United States Department of Agriculture
Natural Resources Conservation Service

A W M

Animal Waste Management

Version 2.22

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Introduction:

The Animal Waste Management **(AWM)** program was designed to assist with the many calculations that are necessary in designing a waste facility as well as to provide guidance on the items that need to be considered in operating and managing such a system.

Several features are contained in the program that relate to this process. They include such subjects as:

- A variety of system types.
  - Waste Storage Pond
  - Tank - Waste Storage Structure
  - Stacking - Waste Storage Structure
  - Single Cell Anaerobic Lagoon
  - Double Cell Anaerobic Lagoon
  - Anaerobic Lagoon → Storage Pond
  - Naturally Aerated Lagoon
  - Mechanically Aerated Lagoon
- Multiple Lagoon Design Procedures.
  - National Agricultural Waste Management Field Handbook
  - Rational Method (Developed by Clyde Barth)[1]
  - Optimization of Biogas Production (AgSTAR[2])
- Various shapes.
  - Circular
  - Rectangular
  - Oval
- Consideration of rainfall / runoff / evaporation.
- Ability to add extra water to the system.
- A selectable variety of animals and bedding types.
- Selectable hauling methods.
- Utilization of waste using controlled land application.
- Ability to change controlling nutrients
  - Nitrogen
  - Phosphorus
  - Potassium
- Variety of crops.
- Customizable management reports.
- Completely documented designs.

[1] Clyde Barth - retired Extension Agricultural Engineer, Clemson University, Clemson, SC.

[2] AgSTAR is a program being jointly developed by the Environmental Protection Service, the Department of Energy and the Natural Resources Conservation Service that deals with methane collection.

Supporting Files:

The animal waste system design and management program is contained in a file called ***"AWM.EXE"***. In order to run, it must be supported by at least seven additional files on the default drive. The recommended setup follows:

BRT71EFR.EXE	This is a runtime module that is copyrighted to Microsoft Quick BASIC ™
OH_ENG.CFG	The file containing all of the specifics about your computing system such as type of printer.
ANIMAL.DAT	All of the data related to the animals such as daily waste production, nutrients excreted by the animals, total and volatile solids generated by each type of animal, etc. is contained in this "random access" file. The data within this file can be managed using a supporting program titled *"data_ed.exe"*.
AWM.STD	This file contains the default values or any standard values that may apply to this program. The data in this file is controlled by the "modify defaults" portion of the program (see page 21)
AWM.ST2	Many of the values that support the program such as straw densities, storage losses, maximum trial computations etc. are contained in this ASCII file. While this data can be edited using conventional text editors, it is recommended that changes be left to the experts.(See Page 39 for details)
AWM.HLP	A file that contains the help information for this program. The program will run without this file but there will obviously be no help information available. Should the program be run without this file, a file with this name containing no data, will be created. The information in this file can be modified or clarified using a supporting program named *"edithelp.exe"*.
CLIMATE.DAT	This file contains the rainfall, evaporation, and other environmental data that can be retrieved based on the name of the county involved. The information within this file can also be managed using the *"data_ed.exe"* program. ***** Note ***** Much of the evaporation data used in this file was obtained from a publication titled "Mean Monthly, Seasonal, and Annual Pan Evaporation for the United States", published by the US Dept. of Commerce and available from the National Technical Information Service. (PB83-161729)

BROWSE.COM	This utility program is used so that some of the reports can be generated in a file format and then viewed on the screen in a controllable manner.
****.RPT***	There are (or can be) several files with a “rpt” extension, stored with the system. These files contain reports that can be used for various management situations. Details related to these reports can be found on page 24.
****.O&M***	The system is supported by on Operation and Maintenance (O&M) plan for each type of facility. More details on these reports and their formats are outlined on page 24.

Loading AWM:

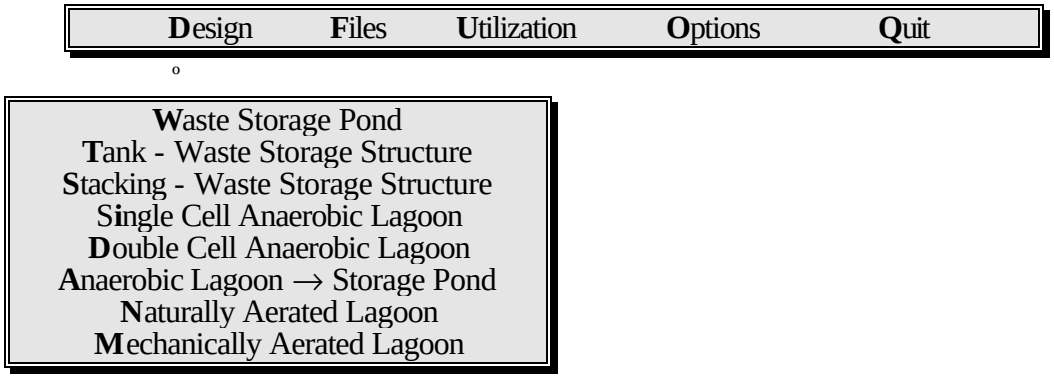
"AWM" can be loaded in one of two ways. Make certain that you are in the subdirectory where the engineering programs reside. The main **"Ohio Engineering Menu"** can be loaded first by entering **"ENGMENU"** at the DOS prompt (C>) and then selecting the "**A**nimal Waste Management" program from the choice list. The second option is to simply enter **"AWM"** at the DOS prompt.

AWM Main Menu -

When the program is first activated, a menu similar to that below will be displayed. The marker identifies the function that is currently active. Pressing "F1" will display a small description of the function. Pressing "Enter" (↵) or the left mouse button will activate the current function. The first letter can also be used to activate any of the specific selections. The right and left arrow keys or the mouse can be used to move the marker.

Design:

Selecting "D" for design will cause the following screen, showing the types of facilities that can be processed by the program, to appear.



The program is capable of sizing the following types of facilities:

Waste Storage Pond -

These systems, sometimes referred to as holding ponds, are typically used for large dairies and occasionally for swine. They are simply earthen holes that contain the waste. They are prone to becoming anaerobic and without a crust can produce objectionable odors. Crusts can normally be expected to form naturally on dairy or beef operations. On some other systems, a crust can be made to form by blowing chopped bedding on the surface or by other techniques. The important fact is that if a waste storage pond is selected because the crust will contain the odors, be certain that a crust will in fact be present.

Separate storage should be provided for large amounts of bedding or frozen material as neither should be permitted in a waste storage pond. Feedlot runoff and milking plant waste should be directed into the pond.

The digestive activity that will likely take place in these systems is not significant enough to consider in the design.

Adequate soils investigation is required before a waste storage pond should be considered.

Tank -Waste Storage Structure -

These tanks are normally constructed of concrete or steel. They are typically used on sites that have a soils problem or where the site has confining physical features. The soil problems might involve sands or gravels that might not contain the waste or bedrock areas that would hinder the construction of a storage pond.

The mathematics involved in the design for sizing a liquid tank are almost identical to that of a waste storage pond.

Stacking - Waste Storage Structure -

Normally these systems, sometimes referred to as dry systems, are used on small dairy facilities and require a substantial amount of bedding and management in order to function successfully.

Water from feedlots or milking plants normally have to be dealt with separately in an additional storage or treatment device.

Single Cell Anaerobic Lagoon -

These lagoons consider anaerobic digestion in the design. They are typically used where odor might be a problem. Typically they are larger and deeper than a waste storage pond. Three design methods are available under this option. They are:

- National Agricultural Waste Management Field Handbook - the loading rates and methods outlined in this document are used to size the lagoon.
- Rational Method - The procedures and values developed by Clyde Barth are used for sizing the lagoon and evaluating the nutrients that will be available from the lagoon.
- Optimizing Biogas Production - This method is normally used where collection of methane gas is a consideration. The method allows an increase in the loading rate providing that hydraulic retention time values are controlled. Total solid loading rates are also controlled and in most cases solids will need to be separated and dealt with in a different system.

Soils and location should be prime considerations in the design of these lagoons.

Double Cell-Anaerobic Lagoon -

In this module, two structures will be designed and evaluated. The majority of the digestion will take place in the first cell. While digestion continues in the second cell, the consistency of the second cell is mostly liquid and is of sufficient quality to be used as recycled flush water.

Two design methods will be presented with this option. They are:

- National Agricultural Waste Management Field Handbook method which uses the procedures and values from this document to size and evaluate the system.
- Rational Method - The procedures and values developed by Clyde Barth are used for sizing the lagoon and evaluating the nutrients that will be available from the lagoon.

Anaerobic Lagoon ® Storage Pond -

In this module, two structures will be designed and evaluated. The first module relies on digestion of the waste while the second cell is simply designed to store everything that is not processed in the first cell. This might involve discharge from the first cell or material that was separated and not allowed to enter the first cell.

Once again, two design methods will be presented upon selection this option. They are:

- National Agricultural Waste Management Field Handbook method which uses the procedures and values from this document to size and evaluate the system.

- Optimizing Biogas Production - This method is normally used where collection of methane gas is a consideration. The method allows an increase in the loading rate providing that hydraulic retention time values are controlled. Total solid loading rates are also controlled and in most cases solids will need to be separated and dealt with in a different system.

