A/D	V	Rare/None	5	50	60	50	60	80	90	2.0	3.5
Niagara	C	S	Rare/None	3	60	65	65	75	110	125	4.0	5.0
Nicholville	C	M	Rare/None	4	70	70	70	70	105	110	4.0	4.5
Ninigret	B	M	Rare/None	4	70	70	70	70	130	135	5.5	6.0
Norchip	D	P	Rare/None	3	55	60	70	80	60	80	2.5	3.5
Norwell	C	S	Rare/None	5	60	65	60	70	100	120	3.5	4.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential			
									Corn bu/acre		Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Norwich	D	V	Rare/None	3	55	60	60	70	70	90	2.5	3.5
Nunda	C	M	Rare/None	2	70	70	75	75	125	130	5.0	5.5
Oakville	A	W	Rare/None	5	70	70	50	50	90	100	4.5	4.5
Occum	B	W	Occasional	4	75	75	75	75	140	140	5.5	5.5
Odessa	D	S	Rare/None	2	60	65	75	75	105	115	4.0	4.5
Ogdensburg	C	S	Rare/None	4	55	65	60	70	95	115	3.5	4.5
Olean	B	M	Rare/None	2	70	70	75	80	125	130	5.5	6.0
Ondawa	B	W	Occasional	4	75	75	75	75	135	135	6.0	6.0
Oneida	C	S	Rare/None	4	60	65	65	75	105	125	3.5	4.5
Onoville	C	M	Rare/None	3	70	70	70	75	105	115	4.0	4.5
Ontario	B	W	Rare/None	2	75	75	75	75	140	140	6.0	6.0
Onteora	C	S	Rare/None	3	60	65	65	75	90	115	3.5	4.5
Ontusia	C	S	Rare/None	3	60	65	60	70	95	105	3.5	4.5
Oquaga	C	W	Rare/None	3	70	70	65	65	100	100	4.5	4.5
Oramel	C	S	Rare/None	2	70	70	75	75	130	130	5.5	5.5
Organic	A/D	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Orpark	C	S	Rare/None	2	60	65	65	75	100	110	3.5	4.5
Orwell	D	P	Rare/None	2	55	60	65	75	90	100	3.0	4.5
Ossipee	D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Otego	B	M	Occasional	2	70	70	70	75	140	150	5.0	5.5
Otisville	A	E	Rare/None	4	70	70	50	50	95	95	4.5	4.5
Ottawa	A	W	Rare/None	5	70	70	50	50	115	115	5.0	5.0
Ovid	C	S	Rare/None	2	65	70	70	75	105	125	4.0	4.5
Palatine	B	W	Rare/None	2	65	70	65	70	100	100	4.5	4.5
Palms	A/D	V	Frequent	6	50	65	90	140	60	150	2.5	3.5
Palmyra	B	W	Rare/None	3	75	75	70	70	140	140	5.5	5.5
Panton	D	P	Rare/None	1	55	65	65	75	90	105	3.5	4.5
Papakating	D	P	Frequent	2	55	60	60	75	70	95	2.5	3.5
Parishville	C	M	Rare/None	4	70	70	70	70	100	110	4.0	5.0
Parsippany	D	P	Rare/None	1	50	60	60	75	80	105	2.5	3.5
Patchin	D	P	Rare/None	3	55	60	65	75	65	85	2.5	3.5
Pawcatuck	D	V	Frequent	6	50	65	90	130	60	130	2.5	3.5
Pawling	B	M	Occasional	4	70	70	75	75	140	140	5.5	5.5
Paxton	C	W	Rare/None	4	75	75	65	65	125	125	5.0	5.0
Peacham	D	P	Rare/None	3	55	60	70	80	60	75	2.0	3.0
Peat	A/D	V	Rare/None	6	55	65	90	130	60	150	2.5	3.5
Peat-Muck	A/D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Peru	C	M	Rare/None	4	70	70	60	60	115	120	4.5	5.0
Petoskey	A	W	Rare/None	4	75	75	50	50	125	125	5.5	5.5
Phelps	B	M	Rare/None	3	70	70	70	70	140	140	5.0	5.5
Philo	B	M	Occasional	3	70	70	75	75	135	135	5.5	6.0

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Pillsbury	C	S	Rare/None	4	60	65	65	75	70	100	2.5	4.0
Pinckney	C	M	Rare/None	3	70	70	75	75	115	120	4.5	4.5
Pipestone	B	S	Rare/None	5	60	65	55	65	70	100	2.5	4.0
Pittsfield	B	W	Rare/None	4	75	75	75	75	140	140	5.5	5.5
Pittstown	C	M	Rare/None	4	65	70	70	70	125	135	5.0	5.5
Plainbo	A	E	Rare/None	5	70	70	50	50	80	80	3.0	3.0
Plainfield	A	E	Rare/None	5	70	70	30	30	90	90	4.5	4.5
Plessis	D	S	Rare/None	3	60	65	65	75	80	95	3.5	4.0
Plymouth	A	E	Rare/None	4	70	70	50	50	75	75	4.0	4.0
Podunk	B	M	Occasional	4	70	70	75	75	130	130	5.5	6.0
Poland	B	W	Rare/None	2	75	75	75	75	140	140	5.5	5.5
Pompton	B	M	Rare/None	4	70	70	50	50	115	115	4.5	5.0
Pootatuck	B	M	Occasional	4	70	70	65	65	130	130	5.0	5.5
Pope	B	W	Occasional	4	75	75	75	75	140	140	5.5	5.5
Potsdam	C	W	Rare/None	4	70	70	70	70	120	120	5.0	5.0
Poygan	D	V	Rare/None	1	50	60	60	70	70	90	2.0	3.0
Punsit	C	S	Rare/None	3	60	65	65	75	95	110	3.0	4.5
Pyrities	B	W	Rare/None	4	75	75	75	75	140	140	5.5	5.5
Quetico	D	W	Rare/None	4	70	70	50	50	65	65	3.0	3.0
Quetico-Rock Outcrop	D	W	Rare/None	4	70	70	50	50	65	65	3.0	3.0
Raquette	B	S	Rare/None	4	60	70	60	70	105	120	4.0	5.0
Rawsonville	C	W	Rare/None	5	75	75	50	50	75	75	4.0	4.0
Rawsonville-Beseman-	C	W	Rare/None	5	75	75	50	50	75	75	4.0	4.0
Rayne	B	W	Rare/None	3	75	75	75	75	130	130	5.0	5.0
Raynham	C	S	Occasional	3	55	65	65	75	95	125	3.5	4.5
Raypol	C	P	Rare/None	3	55	60	60	75	75	90	2.5	3.5
Red Hook	C	S	Rare/None	4	60	65	65	75	105	125	3.5	4.5
Redwater	B	S	Frequent	3	65	70	75	75	135	135	4.5	5.5
Remsen	D	S	Rare/None	2	60	65	65	75	90	115	3.0	4.5
Retsof	C	S	Rare/None	2	60	65	65	75	95	115	3.5	4.5
Rexford	C	S	Rare/None	4	50	65	65	75	90	110	3.0	4.5
Rhinebeck	D	S	Rare/None	2	60	65	65	75	105	120	4.0	4.5
Ricker	A	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Ricker-Lyman	A	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Ridgebury	C	P	Rare/None	4	55	65	60	70	90	110	3.0	4.0
Rifle	A	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Riga	D	M	Rare/None	2	70	70	75	75	120	120	4.5	4.5
Rippowam	C	P	Frequent	4	55	65	60	70	80	105	2.5	3.5
Riverhead	B	W	Rare/None	4	75	75	40	40	105	105	4.5	5.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Rockaway	C	W	Rare/None	2	75	75	75	75	125	125	5.5	5.5
Romulus	D	P	Rare/None	2	55	60	60	75	80	100	3.0	4.0
Ross	B	W	Rare/None	2	75	75	75	75	155	155	6.0	6.0
Roundabout	C	S	Rare/None	3	60	60	60	70	95	110	3.5	4.0
Rumney	C	P	Frequent	2	55	65	65	75	85	115	2.0	4.0
Runeberg	C	P	Rare/None	4	50	55	60	70	70	90	2.0	3.0
Ruse	D	P	Rare/None	4	55	60	55	65	75	90	2.5	3.5
Rushford	B	M	Rare/None	3	70	70	75	75	120	125	4.5	5.0
Saco	D	V	Frequent	3	50	55	65	75	65	95	2.0	3.0
Salamanca	B	M	Rare/None	3	70	70	75	75	100	105	4.0	4.5
Salmon	B	W	Rare/None	4	75	75	70	70	115	115	5.0	5.0
Saprists	A/D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Saugatuck	C	S	Rare/None	5	60	65	60	70	70	95	3.0	4.5
Scantic	D	P	Rare/None	2	55	60	65	75	90	100	3.0	4.5
Scarboro	D	P	Rare/None	4	55	65	60	70	75	105	2.5	4.0
Schoharie	C	M	Rare/None	1	70	70	75	75	135	135	5.0	5.0
Schroon	B	M	Rare/None	5	70	70	50	50	130	130	5.0	5.0
Schuyler	B	M	Rare/None	3	70	70	75	75	115	115	4.5	5.0
Scio	B	M	Rare/None	3	70	70	75	75	135	140	5.0	5.5
Scituate	B	M	Rare/None	4	70	70	75	75	115	115	4.5	4.5
Scriba	C	S	Rare/None	4	60	65	65	75	94	105	3.5	4.5
Searsport	D	P	Rare/None	4	55	65	60	70	75	105	2.5	4.0
Shaker	C	P	Rare/None	2	60	65	65	75	105	125	3.5	4.5
Shoreham	D	V	Rare/None	2	50	60	70	70	65	95	2.0	3.5
Sisk	C	V	Rare/None	4	55	60	65	75	60	85	2.0	3.5
Skerry	C	M	Rare/None	5	60	65	65	75	95	100	4.0	4.5
Sloan	B	V	Frequent	3	50	55	65	75	70	90	2.0	3.5
Sodus	C	W	Rare/None	4	75	75	75	75	120	120	5.0	5.0
Somerset	C	P	Rare/None	5	60	65	65	75	90	105	3.0	4.5
St Johns	D	P	Rare/None	4	55	65	60	70	75	105	2.5	4.0
Staatsburg	C	W	Rare/None	3	75	75	70	70	90	90	4.0	4.0
Stafford	C	S	Rare/None	4	60	65	50	60	95	110	3.5	4.5
Steamburg	B	M	Rare/None	3	70	70	75	75	100	105	4.0	4.5
Stetson	B	W	Rare/None	5	75	75	70	70	110	110	5.0	5.0
Stissing	C	P	Rare/None	4	60	65	60	70	90	115	2.5	4.0
Stockbridge	C	W	Rare/None	3	75	75	75	75	140	140	5.5	5.5
Stockholm	C	P	Rare/None	5	60	60	60	70	90	100	3.0	4.0
Stowe	B	W	Rare/None	4	75	75	65	65	110	110	4.5	4.5
Sudbury	B	M	Rare/None	4	60	65	65	65	105	110	4.0	5.0
Suffield	B	M	Rare/None	2	70	70	80	80	135	135	5.0	5.5
Summerville	D	E	Rare/None	4	70	70	50	50	80	80	4.0	4.0

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential			
									Corn bu/acre		Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Sun	D	V	Rare/None	4	55	60	60	70	75	100	2.5	3.5
Sunapee	B	M	Rare/None	4	70	70	65	65	95	110	3.5	4.5
Suncook	A	E	Occasional	5	70	70	40	40	90	90	3.0	3.0
Suny	D	P	Rare/None	4	50	55	60	70	70	110	2.0	3.4
Surplus	C	V	Rare/None	4	55	60	65	75	60	90	2.0	3.5
Surplus-Sisk	C	V	Rare/None	4	55	60	65	75	60	90	2.0	3.5
Sutton	B	M	Rare/None	4	70	70	70	70	130	130	5.0	5.0
Swanton	C	P	Rare/None	4	60	65	50	60	95	125	3.0	4.5
Swartswood	C	W	Rare/None	4	75	75	70	70	120	120	5.0	5.0
Swormville	C	S	Rare/None	1	60	65	65	75	90	115	3.0	4.5
Taconic	C	W	Rare/None	3	75	75	75	75	75	90	3.5	3.5
Taconic-Macomber	C	W	Rare/None	3	75	75	75	75	75	90	3.5	3.5
Tawas	A	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Teel	B	M	Frequent	2	65	70	75	75	140	140	4.5	5.5
Tioga	B	W	Occasional	3	75	75	75	75	140	140	6.0	6.0
Toledo	D	V	Rare/None	2	50	60	70	80	70	100	2.0	3.5
Tonawanda	D	S	Rare/None	2	60	65	65	75	105	120	3.0	4.5
Tor	D	S	Rare/None	4	60	60	65	75	60	85	2.0	3.5
Torull	D	S	Rare/None	3	60	65	65	75	90	110	3.0	4.0
Towerville	B	M	Rare/None	3	70	70	75	75	115	115	4.5	5.0
Trestle	B	W	Occasional	3	75	75	75	75	145	145	5.5	5.5
Trout River	A	E	Rare/None	5	70	70	50	50	95	95	4.0	4.0
Troy	C	M	Rare/None	3	70	70	70	70	120	125	5.0	5.5
Trumbull	D	P	Rare/None	1	55	60	65	75	75	105	2.5	3.5
Tughill	D	V	Rare/None	4	50	55	55	65	60	85	2.5	3.5
Tuller	D	S	Rare/None	3	60	65	65	75	80	95	3.5	4.0
Tunbridge	C	W	Rare/None	4	75	75	70	70	90	90	4.5	4.5
Tunbridge-Adirondack	C	W	Rare/None	4	75	75	70	70	90	90	4.5	4.5
Tunkhannock	A	W	Rare/None	3	75	75	75	75	120	120	5.5	5.5
Turin	C	S	Rare/None	2	60	65	70	80	105	125	3.0	4.5
Tuscarora	C	M	Rare/None	4	70	70	50	50	125	125	5.5	5.5
Unadilla	B	W	Rare/None	3	75	75	75	75	140	140	6.0	6.0
Valois	B	W	Rare/None	3	75	75	75	75	130	130	5.5	5.5
Varick	D	P	Rare/None	2	55	60	75	75	80	100	2.5	3.5
Varysburg	B	W	Rare/None	2	70	70	75	75	130	130	5.5	5.5
Venango	C	S	Rare/None	3	60	65	60	70	100	120	3.5	4.5
Vergennes	C	M	Rare/None	1	70	70	75	75	115	120	4.5	5.0
Vly	C	W	Rare/None	3	75	75	75	75	90	90	4.0	4.0
Volusia	C	S	Rare/None	3	60	65	60	70	95	105	3.5	4.5

