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# Appendix C FarmWare User's Manual

## Version 3.0

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### CHAPTER 1.0: INTRODUCTION

Welcome to AgSTAR FarmWare, a computerized decision support system that determines whether a methane recovery facility can be integrated into your farm's existing or planned manure management system. FarmWare estimates how much the methane recovery system will cost and the financial benefits that may be gained by producing energy for on-farm use.

#### *Installing the FarmWare Software*

Before you begin working with FarmWare, make sure you have the correct equipment to run the program, and read through the rest of this section to be sure you have a clear understanding of the installation procedure.

#### **Required Equipment**

- An IBM compatible computer with a Pentium processor and at least 128MB RAM (256MB RAM is recommended);
- Windows 98 or later; and
- Hard disk with at least 50 MB of space available.

#### **Recommended Equipment**

- **Monitor Resolution:** FarmWare operates at a screen resolution of 800 x 600 or greater.
- **Mouse:** FarmWare requires a mouse to operate the menus and screens.
- **Printer:** You will require a printer if you wish to print reports. FarmWare reports are formatted for black and white printing.

#### **Installation Instructions**

To install FarmWare on your computer, follow the instructions below:

- 1) Copy the installation file from the FarmWare CD or from the EPA AgStar web page:  
<http://www.epa.gov/agstar/library/handbook.htm>
- 2) Double click the installation file named "SetupFW3.exe"
- 3) Follow the instructions during the installation process.

#### **To Run FarmWare**

FarmWare appears as an option in your programs menu. To run FarmWare, double click on the FarmWare icon in your programs list.

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### CHAPTER 2.0: OVERVIEW OF FARMWARE v. 3

If you were a FarmWare v.2 user, you will notice some changes in FarmWare v.3. FarmWare v.3 contains the same options and general information, however, the user interface has been updated, and the Interview portion of the application was removed. Additionally, FarmWare v.3 presents environmental benefits associated with the use of biogas recovery waste management. Finally, FarmWare v.3 contains an option to simultaneously model costs for a “baseline waste management system” that does not contain a biogas recovery system as well as a “biogas recovery waste management system”. This allows the user to immediately compare the costs and benefits associated with biogas recovery against an existing or planned baseline system.

#### 2.1 Introductory Screen

Upon opening FarmWare v.3, the Welcome Screen appears which provides the user with the option to view the “Getting Started” help screen or to proceed directly to the analysis.

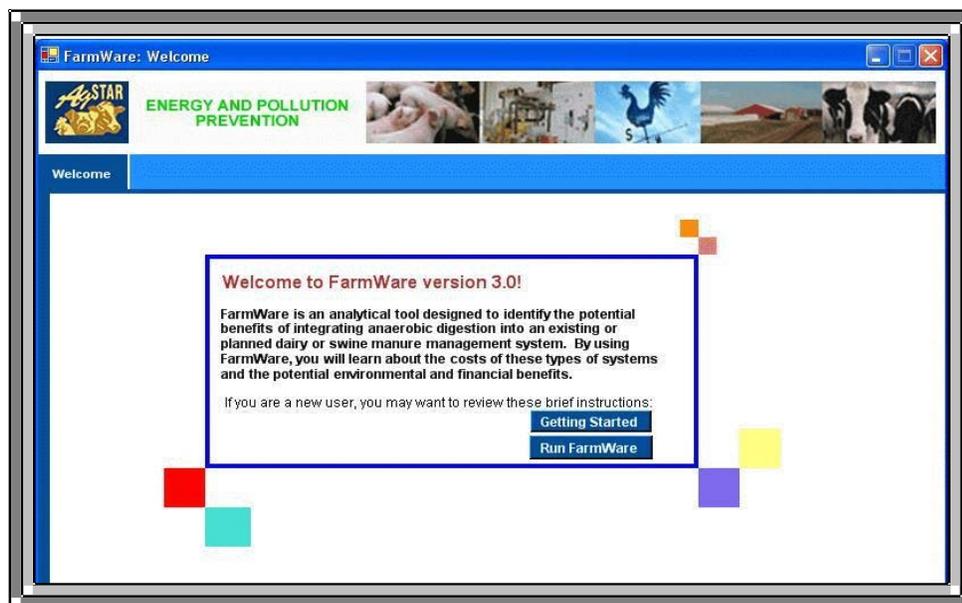


Figure 2.1: Welcome Screen

The “Getting Started” screen presents a very brief overview of the application and its potential utility to the user. The “User Interface” screen appears after you select “Run FarmWare” from either the “Welcome Screen” or the “Getting Started” screen.

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### 2.2 User Interface

FarmWare is configured so that the user can view each step of the analysis as tabs at the top of the working screen. There are eight tabs corresponding to eight general steps of the analysis:

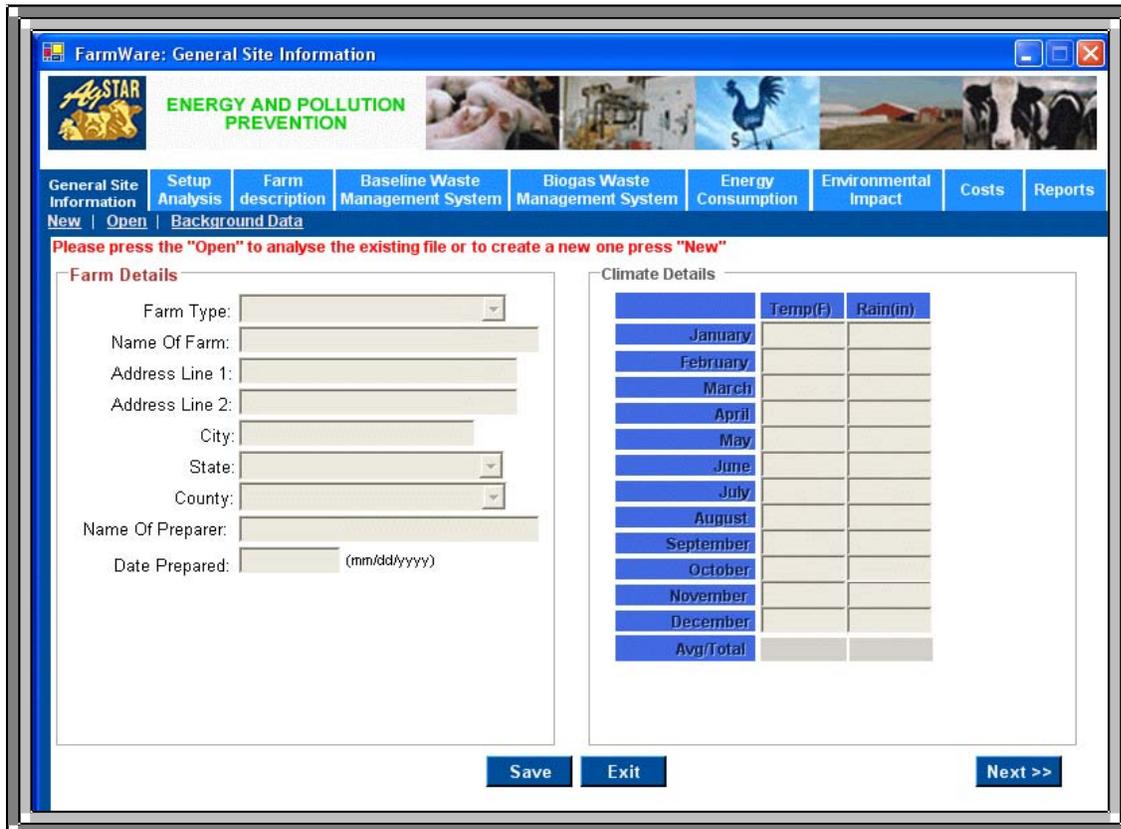


Figure 2.2: User Interface

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- 1) General Site Information: Allows the user to select an existing analysis to edit or view, or to perform a new analysis. Requests identifying information about the farm.
- 2) Setup Analysis: Requests basic housing and waste management information.
- 3) Farm Description: Requests specific information on the type of animals and manure distribution at the farm.
- 4) Baseline WMS: Presents a flow chart of your waste management system, with access to edit information about water use and collection frequency of each WMS component.
- 5) Biogas WMS: Presents a flow chart of your selected biogas recovery waste management treatment train, with access to edit information about water use and collection frequency of each WMS component.
- 6) Energy Consumption: Requests information regarding your current energy use for the past 12 months.
- 7) Environmental Impact: Presents a matrix of the potential environmental benefits of using biogas recovery compared to your baseline system.
- 8) Reports: Provides access to view and print four reports generated by the data collected in the analysis: the Quick Report, Energy Balance, Detailed Costs, Environmental Issues, and the Summary Report.

Chapters 3 through 8 of this Users Guide provide details on the function of each of these screens.

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### 2.3 Data Needed to Complete an Analysis

Before beginning your new FarmWare session, you should ensure that you have the following items readily available:

#### Information Required for Completing FarmWare Analysis

- ✓ How would you classify your farm operation:
  - Dairy
  - Replacement Heifer
  - Swine - farrow-to-finish
  - Swine - farrowing
  - Swine - nursery
  - Swine - farrow and nursery
  - Swine - grow-finish
- ✓ Address and contact information for the farm
- ✓ How many animals do you have of each age?
- ✓ How are your animals housed? For how many hours per day?
- ✓ How do you manage liquid waste?

The AgStar Manual provides dairy and swine farm evaluation forms to assist in the collection of these data. Additionally, you may want to know the following information so that you can modify the default assumptions that FarmWare supplies:

#### Optional Information for Completing FarmWare Analysis

- ✓ How much fresh water is used per day in each housing center for waste management?
- ✓ How much recycled water is used per day in each housing center?
- ✓ How frequently is solid or semi-solid manure collected?
- ✓ What type of solid separation is in use, if any? What is the efficiency of the separation?
- ✓ If your treatment/storage facility is covered, what type of cover is used?
- ✓ How many days storage can your facility accommodate?
- ✓ How frequently is sludge removed from the facility?
- ✓ For biogas recovery options, how frequently will the recovery and utilization component be running?

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### 2.4 Opening, Closing, and Saving FarmWare Sessions

#### *Opening a Session or Beginning a Session*

The user can select a new or existing FarmWare session from the General Site Information Screen. Upon beginning FarmWare, the user should select either “New” to open a new session, or “Open” to open an existing session (Figure 2-3).

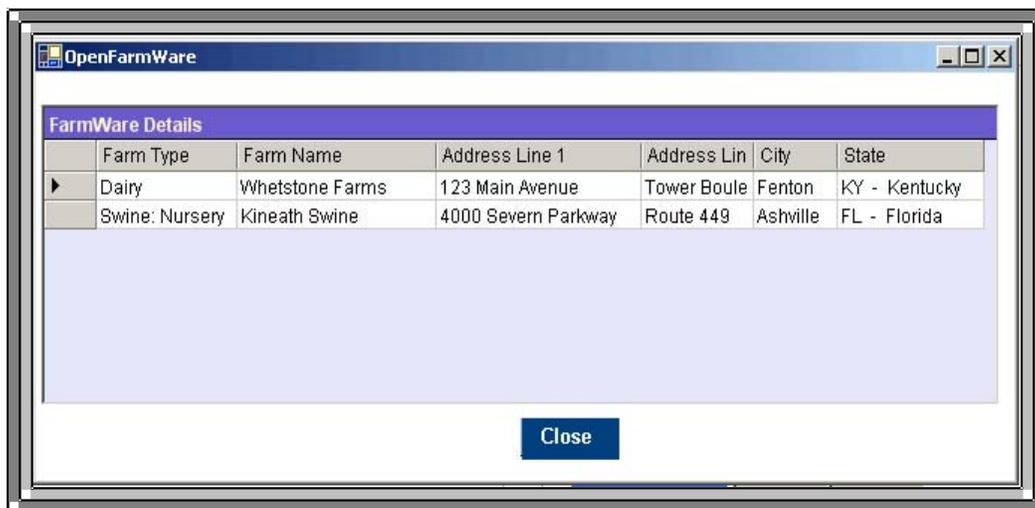


Figure 2-3: FarmWare Session List

FarmWare already contains two case studies in the session list. These are the case studies that are presented in detail in Appendix E of this Manual.

#### *Saving a Session*

Each screen in FarmWare contains a button at the bottom of the screen from which you can save your session. If you have selected an existing session and have made changes to that session, FarmWare will overwrite the previous session.

#### **WARNING!!!**

You must finish the minimally required inputs to the FarmWare session in order for the session to save. You must complete inputs to the General Site Information, Set up Analysis, and Farm Description screens in order

#### *Closing a Session*

At any time, the user may close the FarmWare session by clicking the Exit button, located at the bottom of the screen.