Naturally Aerated Lagoon-

This lagoon design relies on natural aeration in order to maintain proper digestion. They typically are shallow, have large surface areas and are in moderately temperate areas. Management of the storage volumes is important to a successful operation.

The program sizes this lagoon based on loading rates found in the National Agricultural Waste Management Field Handbook.

Mechanically Aerated Lagoon -

These lagoons have air introduced using pumps or other mechanical means. They typically have less odor than other types of lagoons but the operation costs are higher. Maintenance is mandatory if they are to be successful.

The program sizes this lagoon based on loading rates found in the National Agricultural Waste Management Field Handbook.

Factors included in sizing the various systems:

	Animal Waste	Rainfall	25-Yr. Rainfall	Runoff	Bedding	Sludge Volume	Minimum Treatment Volume	Waste Water	Freeboard
Waste Storage Pond	a	b	c	d	e	---	---	n	√
Tank - Waste Storage Structure	a	b*	c*	d	e	---	---	n	√
Stacking - Waste Storage Structure	a	---	---	---	e	---	---	n	√
Single Cell Anaerobic Lagoon									
Nat'l Ag. Waste Mgt. Field Handbook	a	b	c	d	e	f	g	n	√
Clyde Barth	a	b	c	d	e	f	h	n	√
Optimizing Biogas Production	a	b	c	d	e	f	i	n	√
Double Cell Anaerobic Lagoon									
Nat'l Ag. Waste Mgt. Field Handbook									
First Cell						f	g		√
Second Cell	a	b**	c**	d	e		j	n	√
Clyde Barth									
First Cell						f	h		√
Second Cell	a	b**	c**	d	e		k	n	√
Anaerobic Lagoon → Storage Pond									
Nat'l Ag. Waste Mgt. Field Handbook									
Lagoon						f	g		√
Storage Pond	a	b**	c**	d	e			n	√
Optimizing Biogas Production									
Lagoon						f	i		√
Storage Pond	a	b**	c**	d	e			n	√
Naturally Aerated Lagoon	a	b	c	d	e	f	l	n	√
Mechanically Aerated Lagoon	a	b	c	d	e	f	m	n	√

a. - Waste - computed based on table values, weight of animals involved and days on the system.
b. - Monthly rainfall over design period minus the evaporation (not to exceed rainfall) for the most critical period within a year.
c. - 25 year - 24 hour storm event applied to structure surface and feedlot.
d. - Runoff from the feedlot area based on the rainfall for the design period reduced by the adjustment value contained in "awm.st2".
e - Bedding volume calculated based on the effective density of the material selected.
f. - Sludge volume based on the sludge accumulation ratio in "animal.dat" and the total solids generated by the selected animals.
g - Minimum treatment volume based on the recommended loading rate from the National Agricultural Waste Management Field Handbook and the volatile solids contained in the waste from the animal type(s) selected.
h. - Minimum treatment volume based on the larger of an odor control volume or a volume consisting of the sum of a treatment volume and the accumulated sludge. The odor control volume and the treatment volume are based on values recommended by Barth with appropriate temperature adjustments.
i. - Minimum treatment volume is the same as "g" except it is increased by an adjustment value as long as a minimum hydraulic retention time is satisfied.
j. - Volume based on a percentage of the treatment volume from the first cell.
k. - Volume based on flow from first cell as outlined in Barth's paper.
l. - Size based on a specified surface area requirement for the calculated BOD_5 loading.
m. - Based on rates recommended in the Nat'l Ag. Waste Mgt Field Handbook.
n . - Waste water from milking plant, watering systems, wash water, etc.
* - Optional Entries. ** - rainfall & 25 yr from both cells.

Once the type of facility has been selected, a data input screen will appear that varies slightly with each type of facility. The following information will be requested:

Landowner - This entry will identify the project that is being designed. This data will appear on the printed reports. It will also be used in identifying the data when the file is retrieved subsequent to being saved.

County - Enter the name of the county or rainfall area that is involved for this project. It is important that this information is spelled correctly as the program uses this information to search the "climate.dat" file to determine some of the climate related data that will be used in the design process.

Designed by - This information will appear on the printed reports to identify the person responsible for this great design.

Storage Period (days) - Enter the number of sequential days that the system will be required to contain the waste. A minimum value is often dictated by the standards. In addition, this value should be based on factors such as cropping systems, drainage systems, ground conditions, weather conditions, etc. For example, don't design a system for 60 days storage when it is known that there will be 90 day periods when there will be no area available to dispose of waste because of crops or frozen ground.

Loading Rate - this value varies depending upon the type of design and will normally be populated automatically. In most cases there will not be a need to change the value that is initially displayed. The value represents the number of pounds of volatile solids per 1000 cubic feet of waste per day that the lagoon can successfully process. The value will change based on the assumptions that are used for the particular design option selected.

Rational Method `kval' - this is an adjustment value that modifies the acceptable loading rate for lagoons that are designed using the rational method developed by Clyde Barth. The loading rates are affected by temperature and this adjustment relates to the average temperature where the designed system is located. The value is normally populated from the supporting data file and will not need to be changed.

HRT - this value reflects the hydraulic retention time. This is defined as the number of days manure and process water inflow that a lagoon will hold when filled from empty to maximum volume. This value is also typically populated from supporting files and will not require modification. For more information, refer to the AgSTAR design methods for optimizing biogas production.

Critical Months - If the program finds a county name in "climate.dat" that matches the one that was entered, it will search through the rainfall and evaporation data for that county and determine the most critical series of days for that county. For example, if 180 days is used as the storage period, the worst

period of 180 days will be determined by the program. This analysis is based on the accumulative rainfall minus evaporation for each month. If the evaporation exceeds rainfall for any particular month, a net value not exceeding rainfall is used.(Unless the "awm.st2" file is changed to allow evaporation to exceed rainfall.) If everything works according to plan, the months that are determined to be the most critical will be displayed.

Design Period Rainfall (in.) - This value represents the accumulative monthly rainfall that can be expected over the critical period.

Design Period Evaporation (in.) - This value represents the amount of evaporation that normally occurs over the design period. When the program determines this value, monthly values that exceed rainfall amounts are reduced to the rainfall amount. In other words, for those months where the evaporation might exceed the rainfall, the rainfall for that month is used to represent the evaporation. This same philosophy should be used when the value are entered by hand. Basically this says, don't allow the evaporation for any one month to exceed the rainfall for that month. (Note: this process can be modified by changing the awm.st2 file).

25 yr. Rainfall (in.) - This value represents the worst 24 hour rainfall that can be statistically expected to fall in a 25 year period. This value will be retrieved by the program when a proper county is entered or it can normally be found in weather bureau publications or design manuals.

Type of Animals: - When the cursor is positioned on this entry area, a message will appear indicating that pressing F4 will change the animals. Pressing F4 will also cause a window to open that displays all of the animal type that are included in the program. The up and down arrow keys will scroll through the animal types. In addition to displaying the types of animals available, an opportunity to identify the number and weight of each type of animal is presented. These values should represent the **average** number and weight of each type of animal over the storage period that is being used for the system. Press "**Esc**" when all of the animal specifics have been entered.

Animal Days - Often times, groups of animals are rotated through a system. For example, feeder pigs are placed on a system for six months and then moved to a new site (perhaps market). Three months later another group is added to the system. Another situation might be where a dairy herd is on pasture for a portion of the design period. This entry provides a means to deal with these types of situations. The program will prorate the waste production rates to reflect these situations. It is important that the right number of days, number of animals and the proper average weight be included if one is to expect a reasonable design.

Additional Waste Water (gal/day) - Most systems receive additional water from various sources such as milk house wash water, leaking watering cups, etc. This entry should represent the best estimate of added volumes of this type in gallons per day.

Bedding (lbs./day) - Estimate the amount of bedding that is used on an average day. The volume that will be used from the storage system will be calculated

based on the effective density of the bedding. Pressing **F4** while the cursor is in this position will cause a window to open providing several optional types of bedding.

Feedlot/Watershed Area (sq. ft.) - Enter the area of all surfaces that will drain into the storage facility. These areas can generate large volumes of water, therefore it is desirable to intercept all areas that will shed clean water, such as roofs, and direct them around the facility. The amount of runoff from these areas will be adjusted by the value that is entered under "modify defaults". (see pg. 22)

Desired depth (ft.) - This entry represents the desired depth of the completed facility. The value should consider the type of facility, the soils involved and the equipment that will be used to load and unload the facility. It probably would not be wise to design a structure 12 feet deep if the pump used to clean it out can only reach 10 feet. (This entry will not be requested for a naturally aerated lagoon).

Sideslope - Sideslope is a value that represents the amount of run per foot of fall for the inside slopes of the storage facility. For example, an entry of 3 would indicate that the inside slope falls one foot in every three feet horizontal. Also, an entry of 3 will be displayed as 3.0:1.

Shape(C-cir,R-rec,O-oval) - Select the shape that is desired by entering "**C**" for a circular or round structure, "**R**" for a rectangular structure or "**O**" for an oval structure. Geometrically, an oval is actually two semi-circles connected by a straight section, similar to a racetrack.