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Waddington	A	W	Rare/None	4	75	75	60	60	125	125	5.0	5.0
Wainola	B	S	Rare/None	5	60	65	60	70	85	125	3.0	4.5
Wakeland	C	S	Frequent	3	60	65	75	75	90	115	3.5	4.5
Wakeville	B	S	Occasional	3	60	65	65	75	95	110	4.0	5.0
Wallace	B	E	Rare/None	5	70	70	40	40	90	100	4.0	4.0
Wallington	C	S	Rare/None	3	60	65	65	75	105	115	3.5	4.5
Wallkill	C	V	Frequent	3	50	60	65	80	65	125	2.0	4.0
Walpole	C	P	Rare/None	4	65	68	55	60	80	105	3.0	4.5
Walton	C	W	Rare/None	3	75	75	75	75	125	125	5.5	5.5
Wampsville	B	W	Rare/None	3	75	75	75	75	140	140	5.5	5.5
Wappinger	B	W	Occasional	3	75	75	75	75	140	140	6.0	6.0
Wareham	C	P	Rare/None	5	60	65	65	75	90	105	3.0	4.5
Warners	C	V	Frequent	3	50	60	70	75	75	90	2.0	3.5
Wassaic	B	M	Rare/None	4	70	70	65	65	120	120	4.5	4.5
Watchaug	B	M	Rare/None	4	70	70	70	70	120	120	3.0	4.0
Waumbeck	B	M	Rare/None	4	70	70	65	65	95	105	3.0	4.5
Wayland	C/D	P	Frequent	2	55	60	60	75	70	95	2.5	3.5
Weaver	C	M	Occasional	3	70	70	75	75	120	130	3.5	4.5
Wegatchie	D	P	Rare/None	3	55	65	70	80	90	110	2.5	4.0
Wellsboro	C	M	Rare/None	3	70	70	75	75	115	125	4.5	5.0
Wenonah	C	W	Occasional	4	75	75	65	65	130	130	5.0	5.0
Westbury	B	S	Rare/None	4	60	65	60	70	80	100	3.0	4.5
Westland	C	V	Rare/None	2	50	55	60	75	90	110	2.5	3.5
Wethersfield	C	W	Rare/None	4	75	75	75	75	120	120	5.5	5.5
Wharton	C	M	Rare/None	2	70	70	75	75	120	120	4.5	5.0
Whately	D	V	Rare/None	4	50	60	60	70	60	105	2.0	3.5
Whippany	C	S	Rare/None	2	60	65	65	75	105	115	3.5	4.5
Whitelaw	B	W	Rare/None	4	75	75	65	65	135	135	5.5	5.5
Whitman	D	V	Rare/None	4	50	60	60	75	76	90	2.0	3.5
Wilbraham	C	S	Rare/None	4	60	65	60	65	95	110	3.0	4.5
Willdin	C	M	Rare/None	3	70	70	75	75	115	120	4.5	5.0
Willette	A	V	Rare/None	6	50	65	90	130	60	130	2.5	3.5
Williamson	C	M	Rare/None	4	70	70	70	70	115	120	4.5	5.0
Willowemoc	C	M	Rare/None	3	70	70	75	75	115	125	4.5	5.0
Wilmington	D	P	Rare/None	4	55	60	60	70	75	110	2.5	4.0
Wilpoint	D	M	Rare/None	1	70	70	80	80	105	110	4.0	5.0
Windsor	A	E	Rare/None	5	70	70	40	40	90	90	4.5	4.5
Winooski	B	M	Rare/None	4	70	70	75	75	135	135	5.0	5.0
Wolcottsburg	D	P	Rare/None	1	55	60	65	75	75	105	2.5	3.5
Wonsqueak	D	V	Rare/None	6	55	65	90	130	60	150	2.0	3.5
Woodbridge	C	M	Rare/None	4	70	70	75	75	120	125	4.5	5.0

Soil Type	HG	D	Flooding Frequency	SMG	N uptake efficiency %		Soil N supply lbs N/acre		Yield Potential Corn bu/acre		Yield Potential Alfalfa tons/acre	
					UDr	Dr	UDr	Dr	UDr	Dr	UDr	Dr
Woodlawn	B	W	Rare/None	4	75	75	75	75	80	80	4.5	4.5
Woodstock	D	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Woodstock-Rock Outcrop	D	E	Rare/None	4	70	70	60	60	75	75	4.0	4.0
Wooster	C	W	Rare/None	3	75	75	75	75	125	125	5.0	5.0
Woostern	C	W	Rare/None	3	75	75	75	75	130	130	5.5	5.5
Woostern-Bath-Valois	C	W	Rare/None	3	75	75	75	75	130	130	5.5	5.5
Worden	C	S	Rare/None	4	60	60	65	75	60	75	2.0	3.5
Worth	C	W	Rare/None	4	75	75	70	70	105	105	4.5	4.5
Wurtsboro	C	M	Rare/None	4	70	70	70	70	115	120	4.0	4.5
Wyalusing	D	P	Frequent	3	55	60	65	75	75	95	3.0	4.0
Yalesville	C	W	Rare/None	4	75	75	60	60	105	105	5.0	5.0
Yorkshire	C	M	Rare/None	3	70	70	75	75	100	110	3.5	4.0

TABLE 17.2: NEW YORK TOWNSHIP-BASED NITRATE LEACHING INDEX FOR SOILS WITH HYDROLOGICAL GROUPS A, B, C AND D.

See Table 17.1 for hydrologic codes for New York soil types.

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Albany	Berne	39.4	18.1	15.0	9.3	5.6	3.7
Albany	Bethlehem	36.4	16.0	12.6	7.4	4.1	2.6
Albany	Coeymans	37.7	16.4	13.5	8.1	4.7	3.0
Albany	Colonie	36.8	15.9	12.9	7.6	4.3	2.7
Albany	Guilderland	37.5	16.5	13.4	8.0	4.6	3.0
Albany	Knox	40.6	18.5	15.9	10.0	6.2	4.2
Albany	New Scotland	37.8	16.5	13.6	8.2	4.8	3.1
Albany	Rensselaerville	38.2	17.0	14.0	8.5	5.0	3.2
Albany	Westerlo	39.0	17.4	14.6	9.0	5.3	3.5
Allegany	Alfred	37.0	16.3	13.1	7.8	4.4	2.8
Allegany	Allen	36.9	15.3	12.7	7.5	4.3	2.7
Allegany	Alma	38.8	16.5	14.2	8.7	5.2	3.4
Allegany	Almond	35.3	14.5	11.6	6.6	3.6	2.2
Allegany	Amity	35.5	14.3	11.6	6.7	3.7	2.2
Allegany	Andover	37.4	16.4	13.3	8.0	4.6	2.9
Allegany	Angelica	36.0	14.8	12.1	7.0	3.9	2.4
Allegany	Belfast	35.7	14.5	11.8	6.8	3.8	2.3
Allegany	Birdsall	36.9	15.6	12.8	7.6	4.3	2.7
Allegany	Bolivar	38.9	16.4	14.3	8.8	5.2	3.4
Allegany	Burns	34.2	13.8	10.7	6.0	3.2	1.8
Allegany	Caneadea	35.0	14.8	11.5	6.6	3.5	2.1
Allegany	Centerville	38.4	15.9	13.8	8.4	4.9	3.2
Allegany	Clarksville	39.0	16.5	14.3	8.8	5.3	3.5
Allegany	Cuba	38.4	16.2	13.9	8.5	5.0	3.2
Allegany	Friendship	36.9	15.1	12.7	7.5	4.3	2.7
Allegany	Genesee	39.0	16.5	14.3	8.8	5.2	3.5
Allegany	Granger	36.7	15.5	12.6	7.5	4.2	2.6
Allegany	Grove	36.4	15.3	12.4	7.3	4.1	2.5
Allegany	Hume	35.5	14.8	11.7	6.8	3.7	2.2
Allegany	Independence	37.0	15.6	12.9	7.7	4.4	2.7
Allegany	New Hudson	37.8	15.4	13.3	8.0	4.6	3.0
Allegany	Rushford	36.4	15.0	12.4	7.3	4.1	2.5
Allegany	Scio	36.9	15.1	12.7	7.5	4.3	2.7
Allegany	Ward	37.3	16.3	13.2	7.9	4.5	2.9

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Allegany	Wellsville	36.2	14.8	12.2	7.1	4.0	2.4
Allegany	West Almond	37.2	16.2	13.1	7.8	4.5	2.8
Allegany	Willing	36.7	15.2	12.6	7.4	4.2	2.6
Allegany	Wirt	38.9	16.5	14.2	8.7	5.2	3.4
Broome	Barker	37.0	16.1	13.0	7.7	4.4	2.7
Broome	Binghamton	38.8	17.5	14.5	8.9	5.3	3.4
Broome	Chenango	37.0	16.0	13.0	7.7	4.4	2.8
Broome	Colesville	40.0	18.0	15.4	9.6	5.9	3.9
Broome	Conklin	38.4	16.7	14.0	8.5	5.0	3.3
Broome	Dickinson	36.7	16.0	12.8	7.5	4.3	2.6
Broome	Fenton	37.8	16.6	13.6	8.2	4.8	3.1
Broome	Kirkwood	38.3	16.6	13.9	8.4	5.0	3.2
Broome	Lisle	37.2	16.6	13.3	7.9	4.5	2.9
Broome	Maine	36.3	16.0	12.5	7.3	4.1	2.5
Broome	Nanticoke	37.0	16.1	13.0	7.7	4.4	2.8
Broome	Sanford	44.2	20.5	18.8	12.4	8.1	5.8
Broome	Triangle	37.5	16.6	13.4	8.0	4.6	2.9
Broome	Union	35.4	15.9	12.0	6.9	3.8	2.3
Broome	Vestal	37.0	16.2	13.1	7.8	4.4	2.8
Broome	Windsor	40.9	18.6	16.1	10.2	6.3	4.3
Cattaraugus	Allegany	42.8	18.5	17.3	11.2	7.1	5.0
Cattaraugus	Ashford	43.6	19.8	18.2	11.9	7.7	5.5
Cattaraugus	Carrollton	43.0	18.6	17.5	11.4	7.3	5.1
Cattaraugus	Cold Spring	44.2	19.8	18.6	12.3	8.0	5.7
Cattaraugus	Conewango	43.5	19.7	18.1	11.9	7.6	5.4
Cattaraugus	Dayton	42.9	19.8	17.7	11.5	7.4	5.2
Cattaraugus	East Otto	43.9	20.1	18.5	12.2	7.9	5.6
Cattaraugus	Ellicottville	46.3	21.2	20.4	13.8	9.2	6.7
Cattaraugus	Farmersville	40.6	17.5	15.6	9.8	6.0	4.1
Cattaraugus	Franklinville	42.6	18.7	17.2	11.1	7.1	5.0
Cattaraugus	Freedom	42.0	18.3	16.7	10.7	6.7	4.7
Cattaraugus	Great Valley	45.1	20.2	19.3	12.9	8.5	6.1
Cattaraugus	Hinsdale	40.5	17.4	15.5	9.8	6.0	4.0
Cattaraugus	Humphrey	43.6	19.1	18.0	11.8	7.6	5.4
Cattaraugus	Ischua	41.0	17.7	15.9	10.1	6.3	4.3
Cattaraugus	Leon	43.6	19.8	18.2	11.9	7.7	5.4
Cattaraugus	Little Valley	48.5	22.9	22.4	15.4	10.6	7.9
Cattaraugus	Lyndon	40.1	17.5	15.3	9.6	5.9	3.9
Cattaraugus	Machias	42.9	18.8	17.5	11.3	7.2	5.1
Cattaraugus	Mansfield	47.1	22.0	21.2	14.4	9.8	7.2

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Cattaraugus	Napoli	47.3	22.0	21.3	14.5	9.8	7.3
Cattaraugus	New Albion	45.7	20.8	19.9	13.4	8.9	6.5
Cattaraugus	Olean	40.8	17.4	15.7	9.9	6.1	4.2
Cattaraugus	Otto	43.0	19.4	17.7	11.5	7.3	5.2
Cattaraugus	Perrysburg	40.1	18.3	15.5	9.7	5.9	4.0
Cattaraugus	Persia	42.3	19.2	17.2	11.1	7.0	4.9
Cattaraugus	Portville	39.6	16.9	14.8	9.2	5.6	3.7
Cattaraugus	Randolph	44.4	20.4	18.9	12.5	8.2	5.9
Cattaraugus	Red House	45.0	20.2	19.2	12.8	8.4	6.1
Cattaraugus	Salamanca	44.7	20.2	19.0	12.6	8.3	5.9
Cattaraugus	South Valley	44.3	20.1	18.8	12.4	8.1	5.8
Cattaraugus	Yorkshire	42.5	18.9	17.2	11.1	7.1	5.0
Cayuga	Auburn	36.4	16.0	12.6	7.4	4.2	2.6
Cayuga	Aurelius	34.9	15.1	11.4	6.5	3.5	2.1
Cayuga	Brutus	37.0	17.0	13.2	7.9	4.5	2.8
Cayuga	Cato	37.6	17.3	13.7	8.2	4.7	3.0
Cayuga	Conquest	36.8	16.9	13.1	7.8	4.4	2.8
Cayuga	Fleming	36.8	15.9	12.9	7.6	4.3	2.7
Cayuga	Genoa	35.9	14.9	12.0	7.0	3.9	2.3
Cayuga	Ira	39.0	18.0	14.7	9.1	5.4	3.5
Cayuga	Ledyard	34.0	14.3	10.8	6.0	3.1	1.8
Cayuga	Locke	37.9	16.2	13.6	8.2	4.8	3.0
Cayuga	Mentz	35.4	15.9	12.0	6.9	3.8	2.3
Cayuga	Montezuma	35.0	15.3	11.6	6.6	3.6	2.1
Cayuga	Moravia	37.8	15.9	13.5	8.1	4.7	3.0
Cayuga	Niles	38.6	17.3	14.3	8.7	5.2	3.4
Cayuga	Owasco	37.7	17.0	13.6	8.2	4.7	3.0
Cayuga	Scipio	37.0	15.5	12.8	7.6	4.3	2.7
Cayuga	Sempronius	40.1	18.0	15.4	9.6	5.9	3.9
Cayuga	Sennett	37.3	17.0	13.4	8.0	4.6	2.9
Cayuga	Springport	34.4	14.8	11.1	6.2	3.3	1.9
Cayuga	Sterling	39.5	19.5	15.4	9.6	5.8	3.8
Cayuga	Summerhill	40.4	17.9	15.6	9.8	6.0	4.1
Cayuga	Throop	35.0	15.5	11.7	6.7	3.6	2.1
Cayuga	Venice	37.3	15.3	13.0	7.7	4.4	2.8
Cayuga	Victory	37.9	17.2	13.9	8.4	4.9	3.1
Chautauqua	Arkwright	46.2	21.9	20.5	13.8	9.2	6.8
Chautauqua	Busti	45.2	20.8	19.5	13.0	8.6	6.2
Chautauqua	Carroll	44.6	20.3	19.0	12.6	8.2	5.9
Chautauqua	Charlotte	47.5	22.9	21.7	14.8	10.1	7.5

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Chautauqua	Chautauqua	46.8	21.9	21.0	14.2	9.6	7.1
Chautauqua	Cherry Creek	45.9	21.7	20.3	13.6	9.1	6.6
Chautauqua	Clymer	47.2	22.3	21.4	14.5	9.8	7.3
Chautauqua	Dunkirk	39.0	18.3	14.8	9.1	5.4	3.6
Chautauqua	Ellery	46.4	22.1	20.8	14.0	9.4	6.9
Chautauqua	Ellicott	45.5	21.4	19.9	13.3	8.8	6.4
Chautauqua	Ellington	45.9	21.6	20.3	13.6	9.1	6.6
Chautauqua	French Creek	47.1	21.9	21.1	14.4	9.7	7.2
Chautauqua	Gerry	46.8	22.3	21.1	14.3	9.6	7.1
Chautauqua	Hanover	41.3	19.0	16.5	10.5	6.5	4.5
Chautauqua	Harmony	47.0	21.7	21.0	14.3	9.6	7.1
Chautauqua	Kiantone	44.3	20.0	18.7	12.3	8.0	5.8
Chautauqua	Mina	47.0	21.9	21.1	14.3	9.7	7.1
Chautauqua	North Harmony	46.4	21.9	20.7	14.0	9.4	6.9
Chautauqua	Poland	44.2	20.3	18.8	12.4	8.1	5.8
Chautauqua	Pomfret	43.0	19.9	17.9	11.6	7.4	5.2
Chautauqua	Portland	43.2	19.6	17.9	11.7	7.5	5.3
Chautauqua	Ripley	45.6	20.7	19.8	13.2	8.8	6.4
Chautauqua	Sheridan	40.9	18.7	16.2	10.2	6.3	4.3
Chautauqua	Sherman	47.1	22.1	21.2	14.4	9.8	7.2
Chautauqua	Stockton	46.4	22.0	20.7	14.0	9.4	6.9
Chautauqua	Villenova	45.3	21.5	19.8	13.2	8.7	6.3
Chautauqua	Westfield	45.6	20.7	19.8	13.2	8.8	6.4
Chemung	Ashland	34.8	15.0	11.4	6.5	3.5	2.0
Chemung	Baldwin	35.5	15.4	11.9	6.9	3.8	2.3
Chemung	Big Flats	33.1	13.7	10.1	5.5	2.8	1.5
Chemung	Catlin	34.4	14.0	10.9	6.1	3.2	1.9
Chemung	Chemung	35.4	15.6	11.9	6.9	3.8	2.3
Chemung	Elmira	33.5	14.2	10.4	5.8	2.9	1.7
Chemung	Erin	36.4	16.1	12.6	7.4	4.1	2.6
Chemung	Horseheads	33.8	14.1	10.6	5.9	3.0	1.7
Chemung	Southport	34.0	14.4	10.8	6.0	3.1	1.8
Chemung	Van Etten	37.7	16.8	13.6	8.2	4.7	3.0
Chemung	Veteran	34.4	14.6	11.0	6.2	3.3	1.9
Chenango	Afton	40.7	18.1	15.9	10.0	6.2	4.2
Chenango	Bainbridge	40.8	17.5	15.8	10.0	6.2	4.2
Chenango	Columbus	39.0	17.5	14.6	9.0	5.4	3.5
Chenango	Coventry	40.3	17.5	15.4	9.7	5.9	4.0
Chenango	German	42.3	19.0	17.2	11.1	7.0	4.9
Chenango	Greene	38.8	17.0	14.3	8.8	5.2	3.4