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### CHAPTER 3.0: FARM DESIGN

The user defines the farm in the first three screens of FarmWare v.3:

- Screen 1: General Site Information
- Screen 2: Setup Analysis
- Screen 3: Farm Description

These screens contain options that allow the user to describe the characteristics of the farm and its methane recovery or baseline components. Not all of the options are available for every case. If you have selected a combination of options that is not technically feasible or otherwise not included in this analysis, an error will appear when the user attempts to save that screen (Figure 3-1).

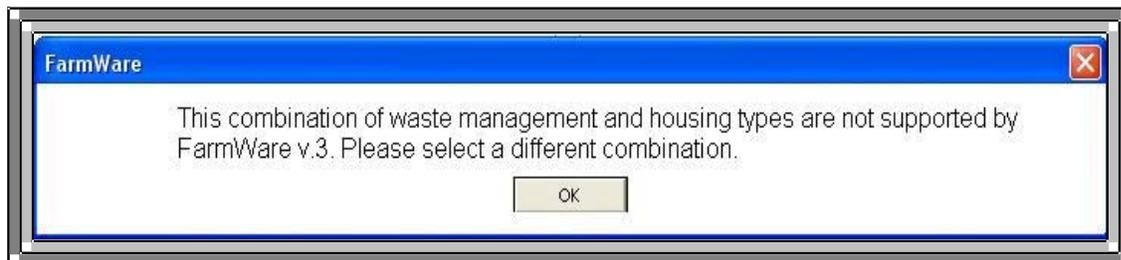


Figure 3-1: Farm description error message.

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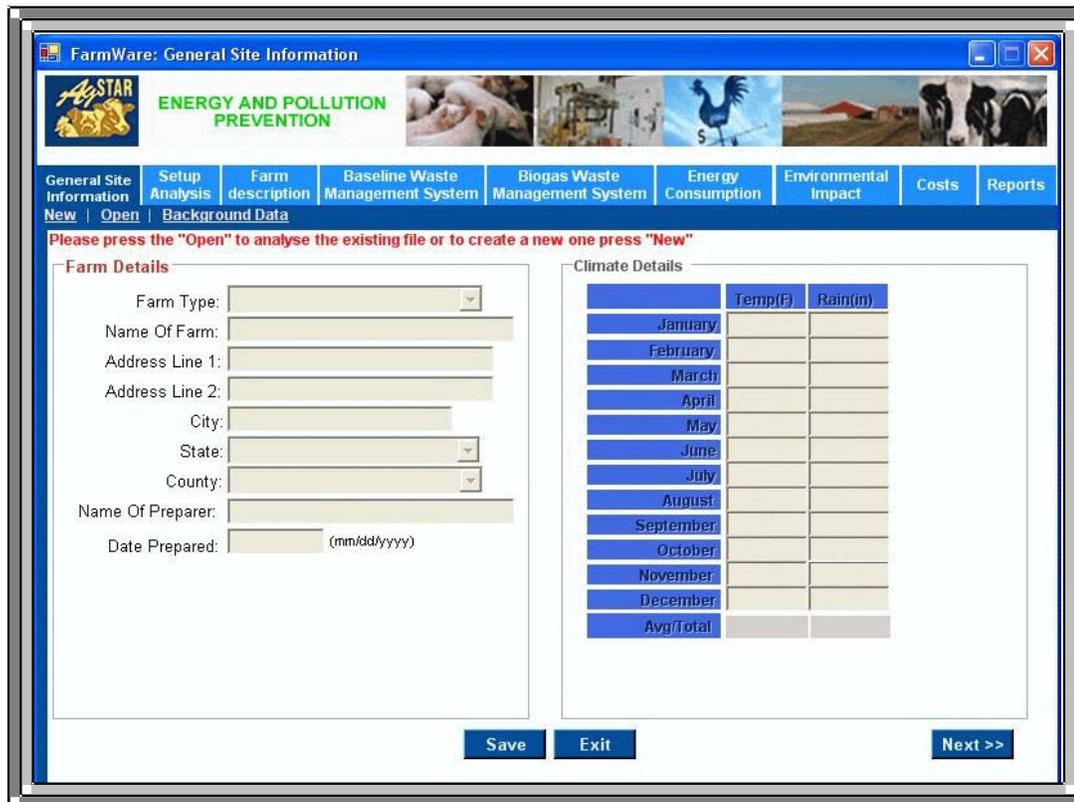


Figure 3-2: General Site Information Screen

### 3.1 General Site Information Screen

Figure 3-2 displays the General Site Information Screen. In this screen the user enters identifying information about the farm, including the name of the farm, address, date, and the users name. Upon entering the county and state, the application displays the estimated monthly precipitation and temperature for that location. This information is important as is it used to calculate methane production and to size liquid treatment and storage facilities. All uncovered treatment and storage facilities are required to have capacity to hold runoff and direct precipitation from the peak storm event. FarmWare assumes that the peak storm event is the 25 year/24-hour storm event for dairies, and the 100-year/24 hour storm event for swine operations.

The user may edit these climate data directly in this screen by clicking in the appropriate box and typing over the data presented. These data are saved to the FarmWare session when the user clicks the Save button at the bottom of the screen.

Background default data are also accessible through the General Site Information screen by clicking “Background Data” at the top of the screen. Unit component costs, animal waste manure production characteristics, and project financial factors are displayed here, and may be adjusted to the user’s site-specific information.

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### 3.2 Setup Analysis Screen

The Setup Analysis Screen contains questions to characterize the basic components of the liquid and solid waste management system for the farm. The first questions inquire about the waste collection in the housing areas. Then, the user identifies the liquid and solid waste management components used in the Baseline Waste Management System and the Biogas Waste Management System.