One top dimension (ft.) - If a rectangular or oval shape is selected, the program will ask for one of the dimensions. In many cases this might be a controlled dimension such as the distance between two buildings or the distance between the feedlot and a property line or fence line. In the case of an oval structure, the entered dimension will always be the width and will also be the diameter of the semi-circle. If a value entered for an oval is large enough that a circular facility would satisfy the needs, the program will display a message indicating as much.

Freeboard - this entry introduces some additional safety to the design. Freeboard is the distance between the top of the stored waste and the lowest point in the top of the container.

Sludge Accum. Period (yrs.) - Sludge is a part of the digestive process and accumulates over the life of a lagoon. Sludge accumulation can be considered in all of the lagoon design procedures. The entry should represent the period of years that are to be included in the design. Guidance can be found in the design standards for lagoons.

Recycled Flush Water (gal/day) - One advantage of lagoons is that the liquid portions or supernatant, can be recycled and used to flush barns or gutters. Enter an estimate of the daily quantity that might be used on an average. While this value has no impact on the design of the containment facility, it may become important in the operation of the system.

Special Keys:

In addition to the normal “arrow” keys, “Page Up” and “Page Down”, several special purpose keys are available at various times in the program. A brief description of the function of these keys follows. Additional information on these keys can be found by using the **F1** key within the program. (It should be noted that the mouse will also simulate the arrow keys, the left button simulates the return key and the right button duplicates the escape key.)

¿ This is a very important key in that inputs are not registered to the program until the **"return"** (↵) key is pressed. Failing to press the "return" key might result in an error message or it might result in computations being made without the input you thought you had made. Remember to input the requested data and then **press return (¿)** before computing, printing or saving the data.

Esc The escape key is most often used to “back up” one action or level in the program. In other words, take you back from whence you cometh. For example, if you are in the data entry screen, "*Esc*" will take you back to the main AWM menu. If you are in the main AWM menu, "*Esc*" will afford you an opportunity to exit from the program.

F1 This function key will display help information if it is available. On some screens, you will be offered an option of selecting help for the particular entry where the cursor is, the entire screen or special keys.

F2 This key has been designated as the **"edit"** key. Pressing this key will afford you the opportunity to edit a previous entry or default value without completely retyping it. In this mode, the system shifts into an automatic "insert" mode and the left and right cursor keys and the backspace key, all become active. Once again, the return **(¿)** key will register your final entry.

F3 In some instances, pressing this key will cause a calculator to pop up on the screen. This is handy when you need to make a quick calculation. Pressing **F1** while the calculator is on the screen will cause a "help" window to appear that explains how to use the calculator.

F4 There are many instances when a message stating **"F4-Choice"** will appear at the bottom of the screen. This means that there is a choice list for making the proper choice for the issue under question. When this occurs, simply press F4, move to the desired selection and press the enter (↵) key.

F5 As indicated at the bottom of the screen, this key causes a design report to be printed. In addition, an O&M report can be developed based upon the files available to the system. (See page 24 for details) The O&M plan can be viewed on the screen, sent to the printer or sent to a file where it can be edited at a later time.

F6 If the size of the structure has been calculated, pressing the F6 key will cause a window to open and additional calculated values will be displayed for information. Review of these values might provide clues to adjustments that might be made to the input values in order to reach a desirable solution. Pressing the **F5** key while this information is displayed will cause the information to be printed on the default printer.

F8 After the calculations have been completed, F8 will guide the program directly to the waste utilization portions of the program.

F9 This function key causes the computation routines to be implemented. This key can be pressed any time a solution is desired. If there is not sufficient data for a successful computation, an applicable message will be displayed. New or changed values on the input screen will clear previous computations and the F9 key will again be needed when all of the changes have been made.

The design process is slightly different for the various storage types but there is a certain similarity as well. The basic process is as follows:

1. Begin with a set of assumed dimensions. Typically these will be relatively small.
2. Calculate the amount of waste that will be added to the system over the design period. This includes the animal waste, bedding, waste water, etc.
3. Determine the amount of rain (design period rainfall minus design period evaporation plus 25 yr. rainfall) that would fall on the facility.
4. Add the waste to the rainwater.
5. Calculate the volume available using the dimensions.
6. If the volume available exceeds the volume needed, accept the dimensions. If not, increment one of the dimensions and return to step 3.

F9(cont) Several error conditions can occur when the F9 key is pressed. The more common ones are reviewed below.

A message might indicate that there is insufficient data to compute. There is a certain list of elements that are required before a computation can be completed. For example, animals with an average weight or in some cases rainfall is necessary or if the selected shape is rectangular or oval, a width dimension is required. While the message is not explicit as to what data is missing, it is most often obvious. The table of items included with each type of system on page 7 might be of some assistance in identifying missing data. If a two stage system is being designed be aware of the parameters for the second stage. (see F10 below)

When a shallow depth is selected for some systems, it is possible that the rainfall depth might exceed the selected facility depth. It is fairly obvious that a solution can not be reached for this situation.

Occasionally a message will appear that indicates that the maximum number of trials has been exceeded. As indicated above, the design process assumes an initial size and then increments one of the dimensions until the facility becomes large enough to contain the required volumes. While this will always result in a solution, in some cases it might not be available until tomorrow. In order to avoid making you wait for what would probably be a ridiculous answer the system is forced to stop after a specified number of trials. Usually this occurs when a shallow depth or narrow width is used with a rather large system. (The number of trials is part of "awm.st2", see page 39.)

Following a successful computation, the results will be displayed at the bottom of the design screen (also see F6). The format of the display will vary with the type of system being used. The waste storage pond design can vary depending upon the data provided. Normally there will be nine sets of results displayed. They represent a variety of design period and depths. The design set specific to the requested design will be blinking. The other information are simply alternatives that are typically pursued by a landowner. If any entry for the days a particular animal is on the system differs from the design storage period, the optional designs will be reduce from nine to three. For example, if a system is designed for a years storage but heifers are on the system for only six months, the result will be three alternatives.

F10 This key is active on the two-stage lagoon design screen. Its purpose is to switch the screen so that the parameters for each stage can be entered. The stage that is currently active will be displayed towards the bottom of the screen.

Alt-S Simultaneously pressing the "Alt" and "S" keys on the design screen will cause a window to appear that relates to separation procedures. Each of these items are covered below. Lagoons that have a maximum total solids loading rate will often require separation.

Separate part of waste to another system (Y/N) - a "Y" response tells the program that you would like to separate portions of the waste so they do not all go into the system being designed. This provides some flexibility to the program but it also complicates some issues. If the separation option is used, the utilization portions of this program are disabled unless a laboratory analysis of the waste is available or estimated.

When "Y" is selected, a message will appear at the bottom of the design screen and on printed reports indicating that the separation process is being used. In addition, the following questions will appear on the separation window.

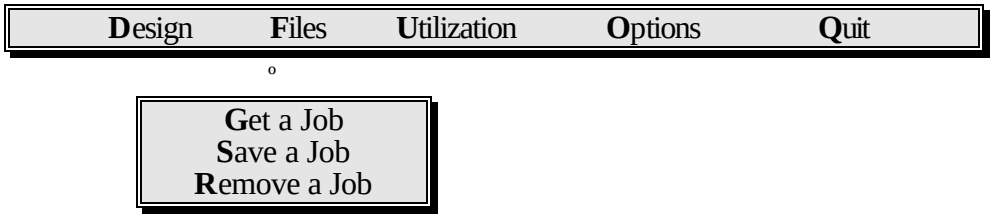
Percentage of solids in this system - enter the percentage of the solids that will be stored or processed in the system under consideration. All of the solids that are not included in this system will be basically unaccounted for and will need to be dealt with in a separate analysis.

Percentage of liquid in this system - enter the percentage of the liquid portion of the waste that will be dealt with in the system being designed.

Percentage of bedding in this system - same as above except this time we are dealing with the bedding.

Percentage of wastewater in this system - the wastewater includes only spilled drinking water, parlor water, wash water, etc. It does not include the rainfall or runoff water.

Percentage of separated to 2nd cell - this entry only appears when a multiple cell system is being designed. The intent of the entry is to attempt to capture the waste that was separated using the four options above. The percentage entered will apply only to the portion that was removed through separation. For example, if 50% of the waste was separated above and 50% was the response to this question, the result would be 25% of the total being sent to the second cell in the operation.



Data File Management:

Get a job:

This feature allows data that has been stored or saved on previous occasions, to be retrieved. A list of the data files that are available on the designated drive will be displayed. If your data is on a different drive or in a different subdirectory than the default, pressing **Alt C** will afford an opportunity to select an alternative drive and a new list of available files will appear. Cursor to the job that is desired and press return (↵) to retrieve the data.

Save a job:

This selection will solicit the information required to save the data for the job that is currently in computer memory. It is wise to visit this area frequently while a large job is being entered so that portions of your work are not lost. You never can tell when the lights might go out or someone might accidentally hit the reset button.