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Chenango	Guilford	39.9	17.3	15.1	9.4	5.7	3.8
Chenango	Lincklaen	41.0	18.4	16.1	10.2	6.3	4.3
Chenango	Mcdonough	41.4	18.4	16.4	10.4	6.5	4.5
Chenango	New Berlin	39.2	17.5	14.7	9.1	5.4	3.6
Chenango	North Norwich	38.1	16.9	13.9	8.4	4.9	3.2
Chenango	Norwich	39.6	17.5	15.0	9.3	5.6	3.7
Chenango	Otselic	41.1	18.1	16.1	10.2	6.3	4.3
Chenango	Oxford	39.4	17.5	14.9	9.2	5.5	3.7
Chenango	Pharsalia	42.8	19.6	17.7	11.5	7.3	5.1
Chenango	Pitcher	41.9	18.6	16.8	10.8	6.8	4.7
Chenango	Plymouth	40.1	17.5	15.3	9.6	5.8	3.9
Chenango	Preston	40.2	17.6	15.4	9.7	5.9	4.0
Chenango	Sherburne	37.7	16.6	13.6	8.2	4.7	3.0
Chenango	Smithville	39.5	17.5	14.9	9.2	5.6	3.7
Chenango	Smyrna	39.3	17.3	14.8	9.1	5.5	3.6
Clinton	Altona	32.9	13.6	9.9	5.4	2.7	1.5
Clinton	Ausable	31.8	13.2	9.2	4.8	2.3	1.2
Clinton	Beekmantown	32.7	13.5	9.8	5.3	2.6	1.4
Clinton	Black Brook	35.8	15.2	12.0	7.0	3.8	2.3
Clinton	Champlain	32.6	13.0	9.6	5.2	2.5	1.4
Clinton	Chazy	32.4	13.0	9.5	5.1	2.5	1.3
Clinton	Clinton	34.9	14.7	11.4	6.5	3.5	2.1
Clinton	Dannemora	37.8	16.6	13.6	8.2	4.8	3.1
Clinton	Ellenburg	36.9	15.9	12.9	7.7	4.4	2.7
Clinton	Mooers	32.1	13.0	9.3	4.9	2.4	1.2
Clinton	Peru	32.2	13.5	9.5	5.1	2.5	1.3
Clinton	Plattsburgh	32.4	13.6	9.6	5.2	2.5	1.3
Clinton	Saranac	36.4	15.5	12.5	7.3	4.1	2.5
Clinton	Schuyler Falls	32.3	13.3	9.6	5.1	2.5	1.3
Columbia	Ancram	43.8	19.7	18.3	12.0	7.8	5.6
Columbia	Austerlitz	46.0	21.2	20.2	13.6	9.0	6.6
Columbia	Canaan	45.3	20.5	19.5	13.0	8.6	6.2
Columbia	Chatham	41.3	18.5	16.4	10.4	6.5	4.5
Columbia	Claverack	41.3	18.5	16.4	10.4	6.5	4.5
Columbia	Clermont	41.4	19.1	16.6	10.6	6.6	4.5
Columbia	Copake	44.4	20.1	18.8	12.5	8.1	5.8
Columbia	Gallatin	42.3	19.0	17.2	11.1	7.0	4.9
Columbia	Germantown	41.0	18.8	16.2	10.3	6.4	4.4
Columbia	Ghent	41.0	18.4	16.1	10.2	6.3	4.3
Columbia	Greenport	39.5	17.5	14.9	9.2	5.6	3.7

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Columbia	Hillsdale	45.2	20.8	19.6	13.1	8.6	6.3
Columbia	Kinderhook	39.2	17.5	14.7	9.1	5.4	3.6
Columbia	Livingston	41.0	18.5	16.2	10.2	6.3	4.3
Columbia	New Lebanon	42.3	18.9	17.1	11.0	7.0	4.9
Columbia	Stockport	39.0	17.5	14.6	9.0	5.4	3.5
Columbia	Stuyvesant	38.4	17.0	14.1	8.6	5.1	3.3
Columbia	Taghkanic	42.4	19.0	17.2	11.1	7.0	4.9
Cortland	Cincinnatus	42.1	18.8	16.9	10.9	6.9	4.8
Cortland	Cortlandville	39.5	18.5	15.2	9.4	5.7	3.8
Cortland	Cuyler	41.1	18.3	16.1	10.2	6.3	4.3
Cortland	Freetown	41.2	18.0	16.2	10.3	6.4	4.4
Cortland	Harford	39.0	17.4	14.6	9.0	5.3	3.5
Cortland	Homer	40.7	18.8	16.0	10.1	6.2	4.2
Cortland	Lapeer	39.0	17.5	14.6	9.0	5.4	3.5
Cortland	Marathon	39.1	17.3	14.7	9.0	5.4	3.6
Cortland	Preble	40.9	18.6	16.1	10.2	6.3	4.3
Cortland	Scott	41.0	18.8	16.3	10.3	6.4	4.4
Cortland	Solon	41.3	18.8	16.5	10.5	6.5	4.5
Cortland	Taylor	42.1	18.9	17.0	10.9	6.9	4.8
Cortland	Truxton	41.0	18.0	16.0	10.1	6.3	4.3
Cortland	Virgl	39.7	17.8	15.1	9.4	5.7	3.8
Cortland	Willet	40.4	17.7	15.6	9.8	6.0	4.1
Delaware	Andes	41.3	17.9	16.1	10.3	6.4	4.4
Delaware	Bovina	40.1	17.0	15.2	9.5	5.8	3.9
Delaware	Colchester	44.3	19.9	18.7	12.4	8.1	5.8
Delaware	Davenport	39.5	16.9	14.8	9.1	5.5	3.7
Delaware	Delhi	41.3	18.1	16.2	10.3	6.4	4.4
Delaware	Deposit	43.4	19.8	18.1	11.8	7.6	5.4
Delaware	Franklin	42.2	18.8	17.0	10.9	6.9	4.8
Delaware	Hamden	43.1	19.2	17.7	11.5	7.4	5.2
Delaware	Hancock	43.7	20.1	18.4	12.1	7.8	5.5
Delaware	Harpersfield	39.0	16.9	14.5	8.9	5.3	3.5
Delaware	Kortright	39.4	17.0	14.7	9.1	5.5	3.6
Delaware	Masonville	43.3	19.4	17.9	11.7	7.5	5.3
Delaware	Meredith	41.3	18.3	16.3	10.4	6.4	4.4
Delaware	Middletown	39.1	16.9	14.5	8.9	5.3	3.5
Delaware	Roxbury	41.1	18.1	16.1	10.2	6.3	4.3
Delaware	Sidney	41.0	18.1	16.0	10.1	6.3	4.3
Delaware	Stamford	40.7	17.8	15.8	9.9	6.1	4.2
Delaware	Tompkins	43.7	20.1	18.3	12.0	7.8	5.5

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Delaware	Walton	45.2	20.6	19.5	13.0	8.6	6.2
Dutchess	Amenia	42.0	18.7	16.9	10.8	6.8	4.7
Dutchess	Beekman	45.2	21.2	19.7	13.1	8.7	6.3
Dutchess	Clinton	43.1	19.4	17.8	11.6	7.4	5.2
Dutchess	Dover	44.7	21.0	19.3	12.8	8.4	6.0
Dutchess	East Fishkill	44.5	20.5	19.0	12.6	8.2	5.9
Dutchess	Fishkill	44.5	20.4	19.0	12.5	8.2	5.9
Dutchess	Hyde Park	43.7	20.1	18.4	12.0	7.8	5.5
Dutchess	La Grange	42.9	19.1	17.5	11.4	7.3	5.1
Dutchess	Milan	42.4	19.1	17.2	11.1	7.0	4.9
Dutchess	Northeast	43.9	19.8	18.4	12.1	7.8	5.6
Dutchess	Pawling	46.1	22.0	20.5	13.8	9.2	6.7
Dutchess	Pine Plains	41.8	18.9	16.8	10.8	6.8	4.7
Dutchess	Pleasant Val'y	43.0	19.0	17.6	11.4	7.3	5.1
Dutchess	Poughkeepsie	41.7	19.0	16.7	10.7	6.7	4.6
Dutchess	Red Hook	42.6	19.6	17.5	11.4	7.2	5.1
Dutchess	Rhinebeck	44.1	20.6	18.8	12.4	8.0	5.8
Dutchess	Stanford	41.0	18.2	16.1	10.2	6.3	4.3
Dutchess	Union Vale	44.2	19.7	18.6	12.2	8.0	5.7
Dutchess	Wappinger	41.9	19.0	16.9	10.8	6.8	4.7
Dutchess	Washington	41.9	18.7	16.8	10.8	6.8	4.7
Erie	Alden	37.9	17.5	14.0	8.4	4.9	3.2
Erie	Amherst	37.9	18.0	14.1	8.5	4.9	3.2
Erie	Aurora	42.8	20.5	17.9	11.6	7.4	5.2
Erie	Boston	45.1	21.9	19.8	13.2	8.7	6.3
Erie	Brant	38.2	17.1	14.0	8.5	5.0	3.2
Erie	Cheektowaga	39.0	18.5	14.9	9.2	5.5	3.6
Erie	Clarence	37.4	17.3	13.6	8.1	4.7	3.0
Erie	Colden	47.1	22.8	21.5	14.6	9.9	7.3
Erie	Collins	39.9	18.4	15.5	9.6	5.9	3.9
Erie	Concord	44.8	21.2	19.4	12.9	8.4	6.1
Erie	Eden	40.7	18.7	16.0	10.1	6.2	4.2
Erie	Elma	39.6	18.6	15.3	9.5	5.7	3.8
Erie	Evans	37.9	17.0	13.8	8.3	4.8	3.1
Erie	Hamburg	38.5	17.7	14.3	8.7	5.1	3.4
Erie	Holland	43.7	20.4	18.5	12.1	7.8	5.6
Erie	Lackawana	37.1	17.6	13.5	8.0	4.6	2.9
Erie	Lancaster	39.0	18.5	14.9	9.2	5.5	3.6
Erie	Marilla	39.8	18.4	15.4	9.6	5.8	3.9
Erie	Newstead	36.4	15.9	12.6	7.4	4.1	2.6

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Erie	North Cllins	42.2	20.0	17.4	11.2	7.1	4.9
Erie	Orchard Park	41.3	19.5	16.7	10.6	6.6	4.5
Erie	Sardinia	43.9	20.1	18.5	12.2	7.9	5.6
Erie	Tonawanda	37.6	18.3	13.9	8.4	4.8	3.1
Erie	Wales	42.5	20.1	17.6	11.4	7.2	5.1
Erie	West Seneca	39.0	18.5	14.9	9.2	5.5	3.6
Essex	Chesterfield	34.7	14.6	11.2	6.4	3.4	2.0
Essex	Crown Point	37.6	16.5	13.5	8.1	4.7	3.0
Essex	Elizabethtown	37.6	16.6	13.5	8.1	4.7	3.0
Essex	Essex	34.4	14.3	11.0	6.2	3.3	1.9
Essex	Jay	35.8	15.5	12.1	7.0	3.9	2.3
Essex	Keene	42.2	18.1	16.8	10.8	6.8	4.7
Essex	Lewis	36.6	15.9	12.7	7.5	4.2	2.6
Essex	Minerva	42.5	19.2	17.3	11.2	7.1	5.0
Essex	Moriah	37.5	16.4	13.4	8.0	4.6	2.9
Essex	Newcomb	43.4	19.2	17.9	11.7	7.5	5.3
Essex	North Elba	41.4	18.1	16.3	10.3	6.4	4.4
Essex	North Hudson	41.3	18.3	16.3	10.4	6.5	4.4
Essex	Schroon	40.6	18.2	15.8	10.0	6.1	4.2
Essex	St. Armand	39.5	17.4	14.9	9.2	5.5	3.7
Essex	Ticonderoga	38.2	16.8	13.9	8.5	5.0	3.2
Essex	Westport	35.7	15.2	12.0	6.9	3.8	2.3
Essex	Willsboro	33.2	13.8	10.1	5.5	2.8	1.5
Essex	Wilmington	38.8	16.7	14.2	8.7	5.2	3.4
Franklin	Altamont	41.7	18.1	16.5	10.5	6.6	4.6
Franklin	Bangor	36.4	15.6	12.5	7.3	4.1	2.5
Franklin	Bellmont	43.0	18.7	17.5	11.4	7.3	5.1
Franklin	Bombay	35.0	14.8	11.5	6.5	3.5	2.1
Franklin	Brandon	40.9	17.7	15.9	10.0	6.2	4.2
Franklin	Brighton	40.0	17.5	15.2	9.5	5.8	3.9
Franklin	Burke	36.6	15.6	12.6	7.4	4.2	2.6
Franklin	Chateaugay	37.3	16.0	13.2	7.9	4.5	2.9
Franklin	Constable	35.1	14.9	11.5	6.6	3.6	2.1
Franklin	Dickinson	37.9	16.1	13.5	8.2	4.7	3.0
Franklin	Duane	41.6	17.9	16.4	10.4	6.5	4.5
Franklin	Fort Covington	35.0	14.5	11.4	6.5	3.5	2.1
Franklin	Franklin	39.5	17.2	14.8	9.2	5.5	3.7
Franklin	Harrietstown	40.8	17.9	15.9	10.0	6.2	4.2
Franklin	Malone	40.3	17.5	15.5	9.7	5.9	4.0
Franklin	Moira	35.1	15.0	11.6	6.6	3.6	2.1