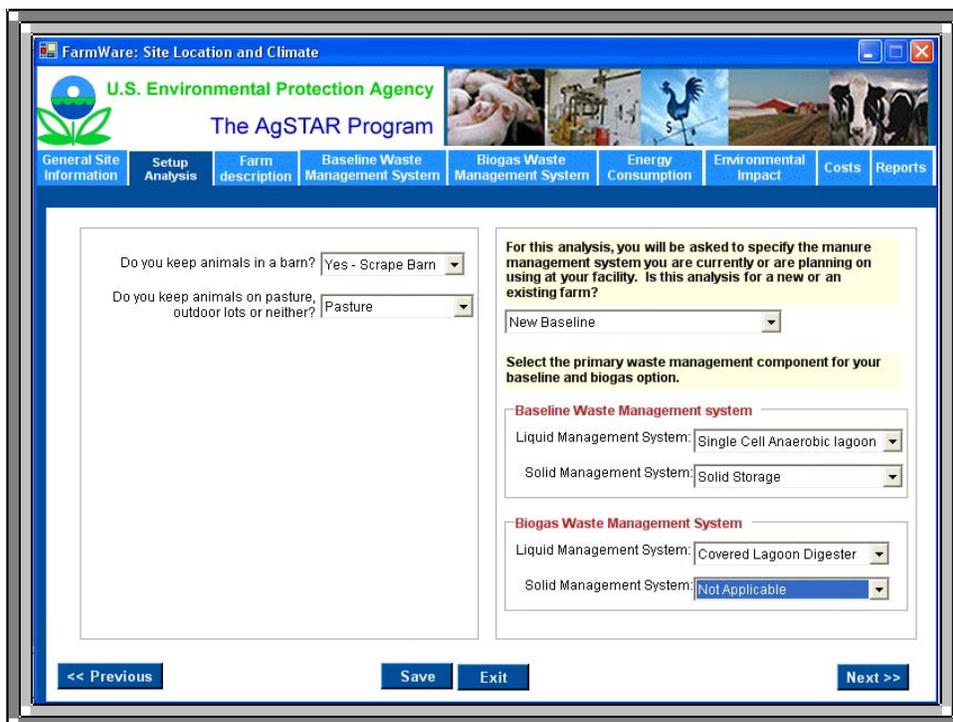


Figure 3-3: Setup Analysis Screen

The user can set up the analysis to consider a traditional system (Baseline Waste Management System), a methane recovery system (Biogas Waste Management System), or the user may setup the analysis to consider both the traditional and methane recovery system.

### 3.3 Farm Description

Users enter data in the Farm Description screen to define animal type, number of animals, housing, and manure placement on the farm.

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**Animals**

Animals On Site	Number Of Animals	Housing Primary/Secondary	
<input checked="" type="checkbox"/> Dairy Cow, Lactating	540	Barn	Barn
<input type="checkbox"/> Dairy Cow, Dry			
<input type="checkbox"/> Dairy Heifer			
<input type="checkbox"/> Dairy Calf			

Please select your breed of dairy cattle  
Holstein

**Dairy Manure Placement - Hours in each Housing Facility**

	Lactating Cow	Dry Cow	Dairy Heifer	Dairy Calf
Barn	20			
Outdoor Lot	0			
Pasture	0			
Milking Center	4			
<b>Total Hours Per Day</b>	<b>24</b>			

<< Previous      Save      Exit      Next >>

Figure 3-4: Farm Description Screen

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### CHAPTER 4.0: WASTE MANAGEMENT SYSTEM TRAINS

FarmWare contains separate screens to present the Baseline Waste Management System and the Biogas Waste Management System. The waste management system train is constructed for each farm according to the specific user inputs established in the Farm Design Screens. The various components of the treatment trains are grouped in five general categories:

#### Housing:

Dairies may have animals in barns, outdoor lots, or pasture. FarmWare allows for animals to be housed in up to two different housing areas. In addition to these areas, the milking center is classified in the "Housing" category.

Swine farms may house animals in barns only. FarmWare does not account for swine housed in outdoor lots or pasture.

#### Pretreatment:

FarmWare assumes that all dairy farms have some form of solid separation. Swine farms are assumed not to have solid separation due to the very low solids content of the manure.

#### Primary Treatment/Storage

% Total Solids	Type of Digestion			
	Covered Lagoon	Complete-Mix	Plug Flow	Fixed Film
0.5%-3%	✓			✓ <sup>1</sup>
3%-10%		✓		
11-13%			✓ <sup>2</sup>	

<sup>1</sup> Before separation to remove coarse solids  
<sup>2</sup> Because of the required solids content for Plug Flow Digestion, this technology is not appropriate for swine farms.

For the Baseline WMS options, liquid waste may be diverted to a lagoon, a storage pond, or a tank, while solid or semi-solid manure may be diverted to the solid storage in a manure stack. Swine farms are assumed to have liquid waste only. For the Biogas WMS options, the available digestion options depend on the animal type and the percent total solids in the incoming waste, and include covered lagoon, complete mix, plug flow, and fixed film digestion.

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### Secondary Storage:

Many farms collect runoff or discharge from a primary manure storage facility. FarmWare refers to this storage as "Secondary Storage".

### End Use

FarmWare assumes three possibilities for end use of the waste and byproducts: liquid land application, solid land application, and biogas recovery and utilization.

As an example, Figure 4-1 presents a sample Waste Management System for a dairy farm in which cows are housed in a scraped barn and on a scraped outdoor lot.