A screen will appear that identifies the data that is to be saved. Refer to the main guide for the Ohio Engineering programs for discussion related to the file naming procedures and assistance related to the information that is requested on this screen. The code used to identify AWM data in the file naming scenario is **"AWM"**.

Remove a job:

Many of us do not like to throw anything away but occasionally reality sets in and we concede to the need. There might be test jobs, old jobs or jobs that you don't want the boss to see that should be removed from the system. This selection works in a similar manner to retrieving data files. Once the desired file has been selected, you will be asked to confirm your request.

It is desirable to remove data files using this procedure rather than simply erasing them with DOS commands. This procedure also will properly manage other related files and do some minor housecleaning that the DOS procedures do not know about.

Utilization:

Design	**F**iles	**U**tilization -	**O**ptions	**Q**uit

This portion of the program deals with disposing of the waste after the facility is designed, constructed and used for a period of time. It is accessed by selection from the main menu or pressing F8 in the main design section. In either case, a design is required before the utilization analysis can be completed.

There are several situations when a message will appear indicating that the utilization portion of the program is not available. Two examples of when this will happen are:

- occasionally on smaller systems, the design process is satisfied by the minimum (startup) dimensions. In these cases the system is basically oversized and it is nearly impossible to estimate the concentration of nutrients that are in the system.

- in cases where the separation option was used and laboratory analysis is not available, the utilization process is disabled because some of the nutrient inputs are basically unaccounted for.

****** NOTE / WARNING ******

The values used by this program are based on the best estimates available for the type of system involved and are intended solely for planning purposes. Several of the lagoon designs include large volumes of water and space for sludge accumulation. This will result in waste that is much more dilute than will be the case in a mature system. The program assumes a mature system when calculating the nutrients available and as such the resulting nutrients might be totally misleading in the early years of the operation. For this reason, it is **imperative** that laboratory analyses be obtained for the waste, soils and crops that are involved in the final utilization planning process.

The utilization process covers four pages of inputs or displays. Each of these areas will be covered in detail in the following discussion.

System Details:

This portion of the program is designed to further explain the details of the system. The details that are expanded have a direct impact on the manner in which the available nutrients available are calculated and the methods that will be used to spread or dispose of the waste.

Nutrients available -

Pressing F4 on the first entry will present a list of various storage scenarios. The list will vary depending on whether the system is determined to be a liquid system or a solid system. The eventual choice will determine the nutrients available.

Bedded Building, regular spread
Manure Pack
Confined Housing, daily scraped
Open Paved Lot w/ storage
Outside Lot w/ stacking facility
Poultry - pit under cages
Below-ground storage tank
Above-ground storage tank
Pits, Tanks, Waste Storage Ponds
Anaerobic Lagoon (agitated)
Aerobic (Aerated) Lagoon

All of these choices, and any others that might be added, use values that are contained in "AWM.ST2" to adjust the nutrients originally generated by the animal based on the manner in which the waste is stored and handled.

Anaerobic Lagoon (supernatant) - uses values of nutrient amounts measured in the studies made by Clyde Barth. These values vary by animal type and are not included for all animals. These values would be the likely choice if the lagoon was not agitated prior to evacuation. This choice normally results in fewer required application acres as the waste is nearly all water.

Anaerobic Lagoon (w/ active sludge) - these values were determined as above except that in this case the lagoon was agitated so that the active sludge is included in the effluent. This choice will require more application acres as the waste includes the "good stuff".

Spreading Method -

Pressing F4 will once again provide a list of optional spreading methods. This selection will affect some of the nutrient losses related to handling. (basically injected or not) It will also determine the units that are used to describe the application.

- Irrigated waste will be calculated in inches applied.
- Hauled liquid waste will be calculated in gallons applied.
- Hauled solid waste will be calculated as bushels or tons applied.

Laboratory Analysis -

A "N" response indicates that no waste analysis is available and the program will continue with the assumptions and average values that are contained in the system. A "Y" response will offer the opportunity to enter the results for an actual laboratory analysis of the waste and these entries will be used.

Cropping Plan:

This section is where most of the work related to waste utilization is done. Most of the "what if" scenarios can be can be pursued from this screen. Crop varieties, acres and application rates can be adjusted and the impacts immediately realized.

When the screen first appears, a portion of the crops available will appear in a window in the upper portion. Additional crops are available by using the cursor keys and causing the data in the window to scroll. Data inputs and edits take place in this area. Below that will appear an accounting area where the initial volume and nutrients will be listed with those remaining in the system. The percentage of waste remaining in the system will be displayed at the bottom of the screen. As entries are made in the upper portion of the screen, their inputs are displayed in the lower portion.

Three columns of inputs are presented on this screen.

Yield - once the desired crop has been selected, enter the yield that is expected for this crop.

Acres - enter the number of acres that will be involved with this crop. The program will respond in one of two ways upon completion of this entry.

The preferred response is that an application rate is calculated based on the nutrient requirements of the crop. This analysis is based on the controlling nutrient that is listed next to the yield column. The quantity of waste necessary to provide these nutrients is computed and deducted from the available amounts and the updated results displayed at the bottom of the screen. At the same time, the amount of waste remaining (in percent) will be updated so that additional crops can be selected and all of the waste eventually used. (see F8 below)

***** Note *****

Calculations in this program are based on a controlling nutrient. This means that application rates are based on the selected nutrient. This **does not** preclude one of the other nutrients from being applied at rates exceeding crop usage rates. It is the user's responsibility to determine if other nutrients are being applied at excessive rates.

Should the acres entered be more than required to use the remaining waste, a message will appear indicating so. In this situation, new values will need to be entered until a satisfactory solution is reached. The object of "the game" is to enter a combination of crop yields and acres sufficient to use all of the available waste.

Application Rate - this value will be calculated if a yield value and acre value has been entered for the crop involved. From time to time situations will arise where the rate of application may need to be adjusted. For example, it might be desirable to apply the waste to more acreage. The rate of application can be changed but the new value can not be larger than the value computed. This procedure assures that waste is not applied at rates greater than the crops can use. (for the controlling nutrient)

Additional functions on cropping plan screen - there is some functionality on this screen that is not described on the bottom of the screen.

F5 - as indicated at the bottom of the screen, this key will cause a report to be printed. This report is titled "a waste utilization plan" and it contains a variety of information. A report of the crop data that was entered, some management information, some maintenance information and utilization details will all be included to varying detail.

Initially the destination of the report needs to be identified. It can be sent to the screen, the printer, or a file. My personal preference would be to send it to the screen where I could review it and then to a file where I could load it into a word processor and personalize it as I see fit. When the report is sent to a file it is saved as an ASCII file. This means that when it is loaded into a word processor, it will probably need to be formatted.

Once the destination has been identified, a list of available reports will be presented. These reports are "canned" documents that can be developed and edited to meet your particular needs. Management of these reports will be covered later on page 24.

F6 - when this key is pressed a window will appear that allows the controlling nutrient for the crop involved to be changed. Any changes will affect the calculations. Caution should be used in exercising this feature and the impacts of such changes should be completely understood. Some state laws determine the nutrient that should control.

F8 - this function will calculate the number of acres that are required to use the remaining waste in the system. This will eliminate much of the trial and error situations and determine real quickly whether enough land is available to utilize the waste or if other options need to be pursued.

Nutrient Totals:

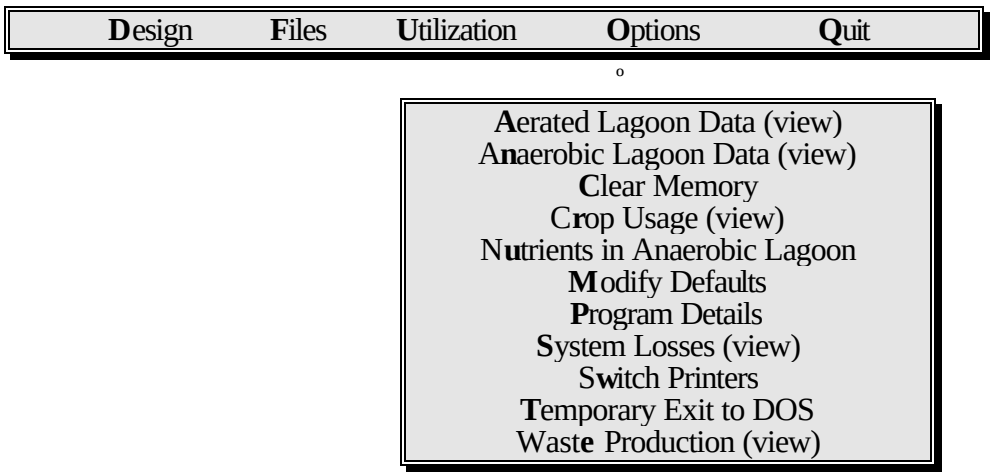
The upper portion of this screen will display the pounds of each nutrient that is being applied and used by each crop. By analyzing the values shown, a conclusion can be reached as to whether too much of one nutrient is being applied or how much supplemental fertilizer might be required to attain the yields requested.

