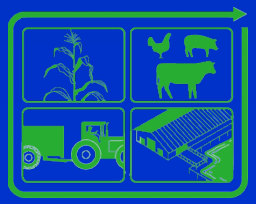
Facility Closure

CNMP Core Curriculum
Section 2 — Farmstead Planning



Objectives

- Learn the appropriate methods to decommission a manure storage facility.

Required Materials

- NRCS Waste Facility Closure practice standard 360.

Final Application Logistics …

Waste Storage System
Closure Plan

Can be prepared in the CNMP planning process

Waste Facility Closure

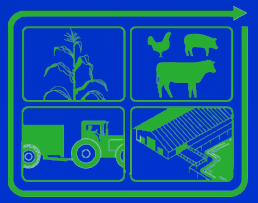
Conservation Practice Standard – Code 360

Purpose

- ✓ Protect Surface and Groundwater
- ✓ Eliminate Safety Hazards
- ✓ Safeguard Public Health

All CNMPs should include a Closure Plan

- ✓ Apply remaining nutrients at agronomic rates
- ✓ Decommission Storage
  - Breach and backfill
  - Conversion to freshwater storage



Apply remaining nutrient at agronomic rates

For systems that do not store nutrients the closure plan application looks like the annual application plan

Example CNMP Farm Final Land Application

- Holding pond fully emptied every 6 months
- Final land application at closure will follow annual application plan

Storage Pond #1

Input Data

Shape: Rectangle

Storage Depth: 6.6 ft

Input Dimension: Bottom Width

Bottom Width: 85.0 ft

Permanent Add'l Storage: 10000 cu. ft

Freeboard: 1.0 ft

Sideslope Ratio: 2

Max. Storage Volume Method

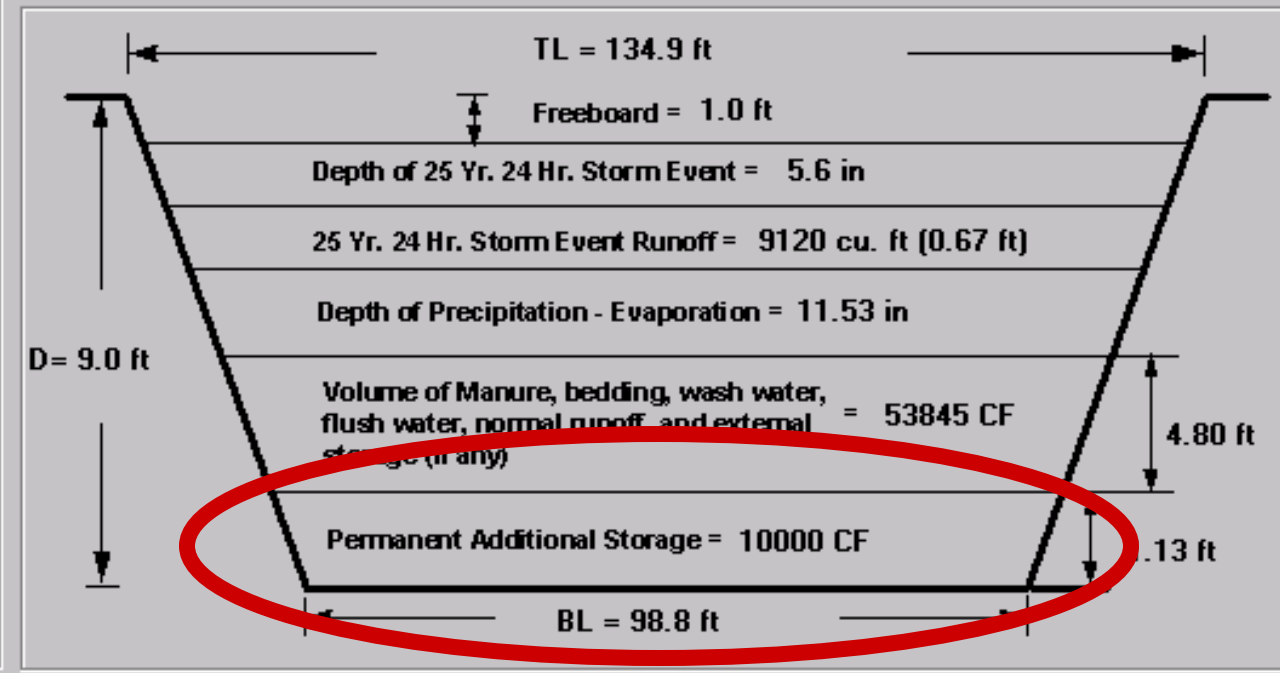
- (•) Define Withdrawal Months
- ( ) Define Storage Period