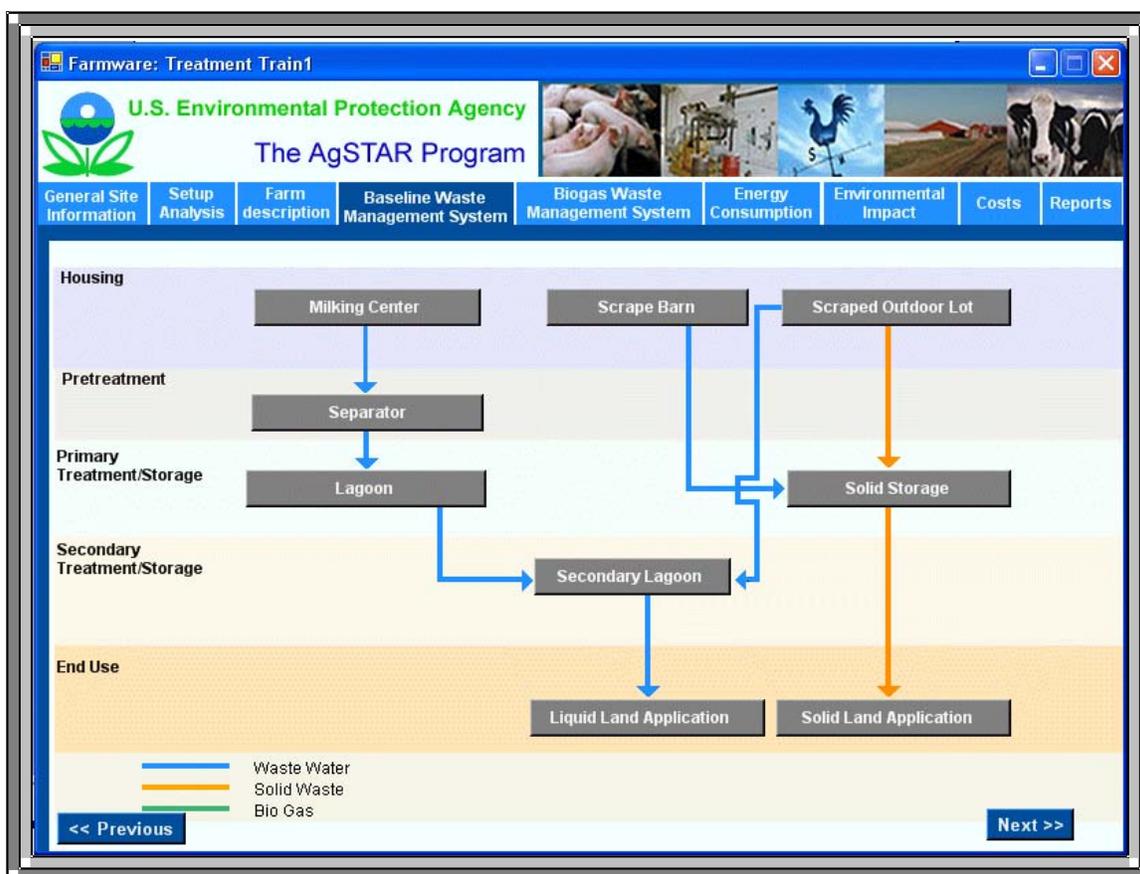


Figure 4-1: Example Waste Management System

The waste from the milking center, including cleaning water and manure deposited in the milking center, is diverted to the solid separator, which then passes the waste to the anaerobic lagoon. The effluent from the primary anaerobic lagoon is contained in secondary storage until land application is possible. The scraped manure from the barn and the outdoor lot is assumed to be stacked in solids storage, where it remains until land application is possible. Runoff from the outdoor lot is diverted to the secondary lagoon.

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Elements of each component's design are available for viewing and editing by double clicking the component of interest. A description of each possible component of the treatment trains is presented in the following sections.

### 4.1 Housing Design Screens

Housing screens are classified into three categories: Barns, Outdoor confinement, and the Milking Center. The detail screens present the total volume of wastewater generated for that housing type, based on the default values or based on the user input. The user may edit these values by typing over the FarmWare generated value.

#### ***BARNS***

FarmWare provides different options for housing animals in barns depending on the animal type. Barn housing at dairies may be flushed barns or scraped barns. Barn housing at swine operations may be flushed barns, deep pit barns, pull plug barns, pit recharge barns, or hoop barns. FarmWare uses default values to complete mass balance calculations. The user may edit some of these default values by accessing the design screen for that component.

#### **Flush Barn**

FarmWare estimates the amount of fresh water and recycled water used per day for manure management in the flush barn using the following default assumptions:

<b>Animal Type</b>	<b>Animal</b>	<b>Fresh Water gallons per head</b>	<b>Recycled Water gallons per head</b>
Dairy	Dairy Calf	0	100
	Dairy Cow: Dry	0	100
	Dairy Cow: Lactating	0	100
	Dairy Heifer	0	100
Swine	Boars	0	15
	Feeder Pigs	0	15
	Nursing Pigs	0	2
	Sow: Gestating	0	25
	Sow: Lactating	0	35
	Weaned Pigs	0	4

SOURCE: Dairy flush water estimates are extracted from the "Cost Methodology for the Final Revisions to the National Pollutant Discharge Elimination System Regulation and Effluent Guidelines for Concentrated Animal Feeding Operations." EPA, December 2002. Swine flush water estimates are from Midwest Plan Service.

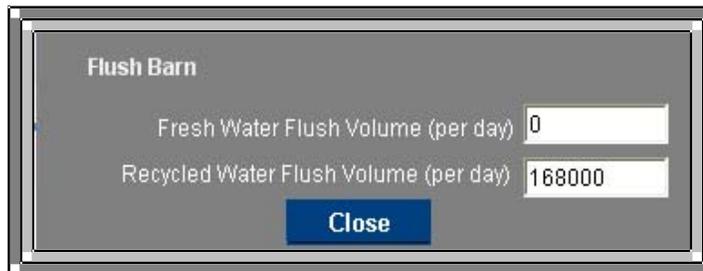
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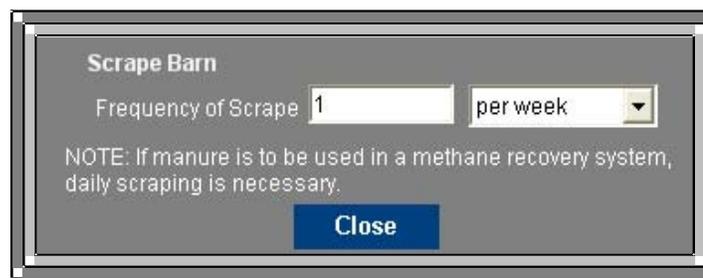
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FarmWare calculates the total water use in the barn based on the number of animals that reside in the barn for their primary housing, as entered in the Farm Description screen. The design view of the Flush Barn screen indicates the result of these default assumptions; the user may edit the total water use per day if site-specific data are known.



### Scrape Barn

FarmWare assumes that a barn with solid waste management is scraping the barn once per week. This is the default for the program, as shown in the design screen. The user may modify this frequency, especially if the user is considering a digestion system for which daily scraping would be necessary.

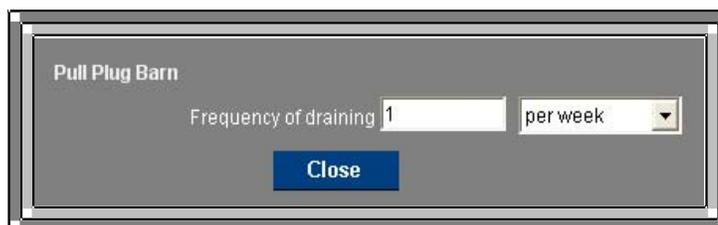


### Deep Pit Barn

FarmWare assumes that deep pit barns are used as short term storage for manure waste, and there is no primary treatment or storage of liquid waste on site. The default draining period of the barn is 30 days.

### Pull Plug Barn

FarmWare assumes that a pull plug barn is drained once per week. This is the default for the program, as shown in the design screen. The user may modify this frequency, especially if the user is considering a digestion system for which more regular draining would be necessary.