The lower portion of the display will graphically display those times of the year when waste can be applied to fields containing the crops selected. This display can help in evaluating whether or not the selected storage period is adequate. (The adequate application times can be changed in "awm.st2")

Field Information:

This screen affords the opportunity to identify fields where waste will be applied and further select fields that might be sensitive to various problems. This sensitivity might be because of slope, flooding, closeness to neighbors, etc. Fields that are included on this screen can be included in plans or reports that are generated by the program. Details on generating these reports are covered on page 24.

Options:



The options selection from the main menu serves two basic functions. It is an information center and it contains several features or functions that help make this program easier to use.

Aerated Lagoon Data (view):

Provides a display of the parameters that are used in the design of an aerated lagoon. These values are also available in the standards and the Agricultural Waste Field Manual.

Anaerobic Lagoon Data (view):

Provides a display of the parameters that are used in the design of an anaerobic lagoon when the rational design method is used. These values are from the work of Clyde Barth and are the results of analysis of samples taken from several lagoons.

Clear memory:

If you get to the point that you have things so messed up that you would like to start over, this is the routine to use. It will give you a fresh start. Everything previously in memory will be gone after this operation. If there is a chance that you may change your mind, it might be wise to save the data before proceeding with this option.

Crop Usage (view):

This display tabulates the values that are used to represent the nutrients used by each of the crops that are available. The default controlling nutrients as well as the yield units for the crops available are also listed.

Nutrients in Anaerobic Lagoon:

Nutrients that are available in an anaerobic lagoon can be reviewed using this selection. These values are used when a rational design is selected and are also a result of the work of Clyde Barth.

Modify Defaults:

The purpose of this feature of the program is to provide a means of "customizing" the program so that it reacts in a manner consistent with the way you typically do business. The following information can all be overridden, for special cases, within the program. The information that you provide on this screen will be used initially by the program (default values).

Waste Storage Ponds / Lagoons:
- **default days of storage -**
- **default design depth -**
- **default freeboard -**
- **spreader size -**
- **loads per hour -**
- **pumping rate -**

Solid Storage Systems:
- **default days of storage -**
- **default design depth -**
- **default freeboard -**
- **spreader size -**
- **loads per hour -**

These entries are all defaults for the elements that are displayed. Defaults imply that these values will be used until they are manually changed. Values related to hauling or application are used for calculations and replaceable parameters in the report features.

Solid Storage Systems:
applied in B(ushels) or T(ons).-this entry controls whether the application rates for applying solid waste are based on bushels or tons.

Default sideslope for facility - provides the default value of the sideslope ratio of the inside of the storage structure.

Default design shape - controls the default shape. Set the shape to whatever is normally used in your office.

Default type of bedding - pressing F4 will provide a choice list of available beddings that can be used as a default.

Percentage of Waste to be used in Management Plan - this value will adjust the amount of waste that is used in the management plan. This might become an issue in situations where portions of the waste are sold or used on other property. The program applies the value entered to the nutrients that would normally be generated by the operation and proceeds with those values.

Should evaporation be considered (N/Y) - the response to this question will determine how the system treats evaporation. No will ignore evaporation considerations on the surface of the facility. A yes response will cause the program to evaluate each month during the design period. If the rainfall exceeds evaporation during the month, the difference in the values is used. If evaporation exceeds rainfall, a net value of zero is used unless the "awm.st2" file is modified..

Percent of Rainfall that runs off from feedlot - all of the rain that falls on a feedlot does not run off. For example, light summer showers are soaked up by the concrete or evaporate as fast as they fall. Winter months might result in snow blowing on or off of the feedlot. The value entered will adjust the runoff from feedlot to compensate for these facts. The adjustment will only affect the area identified as feedlot.

Default Sludge Accumulation Period (yrs) - enter the value that is typically used in your office. This value only affects lagoon designs. (This value has a major impact on the design as well as the nutrient analysis, so don't take this entry lightly.)

Program Details:

This selection will display some specifics related to the program including the date of the last revision or change. Many times there are subtle changes made to the program that do not merit changing the version number for the program. The date of these changes is normally available using this feature.

System Losses (view):

This selection will display the values that are used by the program to compute the losses encountered in the storage and handling of the waste.

Switch Printers:

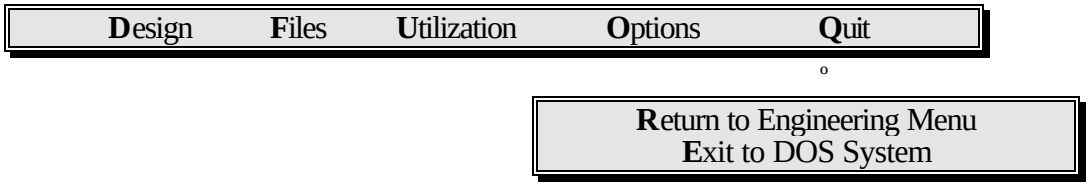
If two different printers are available on your computer system, this option will allow you to change the identity of the printer that the program uses. Basically, this action changes the value of the codes that control the manner in which the printer behaves. For example, the codes that cause the printer to print in compressed code, etc.

Temporary Exit to DOS:

Many times it would be nice or even necessary to execute a DOS command while in the program. As an example, you can't remember the subdirectory where your data is so you need to check several subdirectories or even diskettes. This option will quickly return to the system prompt and still keep your program and data in memory. When you are ready to return to the program, simply enter "exit". There is one important point to remember! Be certain that you have returned to the subdirectory that contains the engineering program before entering "exit".

Waste Production (view):

The daily production of waste and the nutrients that are generated by each of the animal types will be displayed using this selection. This is basically the information that is contained in the “animal.dat” file.



Quit:

The response to “quit” can generate several responses depending upon how your particular system is set up. If the main “engmenu.exe” file is available, you might be offered an option of returning to the Engineering Menu, exiting to the operating system (which could be the DOS prompt, windows, or the batch file that originally called the animal waste program) or going directly to one of several other engineering programs. If this “engmenu.exe” file does not exist, you will simply be asked to confirm that you really do want to quit.

In any case, you will be warned if unsaved data has been entered so that you will have at least two chances to accidentally lose your data.

Customizing Reports:

As mentioned earlier, this program utilizes exterior report files. The purpose of this feature is to provide a means of generating more personalized reports while still utilizing the advantages of automation. These reports can be written or modified using any word processor or ASCII text editor.

Two types of report are accessible by the program. The first is an operation and maintenance (O&M) report. This report normally outlines the way in which a system should be operated and cared for as well as some of the assumptions that might be affected by the manner in which the system is operated. There is one file for each type of system. They are and have to be named as follows:

HoldPond.O&M - Waste Storage Ponds
Tank.O&M - Tank Waste Storage Structure
Solid.O&M - Stacking Waste Storage Structure
Anaerob.O&M - Single Cell NAWMFH Anaerobic Lagoon
Barth_1.O&M - Single Cell Rational Design Anaerobic Lagoon
Barth_2.O&M - Double Cell Rational Design Anaerobic Lagoon
TwoStage.O&M - Double Cell NAWMFH Design Anaerobic Lagoon
AgSTAR.O&M - Biogas Optimized Lagoon Design
NatAerat.O&M - Naturally Aerated Lagoon
MecAerat.O&M - Mechanically Aerated Lagoon

If the system does not locate a file with the appropriate name, the O&M option of the printed report will be skipped. In cases where an O&M report is not desired, simply respond with a "N". If O&M reports are never desired, remove the files with "o&m" extensions or rename them. On the other hand, if they are desired and don't print, make certain that the file exists for that particular system, is properly named and resides in the same subdirectory as the main program.

A second report that is available relates to the utilization of the waste. There are three requirements that must be met for these files. They need to be saved in an ASCII format, the filename that they are saved in must have an "RPT" extension and the file has to saved in the same directory or subdirectory where the animal waste program resides. When the printing of the utilization plan is initiated, a choice of the "rpt" files will be presented. Several example files have been developed by the state agronomist and are included with the program. Others can be written and shared with other offices.

There is a list of replaceable parameters that can be included in all of these report files that will cause values or information from the design to be placed within the text of the report. These parameters are actually numbers and they must appear between a "less than" symbol with an asterisk and an asterisk with a "greater than" symbol in the report file. For example, if the program locates "**<*2*>**" in the text of the report that was selected, it will replace "<*2*>" with the total volume of storage in cubic feet, that was determined in the design process. This feature allows the reports to be tailored for the local situation and still allow the computer to place some of the job specific values into the report. Some of the fancy formatting features will not be available but the program will print out a very presentable report. If fancy is important, save the report to a file and reformat it with a good word processor.

A list of the replaceable parameters and their purpose follows.

Code	Replacement
<*1*>	total volume in the system expressed in gallons.
<*2*>	total volume in the system expressed cubic feet.
<*3*>	total volume in the system expressed in bushels.
<*4*>	number loads using a <*45*> gal spreader.
<*5*>	number of loads using a <*46*> bu spreader.
<*6*>	design depth of the facility.
<*7*>	hours based on <*48*> loads / hr and <*46*> bushel spreader.
<*8*>	hours based on <*47*> loads / hr and <*45*> gal spreader.
<*9*>	type of storage facility used (one of the following).