Cross Section

Critical Months: Dec - Mar Bot W x L.: 85.0 x 98.8 ft Top W x L.: 121.1 x 134.9 ft

Facility Options

☐ Include Soil Liner ☐ Include Ramp



Water Budget (1000 cu ft)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Withdrawal Dates	☐	☐	☑	☑	☐	☐	☐	☐	☐	☑	☑	☐	
Waste	6.14	5.74	6.14	5.94	6.14	5.94	6.14	6.14	5.94	6.14	5.94	6.14	72.47
Runoff	7.08	6.39	8.97	6.26	7.23	5.52	7.67	5.62	4.87	4.67	6.31	7.25	77.85
Prec-Evap	4.26	3.29	3.88	0.33	-0.11	-2.31	-0.71	-1.82	-1.21	0.53	3.36	4.26	
Cum. Storage Vol	35.13	50.55	69.54	12.53	13.26	22.40	35.50	45.44	55.04	66.37	15.61	17.65	

Stage Storage Curve Help OK

Additional 10,000 ft^3 of sludge to be land applied at closure

In-Class Example

- Calculate the nutrients to be land applied in the 10,000 ft^3 of sludge stored in the bottom of the Example Dairy CNMP holding pond.

In-Class Example

- Estimate Sludge Volume – 10,000 ft^3

- Estimate Sludge Nutrient Content
  - 21 lbs N / 1000 gallons sludge
  - 9 lbs P / 1000 gallons sludge
  - 13 lbs K / 1000 gallons sludge

  Actual final land application rates should be based on analysis values

Estimate Sludge Nutrient Content

- Use AWMFH Chapter 4
- Estimate Dairy Sludge Nutrient Content
  - N 21 lbs / 1000 gallons x 0.4 = PAN
  - P 9 lbs / 1000 gallons x 2.29 = P_2O_5
  - K 13 lbs / 1000 gallons x 1.2 = K_2O

Estimate Sludge Nutrient Content

- Using AWMFH Chapter Table 4-7:
- Estimate Dairy Sludge Nutrient Content
  - PAN 8 lbs / 1000 gallons
  - P_2O_5 21 lbs / 1000 gallons
  - K_2O 16 lbs / 1000 gallons

Estimate Sludge Nutrients

- 10,000 ft^3 = 74,800 gallons
- Nutrients to apply
  - PAN 600 lbs
  - P_2O_5 1571 lbs
  - K_2O 1197 lbs

Land Requirements

Target Crop (Corn Silage) nutrient needs:

150 lbs/acre PAN & 65 lbs/acre P_2O_5

PAN 600 lbs / 150 lbs PAN/acre = 4 acres

P_2O_5 1571 lbs / 65 lbs P_2O_5/acre = 24 acres

Apply remaining nutrient at agronomic rates

For systems that store substantial quantities of nutrients (i.e. anaerobic lagoons) the final application closure plan can be very difficult.

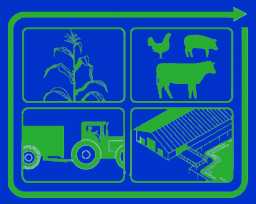
Learning Exercise

What if ……

The farm utilized an anaerobic lagoon sized to store sludge for 10 years ?