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Franklin	Santa Clara	41.0	17.7	15.9	10.1	6.2	4.3
Franklin	Waverly	40.9	17.8	15.9	10.1	6.2	4.3
Franklin	Westville	35.0	14.7	11.4	6.5	3.5	2.1
Fulton	Bleeker	50.3	24.7	24.2	17.0	11.8	9.0
Fulton	Broadalbin	43.0	20.4	18.0	11.7	7.5	5.3
Fulton	Caroga	50.6	24.5	24.4	17.1	11.9	9.1
Fulton	Ephratah	45.0	20.7	19.4	12.9	8.5	6.1
Fulton	Johnstown	44.2	20.6	18.8	12.4	8.1	5.8
Fulton	Mayfield	45.6	21.7	20.1	13.5	8.9	6.5
Fulton	Northampton	43.6	20.6	18.5	12.1	7.8	5.5
Fulton	Oppenheim	44.6	20.3	19.0	12.6	8.2	5.9
Fulton	Perth	42.3	19.6	17.3	11.2	7.1	4.9
Fulton	Stratford	49.8	23.3	23.4	16.3	11.3	8.6
Genesee	Alabama	35.0	14.6	11.4	6.5	3.5	2.1
Genesee	Alexander	36.0	15.0	12.1	7.0	3.9	2.4
Genesee	Batavia	35.0	14.5	11.4	6.5	3.5	2.1
Genesee	Bergen	32.1	13.9	9.6	5.1	2.5	1.3
Genesee	Bethany	35.9	15.0	12.0	7.0	3.9	2.4
Genesee	Byron	33.0	14.4	10.2	5.5	2.8	1.5
Genesee	Darien	36.9	16.1	13.0	7.7	4.4	2.7
Genesee	Elba	33.5	14.5	10.5	5.8	3.0	1.7
Genesee	Le Roy	33.7	14.4	10.6	5.8	3.0	1.7
Genesee	Oakfield	34.7	14.5	11.2	6.3	3.4	2.0
Genesee	Pavilion	35.6	15.2	11.9	6.9	3.8	2.3
Genesee	Pembroke	35.4	14.7	11.6	6.7	3.6	2.2
Genesee	Stafford	34.8	14.5	11.3	6.4	3.4	2.0
Greene	Ashland	38.9	17.6	14.6	9.0	5.3	3.5
Greene	Athens	39.2	17.8	14.8	9.1	5.5	3.6
Greene	Cairo	38.6	17.6	14.4	8.8	5.2	3.4
Greene	Catskill	40.8	18.8	16.1	10.2	6.3	4.3
Greene	Coxsackie	38.8	16.9	14.3	8.8	5.2	3.4
Greene	Durham	37.9	17.1	13.8	8.3	4.9	3.1
Greene	Greenville	38.7	17.0	14.3	8.7	5.2	3.4
Greene	Halcott	45.2	21.0	19.7	13.1	8.7	6.3
Greene	Hunter	45.9	21.4	20.2	13.6	9.0	6.6
Greene	Jewett	41.8	19.2	16.9	10.8	6.8	4.7
Greene	Lexington	46.0	21.9	20.4	13.7	9.2	6.7
Greene	New Baltimore	37.7	16.3	13.5	8.1	4.7	3.0
Greene	Prattsville	37.0	16.3	13.0	7.7	4.4	2.8
Greene	Windham	41.6	19.2	16.8	10.7	6.7	4.6

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Hamilton	Arietta	55.3	27.4	28.5	20.7	15.0	11.9
Hamilton	Benson	51.6	25.7	25.5	18.0	12.7	9.8
Hamilton	Hope	47.2	22.9	21.5	14.7	9.9	7.3
Hamilton	Indian Lake	43.7	20.3	18.4	12.1	7.8	5.6
Hamilton	Inlet	50.1	24.1	23.9	16.7	11.6	8.9
Hamilton	Lake Pleasant	52.4	25.8	26.0	18.5	13.2	10.2
Hamilton	Long Lake	46.1	21.1	20.2	13.6	9.1	6.6
Hamilton	Morehouse	54.7	27.1	28.0	20.3	14.7	11.5
Hamilton	Wells	48.7	23.7	22.8	15.7	10.8	8.1
Herkimer	Columbia	42.9	18.7	17.5	11.3	7.2	5.1
Herkimer	Danube	41.3	18.7	16.4	10.5	6.5	4.5
Herkimer	Fairfield	44.0	19.7	18.4	12.1	7.9	5.6
Herkimer	Frankfort	43.0	18.8	17.5	11.4	7.3	5.1
Herkimer	German Flatts	42.5	19.0	17.2	11.1	7.1	4.9
Herkimer	Herkimer	42.4	19.1	17.2	11.1	7.0	4.9
Herkimer	Litchfield	42.8	18.9	17.4	11.3	7.2	5.0
Herkimer	Little Falls	42.0	19.0	17.0	10.9	6.9	4.8
Herkimer	Manheim	42.5	19.5	17.4	11.2	7.1	5.0
Herkimer	Newport	46.3	21.3	20.4	13.8	9.2	6.8
Herkimer	Norway	49.8	23.1	23.3	16.3	11.3	8.6
Herkimer	Ohio	53.0	25.9	26.5	18.9	13.5	10.5
Herkimer	Russia	51.5	24.5	24.9	17.6	12.4	9.5
Herkimer	Salisbury	49.5	22.9	23.1	16.1	11.1	8.4
Herkimer	Schuyler	44.7	20.1	19.0	12.6	8.2	5.9
Herkimer	Stark	42.6	19.0	17.3	11.2	7.1	5.0
Herkimer	Warren	43.0	19.0	17.6	11.4	7.3	5.1
Herkimer	Webb	48.4	22.9	22.3	15.4	10.5	7.9
Herkimer	Winfield	41.4	18.5	16.4	10.5	6.5	4.5
Jefferson	Adams	38.2	19.0	14.5	8.8	5.2	3.3
Jefferson	Alexandria	37.0	17.3	13.3	7.9	4.5	2.8
Jefferson	Antwerp	37.5	17.1	13.6	8.1	4.7	3.0
Jefferson	Brownville	33.3	16.3	10.8	5.9	3.0	1.7
Jefferson	Cape Vincent	35.0	17.4	12.1	6.9	3.7	2.2
Jefferson	Champion	43.9	21.9	19.0	12.5	8.1	5.8
Jefferson	Clayton	35.3	17.3	12.3	7.1	3.8	2.3
Jefferson	Ellisburg	39.9	20.3	16.0	10.0	6.0	4.0
Jefferson	Henderson	36.3	17.9	13.0	7.6	4.2	2.6
Jefferson	Hounsfield	33.4	16.5	10.9	6.0	3.1	1.7
Jefferson	Le Ray	38.6	19.0	14.8	9.0	5.3	3.5
Jefferson	Lorraine	48.0	24.8	22.7	15.6	10.6	7.9

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Jefferson	Lyme	34.1	16.9	11.4	6.4	3.3	1.9
Jefferson	Orleans	36.2	17.5	12.8	7.5	4.2	2.6
Jefferson	Pamelia	36.0	17.7	12.8	7.5	4.1	2.5
Jefferson	Philadelphia	38.8	18.4	14.7	9.0	5.4	3.5
Jefferson	Rodman	46.6	23.8	21.4	14.5	9.7	7.1
Jefferson	Rutland	45.4	23.0	20.4	13.6	9.0	6.6
Jefferson	Theresa	37.9	17.8	14.0	8.5	4.9	3.2
Jefferson	Watertown	40.7	20.3	16.5	10.4	6.4	4.4
Jefferson	Wilna	39.1	18.3	14.9	9.2	5.5	3.6
Jefferson	Worth	54.6	29.0	28.6	20.7	15.0	11.8
Lewis	Croghan	40.8	19.1	16.2	10.2	6.3	4.3
Lewis	Denmark	43.4	21.3	18.6	12.1	7.8	5.5
Lewis	Diana	39.7	18.4	15.3	9.5	5.8	3.8
Lewis	Greig	47.4	22.9	21.6	14.8	10.0	7.4
Lewis	Harrisburg	53.9	28.1	27.9	20.0	14.4	11.3
Lewis	Lewis	55.7	28.2	29.1	21.2	15.5	12.2
Lewis	Leyden	53.2	26.8	26.9	19.3	13.8	10.7
Lewis	Lowville	43.4	21.4	18.6	12.1	7.8	5.5
Lewis	Lyonsdale	49.4	24.2	23.5	16.3	11.3	8.5
Lewis	Martinsburg	53.9	27.6	27.7	19.9	14.3	11.2
Lewis	Montague	59.5	32.1	33.2	24.7	18.5	14.9
Lewis	New Bremen	40.4	19.1	15.9	10.0	6.1	4.1
Lewis	Osceola	55.7	28.7	29.3	21.3	15.5	12.3
Lewis	Pickney	53.8	28.3	27.8	20.0	14.4	11.2
Lewis	Turin	50.0	24.4	23.9	16.7	11.6	8.8
Lewis	Watson	44.7	21.3	19.4	12.9	8.4	6.1
Lewis	West Turin	55.2	27.0	28.4	20.6	15.0	11.8
Livingston	Avon	31.1	12.5	8.7	4.5	2.1	1.0
Livingston	Caledonia	31.6	13.2	9.1	4.8	2.3	1.1
Livingston	Conesus	34.2	13.8	10.7	6.0	3.2	1.8
Livingston	Geneseo	31.5	12.8	9.0	4.7	2.2	1.1
Livingston	Groveland	31.4	12.6	8.8	4.6	2.2	1.1
Livingston	Leicester	30.4	12.3	8.3	4.2	1.9	0.9
Livingston	Lima	32.3	13.1	9.5	5.0	2.5	1.3
Livingston	Livonia	33.1	13.4	10.0	5.5	2.8	1.5
Livingston	Mount Morris	31.2	12.7	8.8	4.5	2.1	1.0
Livingston	N. Dansville	32.5	12.8	9.5	5.1	2.5	1.3
Livingston	Nunda	35.0	14.5	11.4	6.5	3.5	2.1
Livingston	Ossian	34.4	14.0	10.9	6.2	3.3	1.9
Livingston	Portage	34.7	14.5	11.2	6.4	3.4	2.0

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Livingston	Sparta	33.3	13.3	10.1	5.5	2.8	1.5
Livingston	Springwater	34.9	13.6	11.1	6.3	3.4	2.0
Livingston	West Sparta	32.6	13.1	9.6	5.2	2.6	1.4
Livingston	York	32.2	13.5	9.5	5.1	2.5	1.3
Madison	Brookfield	40.6	17.8	15.7	9.9	6.1	4.1
Madison	Cazenovia	41.7	19.0	16.7	10.7	6.7	4.6
Madison	De Ruyter	41.0	17.8	15.9	10.1	6.3	4.3
Madison	Eaton	39.4	17.6	14.9	9.2	5.6	3.7
Madison	Fenner	43.2	19.6	17.9	11.6	7.5	5.3
Madison	Georgetown	41.0	18.1	16.0	10.2	6.3	4.3
Madison	Hamilton	39.1	17.4	14.6	9.0	5.4	3.5
Madison	Lebanon	39.6	17.5	15.0	9.3	5.6	3.7
Madison	Lenox	41.0	18.1	16.0	10.2	6.3	4.3
Madison	Lincoln	41.8	19.3	16.9	10.8	6.8	4.7
Madison	Madison	40.4	17.7	15.6	9.8	6.0	4.1
Madison	Nelson	41.4	18.6	16.4	10.5	6.5	4.5
Madison	Oneida	41.3	19.0	16.5	10.5	6.5	4.5
Madison	Smithfield	41.5	18.6	16.5	10.5	6.6	4.5
Madison	Stockbridge	40.7	18.2	15.9	10.0	6.2	4.2
Madison	Sullivan	41.0	18.4	16.1	10.2	6.3	4.3
Monroe	Brighton	32.9	15.0	10.3	5.6	2.8	1.5
Monroe	Chili	31.1	14.0	9.0	4.6	2.1	1.0
Monroe	Clarkson	30.2	12.4	8.2	4.1	1.8	0.8
Monroe	E.Rochester	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Gates	31.1	14.4	9.1	4.7	2.2	1.1
Monroe	Greece	32.0	14.5	9.6	5.1	2.5	1.3
Monroe	Hamlin	31.0	13.8	8.9	4.6	2.1	1.0
Monroe	Henrietta	32.1	14.1	9.6	5.1	2.5	1.3
Monroe	Irondequoit	33.0	15.5	10.4	5.7	2.9	1.6
Monroe	Mendon	31.7	13.7	9.3	4.9	2.3	1.2
Monroe	Ogden	31.0	13.6	8.9	4.5	2.1	1.0
Monroe	Parma	31.1	13.8	8.9	4.6	2.1	1.0
Monroe	Penfield	33.3	15.1	10.5	5.8	2.9	1.6
Monroe	Perinton	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Pittsford	33.0	14.5	10.2	5.6	2.8	1.5
Monroe	Riga	31.3	13.6	9.0	4.7	2.2	1.1
Monroe	Rush	31.0	13.1	8.8	4.5	2.1	1.0
Monroe	Sweden	30.9	13.1	8.7	4.4	2.0	1.0
Monroe	Webster	34.5	16.1	11.5	6.5	3.4	2.0
Monroe	Wheatland	31.5	13.5	9.1	4.8	2.2	1.1

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Montgomery	Amsterdam	40.0	18.7	15.6	9.7	5.9	4.0
Montgomery	Canajoharie	41.0	18.4	16.1	10.2	6.3	4.3
Montgomery	Charleston	43.1	19.7	17.8	11.6	7.4	5.2
Montgomery	Florida	40.1	18.7	15.7	9.8	6.0	4.0
Montgomery	Glen	40.0	18.6	15.5	9.7	5.9	4.0
Montgomery	Minden	41.1	18.5	16.2	10.3	6.4	4.4
Montgomery	Mohawk	39.8	18.5	15.4	9.6	5.8	3.9
Montgomery	Palatine	41.3	18.8	16.5	10.5	6.5	4.5
Montgomery	Root	40.9	18.7	16.1	10.2	6.3	4.3
Montgomery	St Johnsville	42.5	19.5	17.4	11.3	7.2	5.0
Nassau	Glen Cove	45.4	21.7	20.0	13.4	8.8	6.4
Nassau	Hempstead	44.2	21.3	19.0	12.5	8.2	5.8
Nassau	Long Beach	43.0	21.0	18.2	11.8	7.6	5.3
Nassau	N Hempstead	45.0	21.7	19.7	13.1	8.6	6.2
Nassau	Oyster Bay	45.1	21.8	19.8	13.2	8.7	6.3
Niagara	Cambria	35.4	16.1	12.0	6.9	3.8	2.3
Niagara	Hartland	34.8	15.8	11.6	6.6	3.5	2.1
Niagara	Lewiston	34.4	15.4	11.2	6.3	3.3	1.9
Niagara	Lockport	36.7	16.9	13.0	7.7	4.4	2.7
Niagara	Newfane	33.3	14.9	10.5	5.7	2.9	1.6
Niagara	Niagara	37.0	16.9	13.2	7.8	4.5	2.8
Niagara	Pendleton	37.0	17.0	13.2	7.9	4.5	2.8
Niagara	Porter	32.1	14.4	9.7	5.1	2.5	1.3
Niagara	Royalton	36.5	16.3	12.8	7.5	4.2	2.6
Niagara	Somerset	33.2	14.6	10.3	5.6	2.9	1.6
Niagara	Wheatfield	37.0	17.0	13.2	7.9	4.5	2.8
Niagara	Wilson	31.6	13.9	9.3	4.9	2.3	1.2
Oneida	Annsville	49.7	24.4	23.7	16.5	11.4	8.7
Oneida	Augusta	42.0	18.8	16.9	10.8	6.8	4.7
Oneida	Ava	57.7	29.9	31.1	22.9	16.9	13.5
Oneida	Boonville	56.0	28.9	29.6	21.6	15.7	12.5
Oneida	Bridgewater	42.2	18.5	16.9	10.9	6.9	4.8
Oneida	Camden	48.7	24.0	22.9	15.8	10.9	8.2
Oneida	Deerfield	47.4	22.2	21.5	14.6	9.9	7.3
Oneida	Florence	52.9	27.2	26.8	19.2	13.7	10.6
Oneida	Floyd	46.8	22.4	21.1	14.3	9.6	7.1
Oneida	Forestport	53.8	26.9	27.3	19.6	14.1	11.0
Oneida	Kirkland	43.1	20.2	18.0	11.7	7.5	5.3
Oneida	Lee	49.0	23.9	23.1	16.0	11.0	8.3
Oneida	Marcy	45.3	21.2	19.7	13.2	8.7	6.3