Waste Storage Pond
Tank - Waste Storage Structure Design
Stacking - Waste Storage Structure Design
Naturally Aerated Lagoon Design
Mechanically Aerated Lagoon Design
Single Cell Anaerobic Lagoon Design (AWMFH Method)
Single Cell Anaerobic Lagoon Design (Rational Method)
Single Cell Anaerobic Lagoon Design (Biogas Method)
Double Cell Anaerobic Lagoon Design (AWMFH Method)
Double Cell Anaerobic Lagoon Design (Rational Method)
Anaerobic Lagoon -> Storage Pond Design (AWMFH Method)
Anaerobic Lagoon -> Storage Pond Design (Biogas Method)

<*10*> ..... disposal plan selected (one of the following).

haul
haul & incorporate within 24 hrs
irrigate
irrigate & incorporate within 24 hrs
inject

<*11*>	max recommended irrigation rate in inches.
<*12*>	hours of pumping at <*49*> gal / min
<*13*>	minimum design volume expressed in gallons.
<*14*>	minimum design volume in cu ft
<*15,#*>	insert # underlined spaces.
<*16*>	pounds of bedding used each day.
<*17*>	type of bedding used.
<*18*>	depth of facility when 1/2 of total volume is used.
<*19*>	depth of facility when 3/4 of total volume is used.
<*20*>	field(s) + data entered under “Fields that will be receiving waste”.
<*21*>	field(s) + data entered under “Fields that would create a problem if the ground were frozen or snow covered”.
<*22*>	field(s) + data entered under “Cropland fields that are steeper than 15%”.
<*23*>	field(s) + data entered under “Pasture fields that are steeper than 20%”.
<*24*>	field(s) + data entered under “Fields that are subjected to flooding”.
<*25*>	field(s) + data entered under “Fields that are particularly sensitive to pollution/nuisance concerns”.

<*30*> ..... volume of recycled water in gal/day.
<*31*> ..... total volume of first stage of lagoon in gallons.
<*32*> ..... total volume of second stage of lagoon in gallons.
<*33*> ..... minimum treatment volume of first stage in gallons.
<*34*> ..... minimum treatment volume of second stage in gallons.
<*35*> ..... gallons per minute to accomplish first stage minimum treatment volume in 60 days.
<*36*> ..... gallons per minute to accomplish second stage minimum treatment volume in 60 days.
<*37*> ..... depth of first stage minimum treatment volume.

<*39*> ..... odor control volume of first stage in gallons.
<*40*> ..... depth of first stage odor control volume.
<*41*> ..... gallons per minute required to increase from minimum treatment volume to odor control volume within on year of initial loading.
<*42*> ..... annual dewatering volume in gallons.
<*43*> ..... dewatering drawdown depth.
<*44*> ..... hours required to dewater at <*49*> gallon per minute.
<*45*> ..... size of liquid spreader in gallons
<*46*> ..... size of solid spreader in bushels
<*47*> ..... loads per hour - liquid spreader
<*48*> ..... loads per hour - solid spreader
<*49*> ..... pumping rate in gal per minute

<*90,#*> ..... increases the left margin by the value of #
<*91*> ..... sets printer to “double strike” mode.
<*92*> ..... cancels “double strike” mode.
<*93*> ..... sets printer in “superscript” mode.
<*94*> ..... cancels “superscript” mode.
<*95*> ..... sets printer in “subscript” mode.
<*96*> ..... cancels “subscript” mode.
<*97*> ..... inserts a line feed (carriage return)
<*98*> ..... inserts a form feed (new page)

Messages:

Several messages appear from time to time while using the program. Following are some of these messages and discussion as to why they appear.

> I currently have no information related to the amount of nutrients that might be available from a `biogas' design and I am not completely certain of the amount of material available to apply. One option that is available to you is to indicate that you have a lab analysis and estimate the nutrients available.
>
> Press Any Key to Continue !!

This design procedure, which is commonly referred to as the "AgStar" method or the "methane optimization method, is relatively new. Solids are typically controlled using a separation procedure and the systems have a unique management technique. For these reasons, there are very few records available as to the nutrients that might be available from such a system and no such data has been made available to the program. Therefore, access to the utilization portion of the program is denied unless you have a lab analysis of the waste or you simulate a lab analysis and provide the data to the program.

> By using the `separation' option, I have lost track of the nutrients that might be available from this design. If you feel that you can make a reasonable estimate of the nutrients available, one option that will allow the utilization to function is to indicate that a lab analysis is available and enter your estimates.
>
> Press Any Key to Continue !!

By opting to separate the waste, it becomes very difficult to estimate the nutrients that might be available when the system is finally placed into operation. Some wastes might be stored as a solid and incur one set of storage losses while the liquid might be stored in a totally different manner with a totally different set of loss parameters. It would be risky at best to attempt an estimate of the nutrients that might be generated by such a system and the program will not proceed into the utilization portion unless a laboratory analysis of the was is provided.

I have no waste to manage - Design must be first !!

This message is displayed when an attempt to use the utilization features is made without first designing a storage system. Much of the information that is used in the utilization plan is derived in the design process and therefore the design must be completed before the utilization features become available.

This solution was satisfied by my minimum values and is therefore, likely oversized. Because of this fact, I cannot provide a valid nutrient evaluation. Sorry, maybe I can help next time.
Press any key to Continue

The procedure used to size a container to store the waste is to start with a relatively small container that is based on the shape, depth and sideslope that the user selects. The program then proceeds to enlarge the container until it becomes slightly larger that it needs be to contain the waste. Occasionally on small operations, the "relatively small" container is larger than need be. In other words, the system is oversized to some unknown degree. This causes the subsequent nutrient analysis to be out of whack and therefore the utilization feature is locked out. A possible solution would be to select a shallower depth, a steeper sideslope or a shorter storage time which will cause the initial size to be inadequate and the procedure can work.

Insufficient data to compute.

Missing input data will cause this message to appear when a computation is called for. Obvious items would be no animals or animals with no average weight. Less conspicuous things might include rainfall amounts, lagoon loading rates or the width dimension of a rectangular or oval shape. The table on page 7 indicates the values that are expected.

This data has already been computed.

If data has not changed since the last time a system was designed (computed) pressing the "F9-Compute" key will cause this message to appear. It's original intent was to keep the user from inadvertantly having to wait for a slower computer to calculate unnecessarily.

Top not wide enough to construct, compute aborted.

The "awm.st2" file contains a value that is labeled the minimum constructable bottom dimension. When rectangular or oval shapes are selected, the user is asked to provide a "controlling" top width. If during the computations it is determined that the sideslopes, depth and top width selected result in a bottom width that is less than the minimum value, the above message will appear and the computation process will be aborted.

I have more rainfall than design depth, compute aborted.

For shallow facilities, it is possible for the annual rainfall to be greater than the depth of the facility. In this situation, the computer would continue making the facility larger and would not be able to reach a solution until the entire earth were devoured. Since I like my house where it is, this message is displayed to indicate that at least in this situation, I have control.

This width is too large for an oval shape!!

In the sense of "pure" geometry, the oval shape in this program is not truly an oval. Instead, it is two semicircles connected by a rectangle. The top width that the user enters, becomes the diameter of the semicircle. Should the user enter a top width large enough that the two semicircles will contain the necessary waste without the rectangular section, the above message will appear. Should this occur, the option is to use a smaller top width or to select the circular shape.

The days entered is less than some of the animal days!! Should I adjust the animal days?

Animal days are the number of days that a particular animal group is using the facility. During initial entry, this value is not permitted to be less than the storage period that the system is to be designed for. If the user returns to storage period and enters a value that is smaller than any one of the animal days values, this message will appear when the computation process is initiated (F9). This makes sense in that you can not have animals contributing waste for more days than the system is designed for. If the user responds with a "yes", the program will automatically adjust all the troublesome animal day values to the value selected for the storage period. A "no"

response will cause the program to return to the design screen without a solution and wait for the user to make the necessary adjustments.

Climate related data has changed from that on file !! Should I replace the current data with that on file ?

All of the climate related data is retrieved from a file named "climate.dat" based on the county name. This data includes rainfall, evaporation rates, and lagoon loading parameters. The program will also allow the user to enter their own values. The first time that the return key is pressed on the county name or any time the county name is changed, the program will search the "climate.dat" file and determine if the values displayed on the screen are the same as those contained in the file. If there is a discrepancy, the above message will appear and the user will have an option of using the data as displayed on the screen (No) or replacing it with that contained in the "climate.dat" file (Yes).

>> Length to Width ratio of ##.#:1 could create management problems. <<

The "awm.st2" file contains an entry that relates to the desired length to width ratio for lagoons. The idea is that the biological activity diminishes if the structure becomes much longer than its width because of uneven loading. This message will indicate that this ratio has been exceeded. It is presented simply as a warning and the program will continue even though this situation exists.

There is a problem with <*##*> in your report !!

There are several so called "replaceable parameters" that allow computed values from the program to be extracted and used with in a user written report or to provide formatting features for the report. The replaceable parameters must be identified in a very specific manner. They are all represented by a number (##) place between the less than and greater than symbols and asterisks (<* ## *>). If any of these symbols are omitted, the above message will be displayed when and attempt is made to generate the report.