Anaerobic Lagoon Example

- Estimate Sludge Volume
  - Chapter 10 AWMFH
  - ANSI/ASAE EP 403.3 "Design of Anaerobic Lagoons for Animal Waste Management"



In-Class Learning Exercise

Estimate the land required at closure to land apply stored sludge from a 175 cow dairy (1300 # cows) using an anaerobic lagoon with a 10-year sludge storage time.

Assume a target crop requiring 150 lbs/acre PAN & 65 lbs/acre P_2O_5.

Estimate Sludge Volume

Using AWMFH Chapter 10

$$SV = 365 \times AU \times TS \times SAR \times T$$

SV = Sludge Volume in ft_3

AU = Number of 1,000 # animal units

TS = TS lbs/AU/day

SAR = Sludge accumulation ratio in ft^3 / lb TS

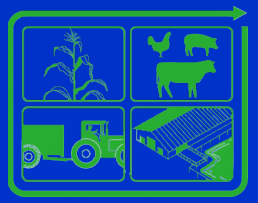
T = Sludge accumulation time in years

TS lbs / AU / day

Table 4–5 Dairy manure characterization—as excreted

(b) In units per day per 1,000 lb animal unit

Components	Units	Lactating cow milk production, lb/d		
		50	75	100
Weight	lb/d/1000 lb AU	96.51	107.67	118.94
Volume	ft^3/d/1000 lb AU	1.56	1.74	1.92
Moisture	% wet basis	87.0	87.0	87.0
Total solids	lb/d/1000 lb AU	12.16	13.75	15.4
VS	lb/d/1000 lb AU	12.03	NA	NA
BOD	lb/d/1000 lb AU	2.08	NA	NA
N	lb/d/1000 lb AU	0.66	0.71	0.76
P	lb/d/1000 lb AU	0.11	0.12	0.14
K	lb/d/1000 lb AU	0.30	0.33	0.35



SAR = Sludge accumulation ratio in ft_3 / lb TS

Table 10–4 Sludge accumulation ratios (Barth 1985)

Animal type	SAR
Poultry	
Layers	0.0295
Pullets	0.0455
Swine	0.0485
Dairy cattle	0.0729

Estimate Sludge Volume

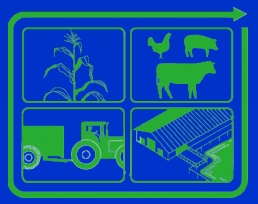
Using AWMFH Chapter 10

SV = 365 x AU x TS x SAR x T

SV = 365 x 228 x 14 x 0.0729 x 10

SV = 849,343 ft^3 = 6,353,086 gallons

Is this a realistic value ?