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Oneida	Marshall	42.7	19.3	17.5	11.3	7.2	5.1
Oneida	New Hartford	43.0	20.0	17.9	11.6	7.4	5.2
Oneida	Paris	43.0	19.5	17.7	11.5	7.4	5.2
Oneida	Remsen	52.9	25.6	26.3	18.8	13.4	10.4
Oneida	Rome	44.5	21.1	19.2	12.7	8.3	6.0
Oneida	Sangerfield	41.9	18.4	16.7	10.7	6.7	4.7
Oneida	Steuben	54.7	27.3	28.1	20.3	14.7	11.5
Oneida	Trenton	47.7	22.4	21.7	14.9	10.1	7.5
Oneida	Utica	43.0	19.4	17.7	11.5	7.4	5.2
Oneida	Vernon	43.1	20.2	18.0	11.7	7.5	5.3
Oneida	Verona	42.5	19.4	17.4	11.2	7.1	5.0
Oneida	Vienna	43.7	20.4	18.5	12.1	7.8	5.6
Oneida	Western	51.9	25.9	25.7	18.2	12.9	10.0
Oneida	Westmoreland	44.7	20.8	19.2	12.8	8.4	6.0
Oneida	Whitestown	43.8	20.7	18.6	12.2	7.9	5.6
Onondaga	Camillus	39.0	17.9	14.7	9.1	5.4	3.5
Onondaga	Cicero	40.9	18.5	16.1	10.2	6.3	4.3
Onondaga	Clay	41.2	19.5	16.6	10.5	6.5	4.5
Onondaga	Dewitt	40.4	17.8	15.6	9.8	6.0	4.1
Onondaga	Elbridge	38.4	17.4	14.2	8.6	5.1	3.3
Onondaga	Fabius	41.0	17.8	15.9	10.1	6.3	4.3
Onondaga	Geddes	39.3	18.1	15.0	9.2	5.5	3.7
Onondaga	Lafayette	40.0	17.6	15.3	9.5	5.8	3.9
Onondaga	Lysander	40.2	19.0	15.8	9.9	6.0	4.1
Onondaga	Manilus	41.0	18.3	16.1	10.2	6.3	4.3
Onondaga	Marcellus	39.0	17.9	14.7	9.0	5.4	3.5
Onondaga	Onondaga	39.6	17.7	15.1	9.4	5.6	3.8
Onondaga	Otisco	39.1	17.6	14.7	9.1	5.4	3.6
Onondaga	Pompey	41.0	18.2	16.1	10.2	6.3	4.3
Onondaga	Salina	39.4	17.8	15.0	9.3	5.6	3.7
Onondaga	Skaneateles	39.0	17.8	14.7	9.0	5.4	3.5
Onondaga	Spafford	39.3	17.9	14.9	9.2	5.5	3.7
Onondaga	Tully	40.0	17.5	15.3	9.5	5.8	3.9
Onondaga	Van Buren	39.7	18.5	15.3	9.5	5.8	3.8
Ontario	Bristol	34.3	14.3	10.9	6.1	3.2	1.9
Ontario	Canadice	34.7	13.9	11.0	6.3	3.3	2.0
Ontario	Canandaigua	33.1	13.7	10.1	5.5	2.8	1.5
Ontario	E. Bloomfield	33.0	13.5	10.0	5.4	2.7	1.5
Ontario	Farmington	33.0	14.3	10.2	5.5	2.8	1.5
Ontario	Geneva	33.0	13.9	10.1	5.5	2.8	1.5

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Ontario	Gorham	33.0	13.9	10.1	5.5	2.8	1.5
Ontario	Hopewell	33.0	14.1	10.1	5.5	2.8	1.5
Ontario	Manchester	33.3	14.8	10.5	5.7	2.9	1.6
Ontario	Naples	33.5	13.1	10.2	5.6	2.9	1.6
Ontario	Phelps	33.2	14.6	10.3	5.7	2.9	1.6
Ontario	Richmond	33.3	13.5	10.1	5.6	2.8	1.6
Ontario	Seneca	33.0	14.4	10.2	5.5	2.8	1.5
Ontario	South Bristol	34.5	14.0	11.0	6.2	3.3	1.9
Ontario	Victor	33.0	14.1	10.1	5.5	2.8	1.5
Ontario	W. Bloomfield	32.8	13.5	9.8	5.3	2.7	1.4
Orange	Blooming Grove	45.6	21.1	19.9	13.3	8.8	6.4
Orange	Chester	45.6	20.8	19.8	13.3	8.8	6.4
Orange	Cornwall	47.1	22.1	21.3	14.5	9.8	7.2
Orange	Crawford	43.3	19.6	18.0	11.7	7.5	5.3
Orange	Deerpark	44.4	20.1	18.8	12.5	8.1	5.8
Orange	Goshen	43.1	19.2	17.7	11.5	7.4	5.2
Orange	Greenville	43.5	19.6	18.1	11.8	7.6	5.4
Orange	Hamptonburgh	43.1	19.3	17.8	11.6	7.4	5.2
Orange	Highlands	48.6	22.7	22.4	15.5	10.6	8.0
Orange	Minisink	43.0	19.4	17.7	11.5	7.4	5.2
Orange	Monroe	47.9	22.2	21.8	15.0	10.2	7.6
Orange	Montgomery	43.1	19.7	17.9	11.7	7.5	5.3
Orange	Mount Hope	43.0	19.1	17.6	11.5	7.3	5.2
Orange	New Windsor	44.5	20.5	19.0	12.6	8.2	5.9
Orange	Newburgh	44.1	20.0	18.6	12.2	7.9	5.7
Orange	Tuxedo	49.6	23.3	23.3	16.2	11.2	8.5
Orange	Wallkill	43.0	19.0	17.6	11.4	7.3	5.2
Orange	Warwick	46.8	21.6	20.9	14.2	9.5	7.0
Orange	Wawayanda	43.0	19.0	17.6	11.4	7.3	5.2
Orange	Woodbury	48.6	22.6	22.4	15.5	10.6	8.0
Orleans	Albion	32.8	14.5	10.1	5.5	2.7	1.5
Orleans	Barre	33.3	14.5	10.4	5.7	2.9	1.6
Orleans	Carlton	32.5	14.5	9.9	5.3	2.6	1.4
Orleans	Clarendon	31.5	13.7	9.2	4.8	2.3	1.1
Orleans	Gaines	32.3	14.5	9.8	5.2	2.6	1.3
Orleans	Kendall	31.0	14.2	9.0	4.6	2.1	1.0
Orleans	Murray	31.0	13.2	8.8	4.5	2.1	1.0
Orleans	Ridgeway	34.4	15.2	11.2	6.3	3.3	1.9
Orleans	Shelby	35.0	15.3	11.6	6.6	3.6	2.1
Orleans	Yates	33.1	14.6	10.3	5.6	2.8	1.6

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Oswego	Albion	46.0	23.4	20.9	14.1	9.4	6.9
Oswego	Amboy	47.8	23.9	22.2	15.2	10.4	7.7
Oswego	Boylston	52.7	27.9	26.9	19.2	13.7	10.6
Oswego	Constantia	43.4	20.9	18.4	12.0	7.7	5.5
Oswego	Granby	40.7	19.8	16.4	10.3	6.4	4.3
Oswego	Hannibal	39.6	19.6	15.5	9.6	5.8	3.9
Oswego	Hastings	43.3	21.2	18.4	12.0	7.7	5.5
Oswego	Mexico	42.4	20.8	17.8	11.5	7.3	5.1
Oswego	Minetto	41.0	20.6	16.7	10.6	6.6	4.5
Oswego	New Haven	41.2	20.6	16.9	10.7	6.7	4.6
Oswego	Orwell	51.1	27.0	25.5	18.0	12.6	9.7
Oswego	Oswego	41.0	20.6	16.8	10.6	6.6	4.5
Oswego	Palermo	43.0	20.8	18.1	11.8	7.5	5.3
Oswego	Parish	45.7	22.9	20.5	13.8	9.1	6.7
Oswego	Redfield	53.2	27.9	27.3	19.5	14.0	10.8
Oswego	Richland	41.8	20.8	17.3	11.1	6.9	4.8
Oswego	Sandy Creek	41.8	21.2	17.5	11.2	7.0	4.9
Oswego	Schroeppel	42.2	20.4	17.5	11.2	7.1	4.9
Oswego	Scriba	41.0	20.9	16.8	10.7	6.6	4.5
Oswego	Volney	41.2	20.5	16.8	10.7	6.6	4.5
Oswego	West Monroe	43.6	21.3	18.6	12.2	7.9	5.6
Oswego	Williamstown	49.6	25.5	24.0	16.7	11.6	8.7
Otsego	Burlington	41.0	18.0	16.0	10.1	6.3	4.3
Otsego	Butternuts	39.5	17.4	14.9	9.2	5.5	3.7
Otsego	Cherry Valley	43.5	19.8	18.2	11.9	7.7	5.4
Otsego	Decatur	43.0	19.4	17.7	11.5	7.4	5.2
Otsego	Edmeston	39.7	17.6	15.1	9.4	5.7	3.8
Otsego	Exeter	41.9	18.5	16.7	10.7	6.7	4.7
Otsego	Hartwick	40.0	17.8	15.3	9.6	5.8	3.9
Otsego	Laurens	39.8	17.5	15.1	9.4	5.7	3.8
Otsego	Maryland	39.6	17.2	14.9	9.2	5.6	3.7
Otsego	Middlefield	40.9	18.2	16.0	10.1	6.3	4.3
Otsego	Milford	39.2	17.3	14.7	9.1	5.4	3.6
Otsego	Morris	39.8	17.5	15.1	9.4	5.7	3.8
Otsego	New Lisbon	40.8	17.8	15.8	10.0	6.2	4.2
Otsego	Oneonta	39.3	17.3	14.8	9.1	5.5	3.6
Otsego	Otego	40.2	17.5	15.3	9.6	5.9	3.9
Otsego	Otsego	40.8	18.2	15.9	10.1	6.2	4.2
Otsego	Pittsield	40.2	17.7	15.4	9.6	5.9	4.0
Otsego	Plainfield	41.6	18.3	16.5	10.5	6.6	4.5

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Otsego	Richfield	42.7	18.7	17.3	11.2	7.1	5.0
Otsego	Roseboom	43.5	19.6	18.1	11.8	7.6	5.4
Otsego	Springfield	42.5	18.7	17.2	11.1	7.0	4.9
Otsego	Unadilla	39.3	17.3	14.8	9.1	5.5	3.6
Otsego	Westford	41.7	18.5	16.6	10.6	6.6	4.6
Otsego	Worcester	40.2	17.6	15.4	9.6	5.9	4.0
Putnam	Carmel	48.8	23.3	22.8	15.7	10.8	8.1
Putnam	Kent	47.3	22.1	21.3	14.5	9.8	7.3
Putnam	Patterson	47.3	22.1	21.3	14.5	9.8	7.3
Putnam	Philipstown	47.8	22.1	21.7	14.9	10.1	7.5
Putnam	Putnam Valley	48.7	23.2	22.7	15.6	10.7	8.1
Putnam	Southeast	48.9	23.3	22.8	15.8	10.9	8.2
Rensselaer	Berlin	45.3	20.1	19.4	13.0	8.6	6.2
Rensselaer	Brunswick	38.8	16.6	14.2	8.7	5.2	3.4
Rensselaer	East Greenbush	37.3	16.2	13.2	7.9	4.5	2.9
Rensselaer	Grafton	45.0	19.3	19.0	12.6	8.3	6.0
Rensselaer	Hoosick	37.5	16.0	13.3	8.0	4.6	2.9
Rensselaer	Nassau	40.7	18.0	15.9	10.0	6.2	4.2
Rensselaer	No. Greenbush	37.5	16.2	13.3	8.0	4.6	2.9
Rensselaer	Petersburg	42.4	18.3	17.0	11.0	7.0	4.9
Rensselaer	Pittstown	37.1	15.9	13.0	7.7	4.4	2.8
Rensselaer	Poestenkill	42.5	18.3	17.0	11.0	7.0	4.9
Rensselaer	Sand Lake	41.2	18.0	16.2	10.3	6.4	4.4
Rensselaer	Schaghticoke	37.0	15.9	12.9	7.7	4.4	2.7
Rensselaer	Schodack	38.1	16.3	13.7	8.3	4.9	3.1
Rensselaer	Stephentown	42.3	18.7	17.1	11.0	7.0	4.9
Rockland	Clarkstown	47.3	22.0	21.3	14.5	9.8	7.3
Rockland	Haverstraw	48.9	22.7	22.6	15.6	10.8	8.1
Rockland	Orangetown	47.8	22.5	21.9	15.0	10.2	7.6
Rockland	Ramapo	49.3	22.4	22.8	15.8	10.9	8.2
Rockland	Stoney Point	48.3	22.4	22.1	15.2	10.4	7.8
Saratoga	Ballston	39.6	18.4	15.2	9.4	5.7	3.8
Saratoga	Charlton	41.4	19.1	16.6	10.6	6.6	4.5
Saratoga	Clifton Park	36.8	16.2	12.9	7.6	4.3	2.7
Saratoga	Corinth	44.4	21.1	19.1	12.6	8.2	5.9
Saratoga	Day	46.3	22.6	20.8	14.1	9.4	6.9
Saratoga	Edinburg	46.1	22.5	20.7	13.9	9.3	6.8
Saratoga	Galway	43.1	20.3	18.0	11.7	7.5	5.3
Saratoga	Greenfield	43.1	20.1	18.0	11.7	7.5	5.3
Saratoga	Hadley	43.3	20.7	18.3	11.9	7.7	5.4

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Saratoga	Halfmoon	37.0	16.0	12.9	7.7	4.4	2.7
Saratoga	Malta	39.5	18.4	15.2	9.4	5.6	3.8
Saratoga	Milton	41.3	19.0	16.5	10.5	6.5	4.5
Saratoga	Moreau	38.0	17.3	14.0	8.4	4.9	3.2
Saratoga	Northumberland	37.9	17.3	13.9	8.4	4.9	3.1
Saratoga	Providence	45.6	21.9	20.2	13.5	8.9	6.5
Saratoga	Saratoga	38.6	17.9	14.5	8.8	5.2	3.4
Saratoga	Saratoga Sprgs	40.6	18.7	16.0	10.1	6.2	4.2
Saratoga	Stillwater	38.4	17.5	14.3	8.7	5.1	3.3
Saratoga	Waterford	37.0	15.5	12.8	7.6	4.3	2.7
Saratoga	Wilton	39.6	18.5	15.3	9.5	5.7	3.8
Schenectady	Duanesburg	42.3	19.5	17.3	11.2	7.1	4.9
Schenectady	Glenville	39.5	18.2	15.1	9.4	5.6	3.8
Schenectady	Niskayuna	36.9	16.1	12.9	7.6	4.3	2.7
Schenectady	Princetown	41.7	19.4	16.9	10.8	6.8	4.7
Schenectady	Rotterdam	38.9	17.7	14.6	9.0	5.3	3.5
Schenectady	Schenectady	37.0	16.1	13.0	7.7	4.4	2.8
Schoharie	Blenheim	37.5	16.4	13.4	8.0	4.6	2.9
Schoharie	Broome	38.4	16.9	14.1	8.6	5.1	3.3
Schoharie	Carlisle	41.0	18.5	16.2	10.2	6.3	4.3
Schoharie	Cobleskill	40.7	18.4	15.9	10.0	6.2	4.2
Schoharie	Conesville	37.3	16.3	13.2	7.9	4.5	2.9
Schoharie	Esperance	40.4	18.5	15.8	9.9	6.1	4.1
Schoharie	Fulton	38.0	16.9	13.9	8.4	4.9	3.1
Schoharie	Gilboa	37.2	16.2	13.1	7.8	4.5	2.8
Schoharie	Jefferson	39.0	17.1	14.5	8.9	5.3	3.5
Schoharie	Middleburg	38.8	17.5	14.5	8.9	5.3	3.5
Schoharie	Richmondville	39.9	18.0	15.3	9.5	5.8	3.9
Schoharie	Schoharie	39.5	18.1	15.1	9.3	5.6	3.7
Schoharie	Seward	41.6	18.5	16.6	10.6	6.6	4.6
Schoharie	Sharon	42.4	18.6	17.1	11.0	7.0	4.9
Schoharie	Summit	39.8	17.7	15.2	9.5	5.7	3.8
Schoharie	Wright	39.9	18.3	15.4	9.6	5.8	3.9
Schuyler	Catherine	37.2	16.4	13.2	7.8	4.5	2.8
Schuyler	Cayuta	37.3	16.6	13.3	7.9	4.6	2.9
Schuyler	Dix	33.9	13.8	10.6	5.9	3.1	1.7
Schuyler	Hector	35.9	15.1	12.1	7.0	3.9	2.4
Schuyler	Montour	33.5	13.9	10.4	5.7	2.9	1.6
Schuyler	Orange	33.8	13.8	10.5	5.8	3.0	1.7
Schuyler	Reading	33.9	13.6	10.5	5.9	3.0	1.7