This program is supported by a file named **`animal.dat'.** I have been unsuccessful in locating this file on the default drive. Without the information contained in this file, I can not proceed. Check with your support staff or the user guide for assistance in resolving this problem." Press Any Key to Continue !!

All of the information related to the waste production, amount of solids, nutrient content, etc. for all of the various animals is contained within a specially formatted file titled “animal.dat”. If this file does not exist on the default drive, the above message will appear when the program is first initiated. The program will run, however, with a corrupt “animal.dat” file. If there are no animal types displayed on the design screen when F4 is pressed or if some of the data seems bogus, this could be the case. It is a good idea to keep the original version of this file secure for these instances.

You have attempted to use MORE waste than there IS !!

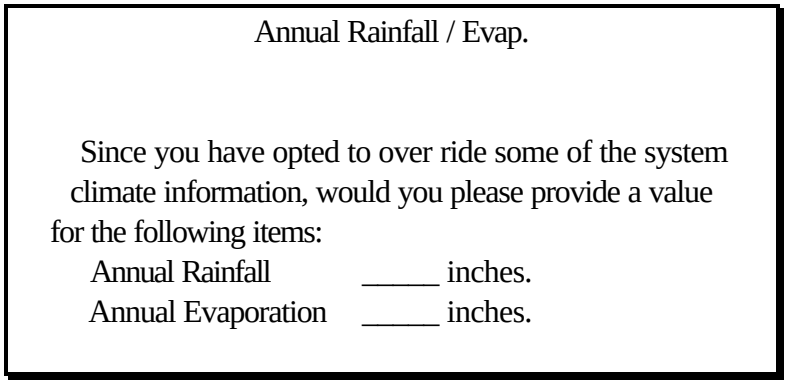
One of the options on the crop screen, is to enter a desired yield and acreage of several crops and the program will calculate the amount of waste necessary to generate that particular yield. If the amount calculated exceeds the amount that is remaining in the storage, the above message will appear. (A tolerance percentage that controls over useage and under useage is contained in the “awm.st2” file.) Once the message has appeared, the acreage or yield goal can be lowered or the F8 key can be used to calculate the maximum acreage for that particular yield.

> The maximum allowable amount of total solids has been exceeded!
>
> The maximum allowable is 2%.
> The computed value is .....12.12%.
>
> Use the separation procedure (AltS) or add water to reduce the concentration of solids entering the system.
>
> Press any key to Continue !!

The biogas collection systems have a maximum suggested solids loading rate.(Also contained in "awm.st2") If this rate is exceeded, the above message will be displayed and the user can use the Alt-S alternative to reduce the amount of solids to an acceptable level.

> Portions of this design have been satisfied using minimum design parameters. This normally results in a system that is over designed or over sized. Please review the results to assure that the landowners needs are adequately met.
>
> Press any key to Continue !!

As has been mentioned on several occasions previously, this program begins the sizing calculations with an initial set of dimensions. Certain of these dimensions are increased during the computation process until the resulting facility is more than adequate to contain the expected wastes. In some cases the situation can be satisfied using these initial values. In these instances, there is assurance that the facility is capable of containing the desired materials but there is also a good possibility that the facility is larger that need be. One good way to evaluate these situations is to use the "F6-Additional Data" feature while on the design screen. By comparing the needed volume with the available volume, the user can get a handle on the degree of "overdesign".



There are several situations when the climate information is changed. It happens when the county name is misspelled or doesn't exist in the *"climate.dat"* data file causing the user to enter the data or when the data that is retrieved is overwritten by the user. If the waste system is designed for other than a complete year and the climate information is different than that in the data file, the program will ask for the amount of annual rainfall and the annual evaporation. This information is necessary in order to estimate the amount of waste that will be handled in the course of a full year. In previous versions of the program, the waste was uniformly prorated over the year. It has been noted that in some areas of the country, this procedure can generate substantial error and therefore this new method was added. It is worthy to note that changing the lagoon loading rates will also trigger this action.

*** Technical Information ***

Equations used in Computations:

There are two basic equation used throughout the program to calculate the volume capabilities of the systems. They are described below:

Circular Structure:

$$Vol = 1/3 \cdot \left(A_1 + A_2 + \sqrt{A_1 \cdot A_2} \right) \cdot h$$

Where:

Vol = the volume of the circular hole (frustrum of a cone) in ft^3.
A_1 = the area of the bottom in ft^2.
A_2 = the area of the top in ft^2.
h = the distance between the top and bottom or depth in ft.

Rectangular Structure:

$$Vol = h/6 \cdot \left(A_1 + A_2 + 4 \cdot A_m \right)$$

Where:

Vol = the volume of the rectangular hole (prismoid) in ft^3.
A_1 = the area of the bottom in ft^2.
A_2 = the area of the top in ft^2.
A_m = the area of the mid-section (@ 1/2 the depth) in ft^2.
h = the distance between the top and bottom or depth in ft.

Rainfall / Evaporation / Runoff Computations:

$$Vol = Feedlot_{Runoff} + Feedlot_{25} + Surface_{Rain-Evap} + Surface_{25}$$

Where

Feedlot $_{Runoff}$ equals the feedlot area times the storage period rainfall times a percentage that represents the amount of annual rainfall that typically runs off of a feedlot. Estimates of this percentage can be found in the National Agricultural Waste Management Field Handook for paved and unpaved feedlots.

Feedlot $_{25}$ equals one hundred percent of the 25 year, 24 hour rainfall event from the feedlot.

Surface $_{Rain - Evap}$ equals the storage period rainfall minus the average evaporation over the surface of the structure.

Surface $_{25}$ equals one hundred percent of the 25 year, 24 hour rainfall event over the surface of the structure.

Format of Data Files:

The following information is provided for those of you who like to dig into the program files and figure out how they work or possibly make some sneaky edits to the data. The list below is a typical saved data file. Each line is followed by a line(s) contained in brackets ([]) that explain the line above. These "bracketed" lines will not be found in an actual data file. Some spaces have been added below to make it easier to read. **Keep in mind** that the quote and comma symbols are **very important** to the program.

```
“Format 1.2"     [ tells the program what form to expect the data in]
“Landowner .....","Sample Data Save"
"County .....","Medina"
"Designer .....","cwl"
"Type of System .....",1
"Days of storage(liquid) .....",365
“Days of storage(solid) .....“,90
"Annual Rainfall .....",37
"Design rain .....",37
"Design evaporation .....",26.8
"First month of critical rain .....",1
"Last month of critical rain .....",1
"25 Yr. - 24 hr rainfall .....",3.9
"Kval (for Barth Lagoon Dsng).....",.55
"Rain data was entered .....",0
"Additional Waste Water .....",100
"Re-cycled Flush Water .....",0
"Pounds of bedding .....",110
"Type of bedding .....","Nonlegume hay (loose)"
"Feedlot Area (SqFt) .....",120
"Sludge Accumulation Period .....",20
"Solid Waste Unit (1=B;2=T) .....",1
"Percent of Waste to Plan .....",100
"Consider Evap. (1=N;2=Y) .....",2
"Percent of Feedlot Runoff .....",50
“Design Depth (solid) .....“,4.5
"Design Depth(s) .....",10,10  [ second value for second stage of two-stage lagoon]
"Design Sideslope(s) .....",2,2
"Shape 1=round, 2=oval, 3=rec.....",1,1
"Top Dimension(s) .....",0,0
“Freeboard Used (liquid).....“,1,1
“Freeboard Used (solid) .....“,.5
"Anaerobic lag. loading rate .....",4.5
"Aerobic lag. loading rate .....",34.8
"AgSTAR hydr. retention time .....",47.6
"Partial Separation (0=Y,1=N) .....",0
```

(more on next page)

"% of Solids if Separation .....",0
"% of Liquid if Separation .....",0
"% of Bedding if Separation .....",0
"% of WasteWater if Separate .....",0
"% of Total if Separate .....",0
"Annual rainfall used ..... ",78.2
"Annual evaporation used ..... ",48
"Size of liquid spreader (gallons) used ..... ",3000
"Size of solid spreader (bushels) used .....",200
"Loads per Hour (liquid) used ..... ",4
"Loads per Hour (solid) used ..... ",3
"Pumping Rate (irrigation) used ..... ",500
"Type of Storage Facility .....","Pits, Tanks, Waste storage Ponds"
"Method of Application .....","irrigate"
"Lab Analysis 0=No, 1=Yes .....",0
"Available N (#/1000 gal) .....",4.475507
"Available P2O5 (#/1000 gal). .....",8.578054
"Available K2O (#/1000 gal) .....",12.6806

"Type of Animal	Number Ave	Weight	Days"
"Dairy, Dry .....",	100,	1000,	365
"Dairy, Heifer .....",	20,	750,	180

"EndOfAnimals"

" Type of Crop	Controlling Nutrient"	Acres	Yield	Applic Rate	User Selected Rate"
"Corn Grain .....",	"P",	91,	100,	391.5489,	0
"Corn Stover .....",	"N",	5,	125,	0.0000,	0