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### Pit Recharge

FarmWare contains an assumption that pit recharge barns are recharges with a certain amount of recycled water in the pit, in an amount commensurate with the number and type of swine kept in the barn.

Animal Type	Animal	Recharge volume gallons per head
Swine	Boars	43
	Feeder Pigs	9
	Nursing Pigs	3
	Sow: Gestating	9
	Sow: Lactating	17
	Weaned Pigs	6

SOURCE: Calculated from estimates of pit recharge volume per animal from Midwest Plan Service-8: Swine Housing and Equipment.

Pit Recharge Barn

Frequency of draining to storage/treatment  per week

Recycled Water for Recharge (gallons per draining event)

Close

### Hoop Barns

Some farms house swine in hoop structure barns using a dry solid waste management system. This is not compatible with biogas recovery option, and therefore FarmWare does not support this baseline option for comparison to biogas recovery.

### *OUTDOOR CONFINEMENT*

Three selections are presented in FarmWare to describe outdoor housing confinement of dairy animals: flushed outdoor lots, scraped outdoor lots, and pasture.

#### Flushed Outdoor Lots

FarmWare accounts for flushed outdoor lots for dairy cows. FarmWare assumes a daily flush volume of recycled water of 100 gallons per head and zero fresh water volume. Additionally, FarmWare assumes that 80 percent of the feeding area is paved and 20 percent of the loafing area is paved. The user may change these values by accessing the

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Outdoor Lots screen. The runoff factors for paved areas is set equal to 90% and for unpaved areas is set equal to 20%.

Outdoor lots are also a source of runoff that is assumed to be collected in the storage pond. In order to calculate the amount of runoff per lot, FarmWare assumes the following outdoor lot area per head for dairy cows:

Animal	Outdoor lot area
Lactating dairy cow	460
Dry dairy cow	460
Dairy heifer	431
Dairy calf	259

source: "Cost Methodology for the Final Revisions to the National Pollutant Discharge Elimination System Regulation and Effluent Guidelines for Concentrated Animal Feeding Operations." EPA, December 2002. Area required for mature dairy cows is set equal to the areas assumed for mature beef cattle.

### Scraped Outdoor Lots

**Flushed Outdoor Lot**

Spilled Fresh Water Flush Volume (per day)

Recycled Water Flush Volume (per day)

Percent of Lot that is used for Loafing Area  Is the loafing area paved?

Percent of Lot that is used for Feeding  Is the feeding area paved?

Percent of Lot that is used for Milking (if milked on the lot)  Is the milking area paved?

FarmWare assumes that only dairy animals are kept on outdoor lots. FarmWare uses the same assumptions regarding percent pavement and area requirements as for flushed outdoor lots.

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Scraped Outdoor Lot

Frequency of Scrape

Percent of Lot that is used for Loafing Area  Is the loafing area paved?

Percent of Lot that is used for Feeding  Is the feeding area paved?

Percent of Lot that is used for Milking (if milked on the lot)  Is the milking area paved?

NOTE: If manure is to be used in a methane recovery system, daily scraping is necessary.

### Pasture

FarmWare allows dairy animals to be confined on pasture for part of the year. As a default, FarmWare assumes that animals are kept on pasture from March through October. For the remaining months that animals are not on pasture, animals are assumed to be housed in the primary housing selected for that farm. Manure from the pasture is not available for biogas recovery.

Confinement Pasture	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dairy	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>							

### 4.2 Pretreatment: Solid Separation

After housing, some portion of liquid waste may be diverted to a solid separator. The Solid Separation screen allows you to edit the characteristics of the solids separator at the farm. FarmWare accounts for solid separation at dairy farms only. The first item to be selected on this screen is the type of solid separation. Each separation type has certain default characteristics including influent total solids concentration, solid separation efficiency, and influent capacity. These default parameters may be edited by clicking in the box you wish to edit, deleting the current value, and entering the more accurate value.

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### 4.3 Primary Treatment or Primary Storage

The third possible stage of the treatment train is either treatment or storage, depending on the selections made in the Farm Description screen. Primary treatment options vary according to the animal type and the influent total solids, and include anaerobic lagoons and digestion system. Manure and waste may also simply be stored in the third stage of the waste management system, in a storage tank, storage pond, or in an area designated for solids storage. The screens and inputs for each of these treatment and storage options are presented below.

#### Primary Treatment Options

- Anaerobic lagoon
- Covered lagoon digester
- Complete mix digester
- Plug flow digester
- Fixed Film Digester

#### Primary Storage Options

- Storage pond
- Storage tank
- Solids storage

#### **PRIMARY TREATMENT**

The following default values are used by FarmWare in the design of the primary treatment systems.

Animal Type	Digester Type	Accumulated Solids <sup>1</sup> lb/ft <sup>3</sup> /period	Minimum Depth ft	Side Slope	HRT <sup>2</sup> (days)	Solids Content Range	
						Min %	Max %
Dairy	Anaerobic Lagoon	0.0729	12	2	60	0	5
Dairy	Ambient Temperature Covered Lagoon	0.0729	12	2	variable	0.5	3
Dairy	Plug Flow	0.0729	8	2	20	11	14
Dairy	Complete Mix	0.0729	12	0	17	2.5	10

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Animal Type	Digester Type	Accumulated Solids <sup>1</sup> lb/ft3/period	Minimum Depth ft	Side Slope	HRT <sup>2</sup> (days)	Solids Content Range	
						Min %	Max %
Dairy	Fixed Film	0.0729	12	0	1 - 6	0	5
Swine	Anaerobic Lagoon	0.0485	12	2	60	0	5
Swine	Ambient Temperature Covered Lagoon	0.0485	12	2	variable	0.5	3
Swine	Complete Mix	0.0485	12	0	17	2.5	10

SOURCE: 1. USDA NRCS Agricultural Waste Management Field Handbook.  
2. USDA NRCS Conservation Practice Standards Codes 359, 365, and 366.

### Primary treatment: Anaerobic lagoon

The anaerobic lagoon panel contains several selections to customize the lagoon design to the user's farm, including:

- Lagoon cover;
- Frequency of solids removal;
- Days of runoff or waste storage; and
- Total depth.

The total volume and surface area of the lagoon are calculated based on the number of animals and process water used in the system as described in previous screens. The user may click in the boxes for these values and change the default values if needed.

**Anaerobic Lagoon**

Is this a single cell or a multiple cell lagoon?