Estimate Sludge Nutrients

- 849,343 ft^3 = 6,353,086 gallons

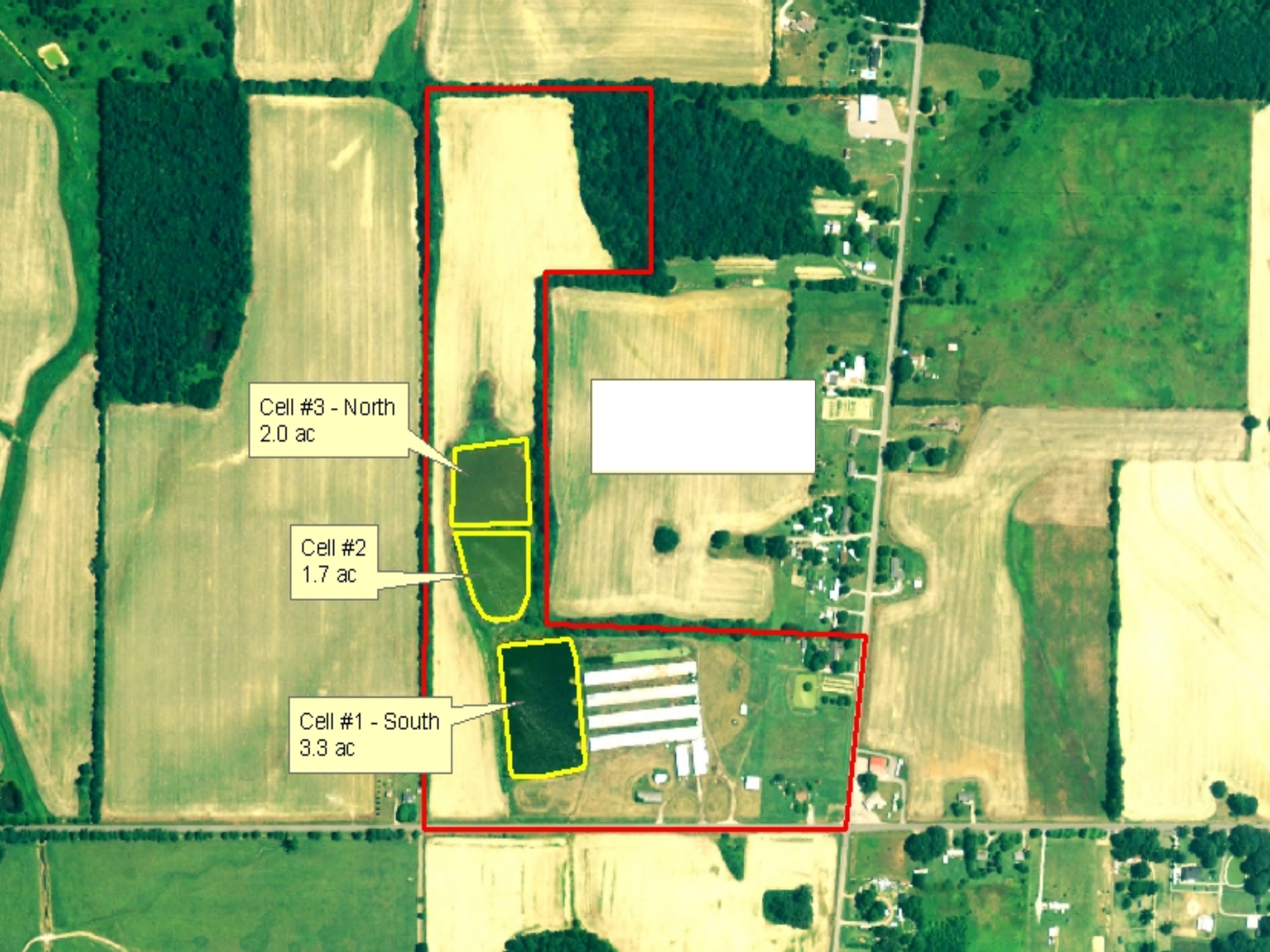
- Nutrients to apply

  - PAN 50,824 lbs
  - P_2O_5 133,413 lbs
  - K_2O 101,648 lbs

Land Requirements

PAN 50,824 lbs / 150 lbs PAN/acre = 339 acres

P_2O_5 133,413 lbs / 65 lbs P_2O_5/acre = 2053 acres


Cell #3 - North
2.0 ac
Cell #2
1.7 ac
Cell #1 - South
3.3 ac

Magnesium (%)	0.41
Aluminum (ppm)	1026
Boron (ppm)	4
Copper (ppm)	51
Iron (ppm)	1049
Manganese (ppm)	271
Sodium (ppm)	770
Zinc (ppm)	372
Ammonium-Nitrogen (ppm)	6800
Nitrate-Nitrogen (ppm)	2

Fertilizer Value (lbs/1000 gallons)

Nitrogen	**58**
Phosphate, P_2O_5	**262**
Potash, K_2O	**9**

DATE: 12-9-09

How do you clean the sludge out of a waste storage structure ?


MF

Agitate?

Geotubes for Sludge Removal
(Filling)

Geotubes for Sludge Removal
(Opening the Tube)

Geotubes for Sludge Removal
(Removal of Solids)

Decommission Storage

- Breach and backfill
- Conversion to freshwater storage


Questions ?
Comments and Discussion