"EndOfCrops"
"Fields receiving waste .....","
"Fields with frozen ground problems .....","
"Fields with steep cropland .....","
"Fields with steep pasture .....","
"Fields with flooding potential .....","
"Fields requiring buffer areas .....","

Supporting Files:

AWM.STD

The following is an example of the data that is contained in the file named "*awm.std*". This data is maintained using the "Modify Defaults" option and any changes that are made will be saved in this file.

```
"*Default days for liquid storage ..... *",365
"*Default days for solid storage ..... *",90
"*Default depth for liquid storage facility ..... *",10
"*Default depth for solid storage system ..... *",4
"*Default freeboard liquid system ..... *",1
"*Default freeboard solid system ..... *",.5
"*Reduction of Runoff From Feedlots in Percent ..... *",50
"*Default shape of Liquid facility (1=C,2=O,3-R) ..... *",1
"*Default shape of Solid facility (1=C,2=O,3-R) ..... *",3
"*Default sideslope of Liquid storage facility ..... *",2
"*Default sideslope of Solid storage facility ..... *",0
"*Sludge Accumulation Period (yrs) ..... *",20
"*B(ushels) or T(ons) per acre (1=B;2=T) ..... *",2
"*Percent of waste included in management plan ..... *",100
"*Size of liquid spreader (gallons) ..... *",3000
"*Size of solid spreader (bushels) ..... *",200
"*Loads per Hour (Liquid) ..... *",4
"*Loads per Hour (Solid) ..... *",3
"*Pumping Rate (irrigation) ..... *",500
```

AWM.ST2

The following is an example of the data that is contained in the file named *"awm.st2"*. This data basically drives the animal waste management program. The purpose of maintaining the data in such a file is that it can be modified when and if a need arises. This can be accomplished using a text editor. It is **very important** that the format and integrity of the file be maintained (commas, quotes, sometimes even spaces). It is strongly recommended that an original copy of the file be maintained prior to attempting any changes. If the program behaves strangely following modifications to this file, you can always fall back on the original version.

```
"*Program Identifier ..... *","OH-Ver 2.21"
"*Date of last revision to the program ..... *","9/1/95"
"*Conversion from Tons to Bushels ..... *", 29.4
"*Maximum weight of an animal ..... *", 3000
"*Maximum number of animals per type (5 digits max) ..... *", 99999
"*Maximum water added per day (6 digits max) ..... *", 999999
"*Maximum size of feedlot in sq. ft. (5 digits max) ..... *", 99999
"*Maximum pounds of bedding per day. (4 digits max) ..... *", 999
"*Maximum design depth ..... *", 20
"*Maximum sideslope (flattest) ..... *", 10
"*Maximum number of acres of each crop (5 digits max) ..... *", 9999
"*Maximum yield for all crops (4 digits) ..... *", 400
"*Maximum top width dimension (rectangular or oval) ..... *", 300
"*Minimum constructable bottom dimension ..... *", 9
"*Maximum recommended irrig. rate (reports only) ..... *","0.5"
"*Minimum depth for Anaerobic Lagoon ..... *", 6
"*Minimum depth for Naturally Aerated Lagoon ..... *", 3
"*Maximum depth for Naturally Aerated Lagoon ..... *", 5
"*Increase in loading when using HRT procedure ..... *", 1.5
"*Loading rate for Mechanical Aeration (cf vol/# BOD5) ..... *", 200
"*Portion of volatile solids passed to second cell ..... *", .25
"*Maximum Volatile Solids in AgSTAR design (percent) ..... *", 20
"*Minimum depth allowed for an AgSTAR design ..... *", 12
"*Maximum length to width ratio for lagoon design ..... *", 5
"*Increment value used for adjusting depth of lagoons ..... *", .1
"*Increment value used for adjusting radius ..... *", 1
"*Increment value used for adjusting length ..... *", 1
"*Tolerance of applying more than available (in percent)..... *", 2
"*Tolerance of acceptable remaining volume (in percent) ..... *", 2
"*Is monthly evap allowed to exceed monthly rainfall ? ..... *", 0
"*Maximum number of trials in any one computation ..... *", 1000
"*Number of days in first optional design (30 min.) ..... *", 180
"*Number of days in second optional design (30 min.) ..... *", 270
```

AWM.ST2 cont.

"* Number of Crop Types in the following table .....*", 15

Crop Type	Yield Units	Controlling Nutrient	Lbs Used / Ac.			Disposal Weeks			
			N	P_2O_5	K_2O	Week to Week		Week to Week	
"Alfalfa "	"Tons"	"P"	56.60	13.30	60.00	14	50	52	52
"Cool Season Grass "	"Tons"	"P"	40.00	12.86	50.00	14	50	52	52
"Corn Grain "	"Bu."	"P"	0.90	0.37	0.27	14	18	45	50
"Corn Stover "	"Bu."	"P"	1.57	0.53	1.33	14	18	45	50
"Corn Silage "	"Tons"	"P"	9.00	3.10	9.00	14	20	40	50
"Forage Legumes "	"Tons"	"P"	57.00	13.00	60.00	27	50	52	52
"Oats (grain only) "	"Bu."	"P"	0.65	0.25	0.20	14	18	52	52
"Oats and Straw "	"Bu."	"P"	1.00	0.40	1.20	14	18	52	52
"Rye "	"Tons"	"P"	10.50	4.55	16.00	14	18	52	52
"Sorghum Grain "	"Tons"	"P"	27.60	7.89	7.89	14	19	40	42
"Sorghum Stover "	"Tons"	"P"	21.00	13.20	60.50	14	19	40	42
"Soybeans "	"Bu."	"P"	3.80	0.80	1.40	14	19	40	42
"Sugar Beet - Roots "	"Tons"	"P"	4.00	2.00	10.00	14	18	40	50
"Tobacco Leaf "	"Tons"	"P"	70.00	16.70	123.30	10	17	31	48
"Wheat (grain only) "	"Bu."	"P"	1.27	0.64	0.36	31	50	52	52
"Wheat and Straw "	"Bu."	"P"	1.82	0.73	1.27	31	50	52	52

(The above values represent the beginning and ending week of the "window of opportunity" for land application of waste. Two windows can be defined. A set with equal value represent a "closed" window.)

"* Types of bedding in the following table *", 16

"*		Eff *"
"*	Lb/CuFt	Lb/CuFt*"
"Cornstalks (shredded)" ,	4.50 ,	11.25
"Ground Limestone" ,	95.00 ,	95.00
"Legume hay (loose)" ,	4.25 ,	8.50
"Legume hay (chopped)" ,	6.50 ,	13.00
"Nonlegume hay (loose)" ,	4.00 ,	8.00
"Nonlegume hay (chopped)" ,	6.00 ,	12.00
"Sand" ,	105.00 ,	105.00
"SawDust / Shavings" ,	10.50 ,	15.75
"Soil" ,	75.00 ,	75.00
"Straw (loose)" ,	2.50 ,	5.00
"Straw (baled)" ,	4.50 ,	9.00
"Straw (chopped)" ,	7.00 ,	14.00
"Straw - Wheat (baled)" ,	6.00 ,	13.20
"Straw - Oats (baled)" ,	7.50 ,	18.75
"Wood Chips" ,	9.00 ,	18.00
"Wood Shavings" ,	9.00 ,	18.00

AWM.ST2 cont.

```
"* Number of Solid facilities and Nutrients Remaining After Handling in following table *", 6
"*                                    Surface Inject*"
"*                                N          N        P2O5    K2O *"
"Bedded Building, regular spread",  60,     67.35,      100,    100
"Manure Pack",                      70,     85.75,      100,    100
"Confined Housing, daily scraped",  75,     91.88,      100,    100
"Open Paved Lot w/ storage",        50,     61.25,      100,    100
"Outside Lot w/ stacking facility", 22,     28.00,       70,     75
"Poultry - pit under cages",        75,     91.88,      100,    100

"* Number of Liquid facilities and Nutrients Remaining After Handling in following table *", 5
"Below-ground storage tank",        77,     94.00,      100,    100
"Above-ground storage tank",        80,     98.00,      100,    100
"Pits, Tanks, Waste storage Ponds", 60,     67.35,      100,    100
"Anaerobic Lagoon (agitated)",      20,     24.50,       50,     60
"Aerobic (Aerated) Lagoon",         60,     67.35,       70,     75

"* Number of lines of Organic N Available from Previous Applications in following table *", 10
        "*Yrs Ago       % N *"
              1,          5.0
              2,          4.7
              3,          4.5
              4,          4.3
              5,          4.1
              6,          3.9
              7,          3.7
              8,          3.6
              9,          3.4
             10,          3.2
"* Show nitrogen losses due to application *", 1
"       Losses that are incurred during application are not included"
"       in the above values.  Available N can be estimated based on"
"       the time of application using the following table."
"                                                   “
"           July - Oct. ..... (not incorporated) .... 25%"
"           Nov. - June .... (not incorporated) .... 30%"
"           Sept.- Oct. ..... (incorporated) ..... 30%"
"           Nov. - April .... (incorporated) ..... 40%"
"           April - Aug. .... (incorporated) ..... 50%"
```