Is the lagoon covered?

Modular or Bank-to-bank?

What is the cover material?

Total Volume (ft<sup>3</sup>)

Surface Area (ft<sup>2</sup>)

How many days between sludge cleanout?

For how many days between sludge cleanout?

What is the depth of the lagoon (ft)?

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### Primary Treatment: Covered Lagoon Digester

Both dairy and swine operations may select a covered lagoon digester to treat the manure and associated wastewater. The design of the covered lagoon digester follows the guidelines set forth in NRCS Conservation Practice Standard 365, which includes the determination of the minimum treatment volume based on the smaller of two values: the regional hydraulic retention time or the volatile solids loading rate. The resulting volume is presented in the covered lagoon digester screen and the user may edit the final volume.

The screenshot shows a window titled "Covered Lagoon Digester". It contains the following fields and values:

Modular or Bank-to-bank?	[Dropdown menu]
What is the cover material?	60 mm HDPE 40 mm HDPE 20 mm HDPE
Total Volume (ft <sup>3</sup> )	95185094.
Surface Area (ft <sup>2</sup> )	1437072.1
Biogas Production (ft <sup>3</sup> /day)	0

A "Close" button is located at the bottom center of the window.

### Primary Treatment: Complete Mix Digester

The complete mix digester screens allows the user to edit the characteristics of the complete mix digester methane recovery system including the following:

The screenshot shows a window titled "Complete Mix Digester". It contains the following fields and values:

What is the hydraulic retention time of the digester? (days)	12200
What is the depth of the digester? (ft)	12
What is the diameter of the digester? (ft)	10
What is the total volume of the digester? (cf)	120
What is the surface area of the digester? (cf)	120
What is the biogas production from the digester? (cf per day)	1200

A "Close" button is located at the bottom center of the window.

- Hydraulic retention time;
- Minimum depth;
- Cover type;
- Height, diameter, volume, and surface area; and
- Biogas production.

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The design of the complete mix digester follows the guidelines set forth in NRCS Conservation Practice Standard 366. The resulting volume is presented in the complete mix digester screen and the user may edit the final volume.

### Primary Treatment: Plug Flow Digester

To consider plug flow digestion as an option for treatment of manure wastes, influent waste must be between 11 and 14 percent total solids. The design of the plug flow digester follows the guidelines set forth in NRCS Conservation Practice Standard 366. The resulting volume is presented in the plug flow digester screen and the user may edit the final volume.

Plug Flow Digester	
What is the Hydraulic Retention Time? (days)	20
What is the Length/Width Ratio? (LW)	2.5
What is the Hydraulic Retention Time? (days)	20
What is the depth? (ft)	8
Does the digester have a flexible or fixed top?	flexible
What is the total available volume of the digester? (cf per retention time)	722.99302
What is the biogas production from the digester? (cf per day)	28741.442

Close

### Primary Treatment: Fixed Film Digester

To consider fixed film digestion of dairy manure, influent waste must be between 0 and 5 percent total solids. The design of the fixed film digester follows the guidelines set forth in NRCS Conservation Practice Standard 366. The resulting volume is presented in the fixed film digester screen and the user may edit the final volume.

### ***PRIMARY STORAGE***

FarmWare defines primary storage areas as facilities that hold waste and are not intended to treat waste. Liquid waste may be stored in a tank or a pond, and solids may be stored in a manure stack. The following values were used in the design of the primary storage systems.

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Storage Type	Animal Type	Accumulated Solids lb/ft3/period	Minimum Height or Depth (ft)	Side Slope
Storage Tank	Dairy	0.0729	12	1
Storage Tank	Swine	0.0485	12	1
Storage Pond	Dairy	0.0729	12	2
Storage Pond	Swine	0.0485	12	2
Manure Stack	Dairy	NA	10	NA
Manure Stack	Swine	NA	10	NA

NA = Not applicable. Solid Storage is assumed to be stacked as a pyramid and the slope will vary according to the height of the stack

Additional guidance for constructing a waste storage facility may be found in NRCS Conservation Practice Standard Code 313: Waste Storage Facility.

### Storage Tank

Either dairy or swine waste may be stored in a storage tank. The characteristics of the tank are shown in the storage tank screen, and may be edited by the user. These characteristics include:

- Depth of the tank
- Tank Material (concrete, steel, or fiberglass)
- Type of cover
- Days between sludge clean out, and
- Waste volume storage days.

**Storage Tank**

Total volume estimated per head animal: 4222689.1

Total height (ft): 12

Tank Material: Concrete

What is your cover type?: No cover

How many days between sludge cleanout?: 365

What is the storage time of the tank?: 90

**Close**

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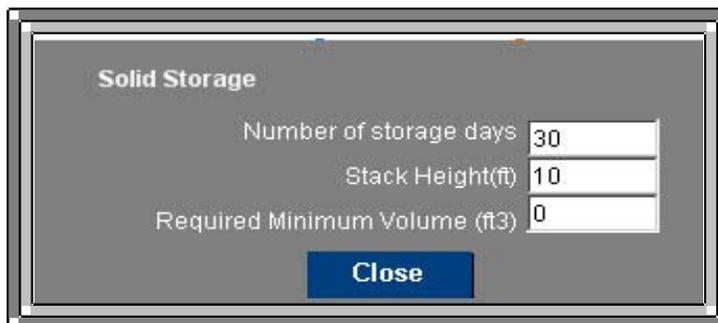
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### Storage Pond

Either dairy or swine waste may be stored in a storage pond. Storage ponds are not typically covered, and therefore allow for precipitation and runoff to enter the pond. Storage ponds are assumed to be a minimum of 12 feet deep with a 2:1 side slope. The resulting volume and surface area as well as depth and storage times are shown in the screen. The user may edit these values.

### Solid Storage

Manure is collected as a solid or semi-solid from scraped barns, scraped outdoor lots, and from solid separation. FarmWare assumes collected solid and semi-solid manure is stacked onsite, with a maximum stacking height of 10 feet. The user may edit this value by accessing the solid storage screen in the Waste Management System. FarmWare calculates the required minimum volume of the storage area based on the number of storage days and the stack height. These values may be edited by the user, and the volume of the stack will be recalculated upon selecting "Save/Exit".