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Schuyler	Tyrone	33.6	13.7	10.4	5.7	2.9	1.7
Seneca	Covert	34.7	14.5	11.2	6.4	3.4	2.0
Seneca	Fayette	33.0	13.9	10.1	5.5	2.8	1.5
Seneca	Junius	33.9	14.8	10.8	6.0	3.1	1.8
Seneca	Lodi	34.4	14.2	11.0	6.2	3.3	1.9
Seneca	Ovid	33.9	14.3	10.7	6.0	3.1	1.8
Seneca	Romulus	33.1	14.0	10.1	5.5	2.8	1.5
Seneca	Seneca Falls	33.1	14.4	10.2	5.6	2.8	1.5
Seneca	Tyre	34.7	15.1	11.3	6.4	3.4	2.0
Seneca	Varick	33.0	14.0	10.1	5.5	2.8	1.5
Seneca	Waterloo	33.0	13.6	10.0	5.4	2.7	1.5
St lawrence	Brasher	35.0	15.1	11.5	6.6	3.5	2.1
St lawrence	Canton	35.8	15.2	12.1	7.0	3.9	2.4
St lawrence	Clare	40.6	17.9	15.7	9.9	6.1	4.1
St lawrence	Clifton	43.2	18.7	17.6	11.5	7.4	5.2
St lawrence	Colton	42.0	18.6	16.8	10.8	6.8	4.7
St lawrence	De Peyster	35.7	16.0	12.2	7.0	3.9	2.3
St lawrence	Dekalb	36.8	16.5	13.0	7.7	4.4	2.7
St lawrence	Edwards	39.0	17.1	14.5	8.9	5.3	3.5
St lawrence	Fine	42.5	19.1	17.3	11.2	7.1	5.0
St lawrence	Fowler	37.8	17.0	13.7	8.3	4.8	3.1
St lawrence	Gouverneur	37.0	17.0	13.2	7.9	4.5	2.8
St lawrence	Hammond	37.0	17.0	13.2	7.9	4.5	2.8
St lawrence	Hermon	37.2	17.0	13.3	8.0	4.5	2.9
St lawrence	Hopkinton	40.2	17.4	15.3	9.6	5.9	3.9
St lawrence	Lawrence	35.4	15.0	11.7	6.8	3.7	2.2
St lawrence	Lisbon	33.9	14.7	10.8	6.0	3.1	1.8
St lawrence	Louisville	35.0	15.2	11.6	6.6	3.6	2.1
St lawrence	Macomb	37.0	16.9	13.2	7.8	4.5	2.8
St lawrence	Madrid	35.3	15.0	11.7	6.7	3.6	2.2
St lawrence	Massena	35.0	15.6	11.7	6.7	3.6	2.1
St lawrence	Morristown	35.9	16.3	12.4	7.2	4.0	2.4
St lawrence	Norfolk	35.4	15.2	11.8	6.8	3.7	2.2
St lawrence	Ogdensburg	33.0	14.0	10.1	5.5	2.8	1.5
St lawrence	Oswegathcie	34.5	15.3	11.3	6.4	3.4	2.0
St lawrence	Parishville	40.2	17.7	15.5	9.7	5.9	4.0
St lawrence	Piercefield	41.9	18.2	16.6	10.7	6.7	4.6
St lawrence	Pierrepont	38.9	17.2	14.5	8.9	5.3	3.5
St lawrence	Pitcairn	39.5	18.0	15.1	9.3	5.6	3.7
St lawrence	Potsdam	37.0	15.8	12.9	7.7	4.4	2.7

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
St lawrence	Rossie	37.0	17.0	13.2	7.9	4.5	2.8
St lawrence	Russell	38.2	16.9	14.0	8.5	5.0	3.2
St lawrence	Stockholm	36.1	15.6	12.3	7.2	4.0	2.5
St lawrence	Waddington	35.0	15.0	11.5	6.6	3.5	2.1
Steuben	Addison	31.9	13.5	9.3	4.9	2.4	1.2
Steuben	Avoca	32.6	13.3	9.7	5.2	2.6	1.4
Steuben	Bath	31.2	13.3	8.9	4.6	2.1	1.1
Steuben	Bradford	32.8	13.4	9.8	5.3	2.6	1.4
Steuben	Cameron	32.3	13.5	9.5	5.1	2.5	1.3
Steuben	Campbell	31.6	13.5	9.2	4.8	2.3	1.2
Steuben	Canisteo	33.7	13.6	10.4	5.8	3.0	1.7
Steuben	Caton	32.9	13.6	9.9	5.4	2.7	1.5
Steuben	Cohocton	33.7	13.2	10.3	5.7	2.9	1.6
Steuben	Corning	32.5	13.5	9.7	5.2	2.6	1.4
Steuben	Dansville	33.7	13.5	10.4	5.8	3.0	1.7
Steuben	Erwin	31.0	13.5	8.8	4.5	2.1	1.0
Steuben	Fremont	34.1	13.7	10.6	6.0	3.1	1.8
Steuben	Greenwood	37.4	15.9	13.2	7.9	4.5	2.9
Steuben	Hartsville	36.1	15.2	12.2	7.2	4.0	2.4
Steuben	Hornby	33.3	13.8	10.2	5.6	2.8	1.6
Steuben	Hornellsville	33.3	13.6	10.2	5.6	2.8	1.6
Steuben	Howard	33.7	13.5	10.3	5.7	2.9	1.7
Steuben	Jasper	34.0	14.1	10.7	5.9	3.1	1.8
Steuben	Lindley	31.3	13.5	9.0	4.7	2.2	1.1
Steuben	Prattsburg	34.7	13.5	10.9	6.2	3.3	1.9
Steuben	Pulteney	32.7	13.1	9.7	5.2	2.6	1.4
Steuben	Rathbone	31.0	13.5	8.9	4.6	2.1	1.0
Steuben	Thurston	31.9	13.5	9.3	4.9	2.4	1.2
Steuben	Troupsburg	33.4	14.0	10.3	5.7	2.9	1.6
Steuben	Tuscarora	32.5	13.5	9.7	5.2	2.6	1.4
Steuben	Urbana	31.3	13.0	8.9	4.6	2.2	1.1
Steuben	Wayland	34.0	13.6	10.6	5.9	3.1	1.8
Steuben	Wayne	32.0	13.0	9.3	4.9	2.4	1.2
Steuben	West Union	37.3	16.0	13.1	7.9	4.5	2.8
Steuben	Wheeler	33.0	13.2	9.9	5.4	2.7	1.5
Steuben	Woodhull	31.7	13.5	9.2	4.8	2.3	1.2
Suffolk	Babylon	45.0	22.0	19.8	13.2	8.7	6.3
Suffolk	Brookhaven	46.1	23.8	21.1	14.2	9.4	6.9
Suffolk	East Hampton	44.7	23.4	20.0	13.3	8.7	6.3
Suffolk	Huntington	45.2	22.7	20.2	13.5	8.9	6.4

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Suffolk	Islip	46.2	23.4	21.1	14.2	9.5	7.0
Suffolk	Riverhead	45.0	23.5	20.2	13.5	8.9	6.4
Suffolk	Shelter Island	45.0	23.2	20.2	13.4	8.8	6.4
Suffolk	Smithtown	45.2	23.5	20.3	13.6	8.9	6.5
Suffolk	Southampton	45.0	23.6	20.3	13.5	8.9	6.4
Suffolk	Southold	45.2	23.5	20.3	13.6	8.9	6.5
Sullivan	Bethel	44.1	19.9	18.5	12.2	7.9	5.7
Sullivan	Callicoon	46.0	21.1	20.2	13.6	9.1	6.6
Sullivan	Cochecton	42.1	19.0	17.0	10.9	6.9	4.8
Sullivan	Delaware	42.6	19.0	17.3	11.2	7.1	5.0
Sullivan	Fallsburg	47.0	21.8	21.1	14.3	9.6	7.1
Sullivan	Forestburgh	46.1	21.2	20.3	13.7	9.1	6.7
Sullivan	Fremont	44.2	20.3	18.7	12.4	8.0	5.8
Sullivan	Highland	42.6	19.1	17.3	11.2	7.1	5.0
Sullivan	Liberty	47.9	22.0	21.7	14.9	10.1	7.5
Sullivan	Lumberland	43.8	19.7	18.3	12.0	7.8	5.5
Sullivan	Mamakating	45.2	20.8	19.6	13.0	8.6	6.2
Sullivan	Neversink	48.5	22.2	22.2	15.3	10.5	7.9
Sullivan	Rockland	46.3	21.0	20.3	13.7	9.2	6.7
Sullivan	Thompson	46.5	21.4	20.6	13.9	9.3	6.9
Sullivan	Tusten	41.4	19.0	16.6	10.6	6.6	4.5
Tioga	Barton	36.3	16.1	12.6	7.4	4.1	2.5
Tioga	Berkshire	37.1	16.5	13.1	7.8	4.5	2.8
Tioga	Candor	37.1	16.5	13.2	7.9	4.5	2.8
Tioga	Newark Valley	37.0	16.4	13.1	7.8	4.4	2.8
Tioga	Nichols	35.0	15.0	11.5	6.6	3.5	2.1
Tioga	Owego	36.2	15.9	12.5	7.3	4.1	2.5
Tioga	Richford	38.8	17.3	14.4	8.8	5.2	3.4
Tioga	Spencer	37.2	16.5	13.2	7.9	4.5	2.8
Tioga	Tioga	36.0	15.9	12.3	7.2	4.0	2.4
Tompkins	Caroline	38.2	16.9	14.0	8.5	5.0	3.2
Tompkins	Danby	37.7	16.6	13.6	8.2	4.7	3.0
Tompkins	Dryden	37.6	16.0	13.3	8.0	4.6	2.9
Tompkins	Enfield	37.8	16.4	13.6	8.2	4.8	3.1
Tompkins	Groton	38.0	16.5	13.7	8.3	4.8	3.1
Tompkins	Ithaca	34.9	15.0	11.5	6.5	3.5	2.1
Tompkins	Lansing	34.8	14.7	11.3	6.4	3.4	2.0
Tompkins	Newfield	38.5	17.2	14.2	8.7	5.1	3.3
Tompkins	Ulysses	34.9	14.7	11.4	6.5	3.5	2.0
Ulster	Denning	53.1	25.3	26.3	18.8	13.4	10.4

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Ulster	Esopus	45.4	21.6	19.9	13.3	8.8	6.4
Ulster	Gardiner	45.3	21.2	19.8	13.2	8.7	6.3
Ulster	Hardenburgh	46.9	21.6	20.9	14.2	9.6	7.0
Ulster	Hurley	47.0	22.1	21.1	14.4	9.7	7.1
Ulster	Kingston	46.1	21.9	20.5	13.8	9.2	6.7
Ulster	Lloyd	45.0	20.9	19.5	13.0	8.5	6.2
Ulster	Marbletown	46.7	21.9	20.9	14.2	9.5	7.0
Ulster	Marlborough	43.7	20.0	18.3	12.0	7.8	5.5
Ulster	New Paltz	45.5	21.5	20.0	13.4	8.9	6.4
Ulster	Olive	49.3	23.1	23.0	16.0	11.0	8.3
Ulster	Plattekill	45.8	21.3	20.2	13.5	9.0	6.6
Ulster	Rochester	46.9	21.8	21.0	14.2	9.6	7.1
Ulster	Rosendale	45.2	21.5	19.8	13.2	8.7	6.3
Ulster	Saugerties	43.6	20.3	18.3	12.0	7.7	5.5
Ulster	Shandaken	49.1	23.8	23.1	16.0	11.0	8.3
Ulster	Shawangunk	44.8	21.0	19.3	12.8	8.4	6.1
Ulster	Ulster	44.8	21.4	19.5	13.0	8.5	6.1
Ulster	Wawarsing	46.3	21.6	20.6	13.9	9.3	6.8
Ulster	Woodstock	48.4	22.5	22.2	15.3	10.5	7.9
Warren	Bolton	40.7	18.7	16.0	10.1	6.2	4.2
Warren	Chester	41.1	19.0	16.4	10.4	6.5	4.4
Warren	Hague	40.6	18.5	15.9	10.0	6.2	4.2
Warren	Horicon	41.0	19.0	16.3	10.3	6.4	4.4
Warren	Johnsburg	44.1	20.5	18.7	12.3	8.0	5.7
Warren	Lake George	43.0	19.9	17.9	11.6	7.5	5.3
Warren	Lake Luzerne	42.9	20.0	17.8	11.6	7.4	5.2
Warren	Queensbury	39.9	18.3	15.4	9.6	5.8	3.9
Warren	Stony Creek	46.5	22.7	21.0	14.2	9.5	7.0
Warren	Thurman	45.4	21.5	19.9	13.3	8.8	6.4
Warren	Warrensburg	43.0	20.1	17.9	11.6	7.4	5.2
Washington	Argyle	38.5	17.0	14.2	8.6	5.1	3.3
Washington	Cambridge	37.3	16.0	13.2	7.9	4.5	2.9
Washington	Dresden	42.3	19.4	17.2	11.1	7.0	4.9
Washington	Easton	37.3	16.2	13.2	7.9	4.5	2.9
Washington	Fort Ann	40.8	18.6	16.1	10.2	6.3	4.3
Washington	Fort Edward	37.0	16.4	13.1	7.8	4.4	2.8
Washington	Granville	39.3	17.5	14.8	9.1	5.5	3.6
Washington	Greenwich	37.5	16.1	13.3	8.0	4.6	2.9
Washington	Hampton	39.2	17.2	14.6	9.0	5.4	3.6
Washington	Hartford	39.7	18.0	15.2	9.4	5.7	3.8