Solid Storage	
Number of storage days	30
Stack Height(ft)	10
Required Minimum Volume (ft3)	0

Close

### 4.4 Secondary Storage

Liquid manure and wastewater is stored in a secondary storage pond after primary treatment or primary storage occurs. In addition to receiving effluent from primary treatment and storage, the storage pond directly collects runoff from outdoor lots. FarmWare assumes liquid waste is stored here until it may be land applied. (Note: If the selected Primary Storage component of the WMS is a Storage Pond, then FarmWare assumes that there is no secondary storage.)

FarmWare assumes the pond is constructed in the shape of an inverted pyramid frustrum. The user may edit the following information by accessing the secondary storage screen. Storage ponds are assumed to be 12 feet deep with a 2:1 side slope. The resulting volume and surface area as well as depth and storage times are shown in the screen. The user may edit these values.

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### 4.5 End Use

Treatment and storage of manure and wastewater generates liquid and solid waste that may be used for land application. Additionally, the use of digestion to treat manure waste generates biogas that may be recovered and used. FarmWare provides three screens in the End Use portion of FarmWare's WMS to address these uses: Liquid Land Application, Solid Land Application, and Methane Shack: Biogas Utilization.

#### Liquid Land Application

FarmWare provides the user with two options for liquid land application: Injection and spray application.



#### Solid Land Application

FarmWare provides the user with two options for solid land application: Broadcast spreading and incorporation.

#### Methane Shack: Biogas Utilization

For digestion with methane recovery options, FarmWare assumes collected gas is diverted to the Methane Shack, the screen in which the user can designate the use of their recovered methane, select and engine size (if needed).

The methane shack screen presents the quantity of methane generated per day from the recovered biogas, based on the data collected in earlier FarmWare screens. The user may also designate how the methane will be used from the following selections:

- Flare;
- Boiler;
- Medium BTU Engine; or
- Chillers.

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The user then selects the expected utilization efficiency (the percent of time that the unit is operational, accounting for downtime for maintenance and repair) of the biogas energy recovery unit from three selections that reflect the attention that operator is able to provide. An excellent operator can run at 95% efficiency, an average operator can run at 90%, and a less efficient operator can run at 80%.

Based on the information provided in earlier FarmWare screens, a recommended engine size is provided. The user may then select the size engine they are interested in based on FarmWare's recommendation and the user's judgement.

**Methane Shack: Bioqas Utilization and Design**

Average Methane Available (cubic feet per day): 17,020

What fraction of the time will the recovery and utilization component be running? (%): 95% - Best operation

How will you use the recovered methane?: Medium BTU Reciprocating Engine with Synchronous Generator

Recommended engine-generator size: 120

Select Engine-Generator Size (kW): 120

Component Efficiency (BTU/kWhr):

Include Heat Recovery System?: No

Operating and Maintenance Costs (\$/kWh of Use):

Relative to the general annual inflation rate, how do you expect annual operating costs to change over the lifetime of the project?: Same as General Inflation Rate

What on-farm energy source will you be offsetting?: Propane

Close

The user is then asked to complete the following information:

- Component efficiency (Btu/kWh);
- Specify presence of a heat recovery system;

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- Operating and Maintenance Cost (\$/kWh);
- Expected inflation rate; and
- Designate which on-farm energy source will be offset.

These data are used in subsequent FarmWare screens to calculate the energy balance and estimate costs.

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### CHAPTER 5.0: ENERGY CONSUMPTION

The Energy Consumption screen collects information about the use and consumption of energy on the farm, as well as information on any energy programs the farm is considering. First, the user must complete a table providing the month-by-month use of energy on the farm for the past year (or another representative year). If this is a new farm, the user should estimate the energy consumption.

HISTORICAL ENERGY USE					
Enter the last 12 months of energy use data for your facility using your monthly utility statements.					
	Electricity kWh	Propane gallons	Natural Gas cubic feet	Fuel Oil gallons	Equivalent Energy cubic ft biogas
January	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
February	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
March	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
April	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
May	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
June	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
July	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
August	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
September	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
October	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
November	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
December	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Then, the user completes information about any utility agreements or programs in which they plan to participate. FarmWare provides the following options to choose:

- Net Metering Program
- Surplus Sales Program
- Sell All Program

The type of programs available vary by state. If the user is interested in pursuing one of these options, the user may contact their state utility commission.

The data collected in this portion of FarmWare is used to calculate costs and generate the Energy Balance report available through the Reports tab.

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### CHAPTER 6.0: ENVIRONMENTAL IMPACT

Different environmental impacts are expected from different waste management systems used to manage swine and dairy manure. Some of these impacts are presented in the Environmental Impact screen, which are based on the selected WMS. This table is presented as part of the Summary Report available by accessing the Reports tab.

### CHAPTER 7.0: REPORTS

Five reports are available through the Reports tab that describe the farm analysis conducted: Quick Report, Energy Balance, Detailed Cost Summary, and the Summary Report.

*Note: Analyses performed using FarmWare are considered preliminary and are to be used for guidance only. The results presented are based on input values. A detailed final feasibility assessment should be completed by qualified agricultural and energy engineers prior to design, purchase of materials, or construction.*

#### Quick Report

The Quick Report presents an overview of the costs and benefits of each farm WMS analyzed in the FarmWare session. To view the **Quick Financial Results** report, select the **Quick Report** tab from the Reports area of FarmWare.

The top of the report contains estimates for total capital costs, annual operating costs, and annual energy savings. Then, the report provides the Net Present Value (NPV), Simple Payback period, the NPV payback, and the Internal Rate of Return. If the NPV is positive, the selected WMS may be profitable.

The financial project factors may be accessed in the Background portion of FarmWare, accessible through the **General Site Information** screen.

#### Energy Balance

The farm Energy Balance report presents the energy production and savings by month, according to the selections made in the WMS screens and **Energy Consumption** screen. The Energy Balance report is accessed by selecting the Energy Balance tab in the Reports portion of FarmWare.

#### Detailed Cost Summary

The Detailed Cost Summary report contains the cost breakdown of the FarmWare analysis, including an economic summary of the financial assumptions, recovered energy value, and component costs. A system with a positive Net Present Value should be financially beneficial. A system with a negative NPV may not be profitable, but should

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be examined for potential methods of expense cuts and reanalyzed for profitability. Annual cost benefits include energy, odor, and tax benefits while expenses include capital costs or loan payments, grants, operation and maintenance costs, depreciation, and interest expenses.

### **Summary Report**

The Summary Report explains detail on the input parameters used to analyze the costs of the selected waste management systems, the energy consumption and use, expected environmental benefits, and screening-level costs and economic value of each system.

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