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Washington	Hebron	38.9	17.0	14.4	8.9	5.3	3.5
Washington	Jackson	38.3	16.5	13.9	8.5	5.0	3.2
Washington	Kingsbury	38.0	17.3	13.9	8.4	4.9	3.1
Washington	Putnam	37.6	16.5	13.5	8.1	4.7	3.0
Washington	Salem	37.7	16.4	13.5	8.1	4.7	3.0
Washington	White Creek	39.6	17.3	14.9	9.2	5.6	3.7
Washington	Whitehall	38.0	17.0	13.8	8.4	4.9	3.1
Wayne	Arcadia	35.2	15.8	11.8	6.8	3.7	2.2
Wayne	Butler	37.3	17.1	13.5	8.0	4.6	2.9
Wayne	Galen	36.2	16.5	12.6	7.4	4.1	2.5
Wayne	Huron	38.8	18.2	14.7	9.0	5.3	3.5
Wayne	Lyons	35.6	16.0	12.1	7.0	3.8	2.3
Wayne	Macedon	33.7	15.0	10.8	6.0	3.1	1.7
Wayne	Marion	35.9	16.4	12.4	7.2	4.0	2.4
Wayne	Ontario	36.4	16.7	12.8	7.5	4.2	2.6
Wayne	Palmyra	35.0	15.6	11.7	6.6	3.6	2.1
Wayne	Rose	37.1	17.3	13.4	8.0	4.5	2.9
Wayne	Savannah	36.2	16.4	12.6	7.3	4.1	2.5
Wayne	Sodus	37.0	17.6	13.4	8.0	4.5	2.8
Wayne	Walworth	35.1	16.2	11.9	6.8	3.7	2.2
Wayne	Williamson	37.0	17.3	13.3	7.9	4.5	2.8
Wayne	Wolcott	39.0	18.6	14.9	9.2	5.5	3.6
Westchester	Bedford	49.0	23.9	23.1	16.0	11.0	8.3
Westchester	Cortlandt	47.0	22.1	21.2	14.4	9.7	7.2
Westchester	Eastchester	47.0	22.1	21.2	14.4	9.7	7.2
Westchester	Greenburgh	48.8	23.5	22.8	15.7	10.8	8.1
Westchester	Harrison	47.8	23.2	22.0	15.1	10.2	7.6
Westchester	Lewisboro	49.4	24.2	23.4	16.3	11.2	8.5
Westchester	Mamaroneck	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	Mount Pleasant	48.6	23.4	22.6	15.6	10.7	8.0
Westchester	Mount Vernon	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	New Castle	48.9	23.9	23.0	15.9	10.9	8.2
Westchester	New Rochelle	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	North Castle	49.0	24.0	23.1	16.0	11.0	8.3
Westchester	North Salem	48.9	23.8	23.0	15.9	10.9	8.2
Westchester	Ossining	47.3	22.8	21.6	14.7	9.9	7.4
Westchester	Pelham	47.0	22.0	21.1	14.4	9.7	7.1
Westchester	Pound Ridge	49.0	24.3	23.2	16.1	11.1	8.3
Westchester	Rye	47.6	23.2	21.9	14.9	10.1	7.5
Westchester	Scarsdale	47.0	22.4	21.2	14.4	9.7	7.2

County	Township	Precipitation		N Leaching Index			
		PA	PW	Soil Hydrologic Group			
		------Inches------		A	B	C	D
Westchester	Somers	48.9	23.6	22.9	15.9	10.9	8.2
Westchester	White Plains	47.2	23.0	21.5	14.7	9.9	7.3
Westchester	Yonkers	47.3	22.4	21.4	14.6	9.9	7.3
Westchester	Yorktown	48.6	23.0	22.5	15.5	10.7	8.0
Wyoming	Arcade	42.2	18.4	16.9	10.9	6.9	4.8
Wyoming	Attica	38.4	17.0	14.1	8.6	5.0	3.3
Wyoming	Bennington	39.2	17.5	14.7	9.1	5.4	3.6
Wyoming	Castile	35.5	15.1	11.8	6.8	3.7	2.2
Wyoming	Covington	36.3	15.4	12.4	7.2	4.0	2.5
Wyoming	Eagle	40.6	17.9	15.7	9.9	6.1	4.1
Wyoming	Gainsville	39.4	17.5	14.9	9.2	5.5	3.7
Wyoming	Genesee Falls	35.3	14.9	11.7	6.7	3.7	2.2
Wyoming	Java	41.0	17.9	16.0	10.1	6.3	4.3
Wyoming	Middlebury	37.8	16.8	13.7	8.2	4.8	3.1
Wyoming	Orangeville	40.8	18.0	15.9	10.0	6.2	4.2
Wyoming	Perry	36.1	15.4	12.3	7.2	4.0	2.4
Wyoming	Pike	38.1	16.6	13.8	8.4	4.9	3.2
Wyoming	Sheldon	40.2	17.9	15.5	9.7	5.9	4.0
Wyoming	Warsaw	38.0	16.7	13.8	8.3	4.8	3.1
Wyoming	Wethersfield	41.6	18.6	16.5	10.6	6.6	4.5
Yates	Barrington	33.7	13.7	10.4	5.8	3.0	1.7
Yates	Benton	33.0	14.0	10.1	5.5	2.8	1.5
Yates	Italy	34.1	13.3	10.5	5.9	3.1	1.8
Yates	Jerusalem	33.1	13.2	10.0	5.4	2.7	1.5
Yates	Middlesex	33.0	13.2	9.9	5.4	2.7	1.5
Yates	Milo	33.0	13.7	10.0	5.5	2.7	1.5
Yates	Potter	33.0	13.7	10.0	5.4	2.7	1.5
Yates	Starkey	33.1	13.6	10.0	5.5	2.7	1.5
Yates	Torrey	33.0	14.0	10.1	5.5	2.8	1.5

TABLE 17.3: EXPECTED N CREDITS FROM PLOWED DOWN SODS.

		Available N		
Legume in sod %	Total N pool lbs N/acre	Year 1* lbs N/acre	Year 2 lbs N/acre	Year 3 lbs N/acre
0	150	83	18	8
1-25	200	110	24	10
26-50	250	138	30	13
50 or more	300	165	36	15

* First year following plow down.

TABLE 17.4: CORNELL CROP CODES AND DESCRIPTIONS.

Crop Code	Crop Description
	Alfalfa
ABE	Alfalfa trefoil grass, Establishment
ABT	Alfalfa trefoil grass, Established
AGE	Alfalfa grass, Establishment
AGT	Alfalfa grass, Established
ALE	Alfalfa, Establishment
ALT	Alfalfa, Established
	Birdsfoot
BCE	Birdsfoot trefoil clover, Establishment
BCT	Birdsfoot trefoil clover, Established
BGE	Birdsfoot trefoil grass, Establishment
BGT	Birdsfoot trefoil grass, Established
BSE	Birdsfoot trefoil seed, Establishment
BST	Birdsfoot trefoil seed, Established
BTE	Birdsfoot trefoil, Establishment
BTT	Birdsfoot trefoil, Established
	Barley
BSP	Spring barley
BSS	Spring barley with legumes
BUK	Buckwheat
BWI	Winter barley
BWS	Winter barley with legumes
	Clover
CGE	Clover grass, Establishment
CGT	Clover grass, Established
CLE	Clover, Establishment
CLT	Clover, Established
CSE	Clover seed production, Establishment
CST	Clover seed production, Established
	Corn
COG	Corn grain
COS	Corn silage

Table 17.4 : Cornell crop codes and descriptions.

Crop Code	Crop Description
	Grasses, pastures, covercrops
CVE	Crownvetch, Establishment
CVT	Crownvetch
GIE	Grasses intensively managed, Establishment
GIT	Grasses intensively managed, Established
GRE	Grasses, Establishment
GRT	Grasses, Established
PGE	Pasture, Establishment
PGT	Pasture improved grasses, Established
PIE	Pasture intensively grazed, Establishment
PIT	Pasture intensively grazed, Established
PLE	Pasture with legumes, Establishment
PLT	Pasture with legumes, Established
PNT	Pasture native grasses
RYC	Rye cover crop
RYS	Rye seed production
TRP	Triticale peas
	Small grains
MIL	Millet
OAS	Oats with legume
OAT	Oats
SOF	Sorghum forage
SOG	Sorghum grain
SOY	Soybeans
SSH	Sorghum sudangrass hybrid
SUD	Sudangrass
WHS	Wheat with legume
WHT	Wheat
	Vegetables
ASP	Asparagus
BDR	Beans - Dry
BET	Beet
BNL	Beans - Lima
BNS	Beans - Snap
BRP	Broccoli-Transplanted
BRS	Broccoli-Seeded
BUS	Brussels Sprouts
CAR	Carrots
CBP	Cabbage-Trans
CBS	Cabbage - Seeded
CEL	Celery

Table 17.4 : Cornell crop codes and descriptions.

CFP	Cauliflower - Transplanted
CFS	Cauliflower - Seeded
CHC	Chinese Cabbage
CKP	Cucumber - Transplanted
CKS	Cucumber - Seeded
CRD	Chard
EGG	Eggplant
END	Endive
GAR	Garlic
LET	Lettuce
MIX	Mixed Vegetables
MML	Muskmelon
MUS	Mustard
ONP	Onion-Transplant
ONS	Onion-Seeded
PEA	Pea
PEP	Peppers
POP	Popcorn
POT	Potato
PSL	Parsley
PSN	Parsnips
PUM	Pumpkins
RAD	Radishes
RHU	Rhubarb
RUT	Rutabagas
SPF	Spinach-Fall
SPS	Spinach-Spring
SQS	Squash-Summer
SQW	Squash-Winter
SWC	Sweet Corn
TOM	Tomato
TUR	Turnips
WAT	Watermelon
Others	
SUN	Sunflower
TRE	Christmas trees, Establishment
TRT	Christmas trees, Established
WPE	Waterways, Establishment
WPT	Waterways, Established

TABLE 17.5: UNSTABLE INORGANIC N (AMMONIA) CREDITS FROM MANURE.

No credits from the inorganic (ammonia) N from manure applied in past years are expected. Ammonia credits from spring applications of manure in the current growing season depend on the method of applications (i.e. number of days between application and incorporation). If a manure source has 4.0 lbs of ammonia N per tons of manure and this manure is applied and incorporated within two days, available for the current year's crop is 4.0 * 0.53 = 2.1 lbs of inorganic N per ton of manure. Hence, from an application of 20 tons of this manure, we expect 20 * 2.1 = 42 lbs of N to be released for plant uptake from the total amount of inorganic N in the manure at the time of application. This amount need to be added to the N credits from the organic N fraction in the manure to determine total N credits from this manure source (see Table 17.6).

Manure application method	Ammonia N utilized by the current crop (%)
Fall application	0
Pre-plant spring application	
Incorporated within 1 day following application	65
Incorporated within 2 days following application	53
Incorporated within 3 days following application	41
Incorporated within 4 days following application	29
Incorporated within 5 days following application	17
Incorporated more than 5 days after application	0
Not incorporated	0
Side-dress application	100

TABLE 17.6: DECAY SERIES FOR ORGANIC N FROM MANURE.

A "Last year" availability of 12% indicates that an estimated 12% of the original amount of organic N that was applied with the manure last year is expected to be utilized by the crop grown this year. Thus, if in the past three years organic N applications from manure amounted to 100 lbs per acre per year, we expect a 17 lbs of N per acre manure N credit for the crop grown this year (12% of 100 lbs = 12 lbs per acre from last year's application plus 5% of 100 lbs = 5 lbs per acre from the application done two years ago and no credits from what was applied three years ago).

Source	Dry Matter	Availability of N from the total amount of organic N applied			
		Time of application			
		This year	Last year	Two years ago	Three years ago
	%	-----------------------------------%-----------------------------------			
Cows	<18	35	12	5	0
Cows	≥18	25	12	5	0
Poultry	<18	55	12	5	0
Poultry	≥18	55	12	5	0
Swine	<18	35	12	5	0
Swine	≥18	25	12	5	0
Horses	<18	30	12	5	0
Horses	≥18	25	12	5	0
Sheep	<18	35	12	5	0
Sheep	≥18	25	12	5	0

TABLE 17.7: SOIL MANAGEMENT GROUPS FOR NEW YORK STATE AGRICULTURAL SOILS.

Potassium recommendations for field crops in New York depend on soil management group. The soil management group is a measure of the potassium supplying power of the soil. It is dependent upon the clay content, the soil rooting depth and the soil structure. A clayey of silty clay loam soil with deep rooting would have a soil management group of 1 and a sandy soil would be a group 5. Most of the silt loam soils of the central plains are group 2's and the silt loam soils of the southern tier are groups 3's. See Table 1 (Cornell Soils Database) to determine the soil management groups of a specific New York soil.

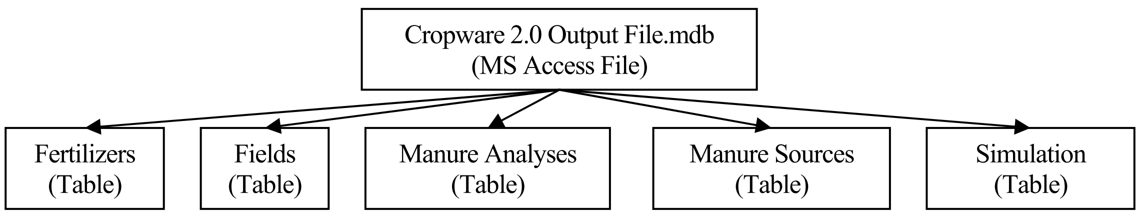
Soil Management Group	General Description
1	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
2	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
3	Moderately coarse textured soil developed from glacial outwash and recent alluvium and medium-textured acid soil developed on glacial till.
4	Coarse- to medium-textured soils formed from glacial till or glacial outwash.
5	Coarse- to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas.
6	Organic or muck soils with more than 80% organic matter.

Modified from: Cornell Field Crops & Soils Handbook, Cornell Cooperative Extension (1987).

TABLE 17.8 CROPWARE 2.0 OUTPUT FILE

An output data file can be generated in a Microsoft Access® compatible database format (.mdb). The output file is independent of the Cropware plan file. This file houses plan inputs and outputs that can be used to share with other database software (e.g. GIS, spreadsheets, databases, etc.) without the risk of inadvertently altering the Cropware plan file. To generate an output file, click on the “Tools” dropdown menu, select “Create Output Database File”, and follow the directions. The file name will be appended with “(Output File).mdb”.

The output file will be generated with the following organization of database tables



The input and output data contained in each database table is outlined below.

Fertilizers Input Data Table

Name	P_2O_5	Mn
Cost	K_2O	Zn
Dry (yes/no)	B	S
Density	Fe	
N	Mg	

Fields Input and Output Data Table

PlanYear	FieldAccess	FertTiming #4
FSA_ID	ManSource #1	LimeRate
FieldName	ManTest #1	RUSLE
Acres	Manure #1 Applied/acre	FloodingFreq
County	Manure #1 Applied	WaterbodyType
Township	Manure #1 Units	BufferWd
Soil	Timing #1	DrainageClass
Sod	AppMethod #1	ConcFlow
Tillage	HydroSenComment #1	Comments
Drainage	ManSource1Yr #1	Morgan Eq P
HighlyErodable	ManSource2Yr #1	Morgan Eq K
PSNT	ManTest1Yr #1	Res Manure N (lbs/acre)

Fields Input and Output Data Table (continued)

ExtractionMethod	ManTest2Yr #1	Res Sod N (lbs/acre)
LabID	ManApp1Yr #1	Gross N Req (lbs/acre)
SampleDate	ManApp2Yr #1	N Req (lbs/acre)
Soil_pH	ManSource #2	P Req (lbs/acre)
Soil_P	ManTest #2	K Req (lbs/acre)
Soil_K	Manure #2 Applied/acre	Lime Req (tons/acre)
Soil_Al	Manure #2 Applied	Lime Req (tons)
Soil_Ca	FieldAccess #2	PI-DP
Soil_Mg	PriorityNutrient #2	PI-PP
Soil_Fe	Manure #2 Units	Annual Rainfall
Soil_Mn	Timing #2	Winter Rainfall
Soil_Zn	AppMethod #2	Soil Hydrologic Class
Soil_OM	HydroSenComment #2	Leaching Index
Soil_Nitrate	ManSource1Yr #2	N Balance (lbs/acre)
ExAcidity	ManSource2Yr #2	P_2O_5 Balance (lbs/acre)
UserYPC	ManTest1Yr #2	K_2O Balance (lbs/acre)
Rotation	ManTest2Yr #2	N Balance (lbs)
RotCrop #1	ManApp1Yr #2	P_2O_5 Balance (lbs)
RotCrop #2	ManApp2Yr #2	K_2O Balance (lbs)
RotCrop #3	Total Manure Applied/acre (gal)	Fert N (lbs)
RotCrop #4	Total Manure Applied/acre (tons)	Fert N (lbs/acre)
RotCrop #5	Total Manure Applied (gal)	Fert P_2O_5 (lbs)
RotCrop #6	Total Manure Applied (tons)	Fert P_2O_5 (lbs/acre)
RotCrop #7	Fert #1	Fert K_2O (lbs)
RotCrop #8	FertRate #1	Fer K_2O (lbs/acre)
RotCrop #9	FertIncorp #1	Manure N (lbs)
RotCrop #10	FertTiming #1	Manure N (lbs/acre)
RotCrop #11	Fert #2	Manure P_2O_5 (lbs)
RotCrop #12	FertRate #2	Manure P_2O_5 (lbs/acre)
RotCrop #13	FertIncorp #2	Manure K_2O (lbs)
RotCrop #14	FertTiming #2	Manure K_2O (lbs/acre)
RotCrop #15	Fert #3	Manure + Fert N (lbs)
RotCrop #16	FertRate #3	Manure + Fert N (lbs/acre)
RotCrop #17	FertIncorp #3	Manure + Fert P_2O_5 (lbs)
RotCrop #18	FertTiming #3	Manure + Fert P_2O_5 (lbs/acre)
RotCrop #19	Fert #4	Manure + Fert K_2O (lbs)
RotCrop #20	FertRate #4	Manure + Fert K_2O (lbs/acre)
PriorityNutrient	FertIncorp #4	

Manure Analyses Input Data Table

Plan Year	N	P_2O_5
Name	NH_4	K_2O
Description	Organic N	DM
Analysis Date		

Manure Source Input Data Table

PlanYear	LbsPerGal	SolidAccum
Name	StorageType	SA_Volume
AnimalType	Length	Storm25Yr
Amt_Starting	Width	WasteWater
Amt_Added	Height	Silage
Amt_Exported	Slope	Bedding
Amt_Available	Diameter	UnCovWstStorArea
Units	DiameterTop	WstStorDrainArea
AnimalUnits	DiameterBottom	PavedLot
Capacity	Freeboard	NumAnalyses

Simulation Input Data

Name	ProducerName	PL_EMail
FarmName	PL_Name	Watershed
Address	PL_Company	County
CityStateZip	PL_Address	Township
Phone	PL_CityStateZip	FirstYear
FAX	PL_Phone	
EMail	PL_FAX	

TABLE 17.9: PHOSPHORUS CONCENTRATIONS FOR FIELD CROPS AND VEGETABLE CROPS.

To obtain P_2O_5 removal rates, multiply yield in lbs/acre with dry matter content in % and P_2O_5 concentration in % and divide the final answer by 10,000. For example, estimated P_2O_5 removal by a 20 tons/acre corn silage crop at 35% dry matter amounts to 20*2000*35*0.62/10,000 = 87 lbs P_2O_5. This equals 4.3 lbs P_2O_5 per ton of silage (35% dry matter). All data on vegetable crops and the data on field crops marked with an asterisk (*) were obtained from the NRCS Plant Database (http://npk.nrcs.usda.gov). All other field crop data were obtained from DairyOne, Inc.

Field Crops		%P	%P_2O_5	Vegetable Crops*		%P	%P_2O_5
		% of dry matter				% of dry matter	
ALT	Alfalfa	0.33	0.76	ASP	Asparagus	0.71	1.62
AGE/ AGT	Alfalfa-grass mix	0.23	0.53	BDR	Beans – Dry	0.53	1.22
ABE/ ABT	Alfalfa-trefoil-grass	0.23	0.53	BET	Beets	0.34	0.79
BTE/ BTT	Birdsfoot trefoil	0.23	0.53	BNL	Beans – Lima	0.45	1.03
BGE/ BGT	Birdsfoot trefoil-grass	0.23	0.53	BNS	Beans – Snap	0.50	1.14
BCE/ BCT	Birdsfoot trefoil-clover	0.23	0.53	BRP	Broccoli – Transplanted	0.75	1.73
BSE/ BST	Birdsfoot trefoil-seed	0.23	0.53	BRS	Broccoli – Seeded	0.75	1.73
CLE/ CLT	Clover	0.34	0.78	BUS	Brussells Sprouts	0.51	1.17
CGE/ CGT	Clover-grass	0.24	0.55	CAR	Carrots	0.33	0.75
CSE/ CST	Clover-seed production	0.34	0.78	CBP	Cabbage – Transplanted	0.36	0.82
CVE/ CVT	Crownvetch	0.34	0.78	CBS	Cabbage – Seeded	0.36	0.82
GRE/ GRT	Grasses	0.28	0.64	CEL	Celery	0.67	1.52

Field Crops		%P	$\%P_2O_5$	Vegetable Crops*		%P	$\%P_2O_5$
		% of dry matter				% of dry matter	
GIE/ GIT	Grass-intensive management	0.34	0.78	CFP	Cauliflower – Transplanted	0.66	1.52
PIE/ PIT	Pasture-grazing rotational	0.34	0.78	CFS	Cauliflower – Seeded	0.66	1.52
PGE/ PGT	Pasture with Improved grass	0.34	0.78	CKP	Cucumber – Transplanted	0.53	1.20
PLE/ PLT	Pasture with legumes	0.24	0.55	CKS	Cucumber – Seeded	0.53	1.20
PNT	Pasture with native grasses	0.34	0.78	EGG	Eggplant	0.31	0.72
WPE/ WPT	Waterways, pond dikes	0.15	0.34	END	Endive	0.45	1.03
BSP	Barley-spring	0.29	0.66	LET	Lettuce	0.60	1.37
BSS	Barley-spring with legume	0.29	0.66	MML	Muskmelon	0.22	0.50
BWI	Barley-winter	0.29	0.66	ONP	Onion – Transplanted	0.30	0.69
BWS	Barley-winter with legume	0.29	0.66	ONS	Onion – Seeded	0.30	0.69
BUK*	Buckwheat	0.36	0.82	PEA	Peas	0.49	1.13
COG	Corn-grain	0.31	0.71	PEP	Peppers	0.34	0.77
COS	Corn-silage	0.27	0.62	POT	Potato	0.24	0.55
MIL*	Millet	0.34	0.78	PSN	Parsnips	0.36	0.83
OAT*	Oats	0.31	0.71	PUM	Pumpkins	0.39	0.90
OAS	Oats-seeded with legume	0.30	0.69	RAD	Radishes	0.44	1.01

Field Crops		%P	$\%P_2O_5$	Vegetable Crops*		%P	$\%P_2O_5$
		% of dry matter				% of dry matter	
RYC	Rye-cover crop	0.36	0.82	RHU	Rhubarb	0.23	0.54
RYS	Rye-seed production	0.36	0.82	RUT	Rutabagas	0.41	0.94
SOG	Sorghum-grain	0.22	0.50	SPF	Spinach – Fall	0.54	1.24
SOF	Sorghum-forage	0.22	0.50	SPS	Spinach – Spring	0.54	1.24
SSH	Sorghum-sudan hybrid	0.50	1.15	SQS	Squash – Summer	0.49	1.12
SUD	Sudangrass	0.50	1.15	SQW	Squash – Winter	0.27	0.62
SOY	Soybeans	0.65	1.49	SWC	Sweetcorn	0.38	0.88
SUN	Sunflower	1.02	2.34	TOM	Tomato	0.47	1.08
TRP	Triticale/peas	0.30	0.69	TUR	Turnips	0.37	0.86
WHT	Wheat	0.29	0.66	WAT	Watermelon	0.11	0.26

Downloadable from: http://nmsp.css.cornell.edu/. Last updated: May 19, 2003.

TABLE 17.10 DEFAULT AGRONOMIC FIELD ACCESSIBILITY

Crop Code	Crop Description	Months when spreading IS allowed according to average agronomic field accessibility
ABE	Alfalfa-Trefoil-Grass	August -October (i.e. August thru October)
ABT	Alfalfa-Trefoil-Grass	June-October
AGE	Alfalfa-Grass Mix	August -October
AGT	Alfalfa-Grass Mix	June-October
ALE	Alfalfa	August -October
ALT	Alfalfa	June-October
ASP	Asparagus	June-December
BCE	Birdsfoot Trefoil-Clover	August -October
BCT	Birdsfoot Trefoil-Clover	June-October
BDR	Beans - Dry	October-April
BET	Beet	August-February
BGE	Birdsfoot Trefoil-Grass	August -October
BGT	Birdsfoot Trefoil-Grass	June-October
BNL	Beans - Lima	October-April
BNS	Beans - Snap	August-March
BRP	Broccoli-Transplanted	August-February
BRS	Broccoli-Seeded	August-February
BSE	Birdsfoot Trefoil-Seed Prod	September-October
BSP	Barley-spring	September-March
BSS	Barley-spring w/ legume	September-March
BST	Birdsfoot Trefoil-Seed Prod	August -October
BTE	Birdsfoot Trefoil	August -October
BTT	Birdsfoot Trefoil	June-October
BUK	Buckwheat	October-June
BUS	Brussels Sprouts	September-March
BWI	Barley-winter	August
BWS	Barley-winter w/legume	August
CAR	Carrots	September-March
CAR	Carrots on	September-March
CBP	Cabbage-	August-February
CBS	Cabbage - Seeded	August-February
CEL	Celery	September-March
CEL	Celery	September-March
CFP	Cauliflower - Transplanted	August-February
CFS	Cauliflower - Seeded	August-February

Crop Code	Crop Description	Months when spreading IS allowed according to average agronomic field accessibility
CGE	Clover-Grass	August -October
CGT	Clover-Grass	June-October
CHC	Chinese Cabbage	August-February
CKP	Cucumber - Transplanted	August-February
CKS	Cucumber - Seeded	August-February
CLE	Clover	August -October
CLT	Clover	June-October
COG	Corn-grain	November-April
COS	Corn-silage	October-April
CRD	Chard	July-January
CSE	Clover-Seed Production	September-October
CST	Clover-Seed Production	August -October
CVE	Crownvetch	August -October
CVT	Crownvetch	June-October
EGG	Eggplant	September-March
END	Endive	August-February
END	Endive on	August-February
GAR	Garlic	August-February
GIE	Grass-Intensive Mgmt	August -October
GIT	Grass-Intensive Mgmt	June-October
GRE	Grasses	August -October
GRT	Grasses	June-October
IDL	Idle Land	March-October
LET	Lettuce	July-January
LET	Lettuce on	July-January
MIL	Millet	July-April
MIX	Mixed Vegetables	July-January
MML	Muskmelon	September-March
MUS	Mustard	July-January
OAS	Oats-seeded w/legume	September-October
OAT	Oats	September-March
ONP	Onion-Transplant	September-April
ONP	Onion-Transplant	September-April
ONS	Onion-Seeded	September-April
ONS	Onion-Seeded	September-April
OTH	Unlisted Crop	None
PEA	Pea	July-January

Crop Code	Crop Description	Months when spreading IS allowed according to average agronomic field accessibility
PEP	Peppers	August-February
PGE	Pasture w/Improved Grass	August -October
PGT	Pasture w/Improved Grass	June-October
PIE	Pasture-Intensively managed	August -October
PIT	Pasture- Intensive Managed	June-October
PLE	Pasture with Legumes	August -October
PLT	Pasture with Legumes	June-October
PNT	Pasture Native Grass	June-October
POP	Popcorn	November-April
POT	Potato	November-April
PSL	Parsley	July-January
PSN	Parsnips	October-April
PUM	Pumpkins	September-March
RAD	Radishes	July-January
RHU	Rhubarb	June-December
RUT	Rutabagas	October-April
RYC	Rye-cover crop	September-April
RYS	Rye-Seed Production	August
SOF	Sorghum-Forage	July-April
SOG	Sorghum-Grain	November-April
SOY	Soybeans	November-April
SPF	Spinach-Fall	October-April
SPS	Spinach-Spring	July-January
SQS	Squash-Summer	August-February
SQW	Squash-Winter	October-April
SSH	Sorghum-Sudan Hybrid	July-April
SUD	Sudangrass	July-April
SUN	Sunflower	November-April
SWC	SWC	August-February
TOM	Tomato	August-February
TRE	Christmas trees	January-December
TRP	Triticale/Peas	November-March
TRT	Christmas trees	January-December
TUR	Turnips	August-February
WAT	Watermelon	September-March
WHS	Wheat Seeded w/Legume	August-October
WHT	Wheat	August

Crop Code	Crop Description	Months when spreading <u>IS</u> allowed according to average agronomic field accessibility
WPE	Waterways, Pond Dikes	None
WPT	Waterways, Pond Dikes	None

TABLE 17.11 COUNTY ANNUAL AND 25 YR 24 HOUR STORM PRECIPITATION (INCHES) AND RUNOFF (% PRECIPITATION)

	-------- Precipitation[2] ---------		Annual runoff[1] (% annual precipitation)	
County	25-yr 24 hour Storm	Annual P	Paved lot (ROVp)	Unpaved lot (ROVu)
Albany	4.9	35.7	55	20
Allegany	4.3	37.6	50	20
Broome	4.8	37.8	50	20
Cattaraugus	4.2	44.1	50	20
Cayuga	4.4	33.6	50	20
Chautauqua	4.1	52.1	50	20
Chemung	4.6	34.3	50	20
Chenango	4.8	41.5	50	20
Clinton	4.0	31.8	45	15
Columbia	5.5	39.9	55	25
Cortland	4.6	43.2	50	20
Delaware	5.0	45.0	55	20
Dutchess	6.0	40.2	60	25
Erie	4.0	44.1	45	15
Essex	4.2	38.2	50	15
Franklin	4.0	47.3	45	15
Fulton	4.6	40.8	50	20
Genesee	4.1	36.8	45	15
Greene	6.0	42.4	55	20
Hamilton	4.3	44.0	50	20
Herkimer	4.4	46.4	50	20
Jefferson	4.0	38.7	45	15
Lewis	4.2	43.3	50	20
Livingston	4.2	33.7	45	15
Madison	4.6	40.3	50	20
Monroe	6.0	30.9	45	15
Montgomery	4.1	36.2	50	20
Nassau	4.7	44.1	60	30
Niagara	4.0	39.9	45	15
Oneida	4.5	49.4	50	20
Onondaga	4.5	40.5	50	20
Ontario	4.3	33.4	45	15
Orange	6.5	48.0	60	25
Orleans	4.0	39.4	45	15
Oswego	4.3	45.3	50	15
Otsego	4.8	39.3	50	20
Putnam	6.0	45.0	60	25
Rensselaer	4.9	44.2	55	20
Rockland	6.0	51.2	60	25

[1] Agricultural Waste Management Field Handbook. April 1992. Part 651 Figures 10C-1, 10C-2. USDA SCS
[2] Liezert, Clinton. Ag Waste Mangement Software version 2.21 October 1995. Ohio Engineering, USDA NRCS.

St Lawrence	4.7	38.5	45	15
Saratoga	4.8	40.1	55	20
Schenectady	4.9	36.2	55	20
Schoharie	4.5	37.3	55	20
Schuyler	4.4	34.4	50	20
Seneca	4.0	37.7	50	20
Steuben	4.5	34.4	50	20
Suffolk	6.0	45.2	60	30
Sullivan	6.0	48.2	55	25
Tioga	4.7	34.6	50	20
Tompkins	4.6	36.6	50	20
Ulster	6.5	50.4	55	25
Warren	4.4	45.8	50	20
Washington	4.6	35.3	55	20
Wayne	4.2	39.1	45	15
Westchester	6.0	49.5	60	30
Wyoming	4.2	38.7	45	15
Yates	4.4	29.8	50	15

[1] Agricultural Waste Management Field Handbook. April 1992. Part 651 Figures 10C-1, 10C-2. USDA SCS
[1] Liezert, Clinton. Ag Waste Mangement Software version 2.21 October 1995. Ohio Engineering, USDA NRCS.

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