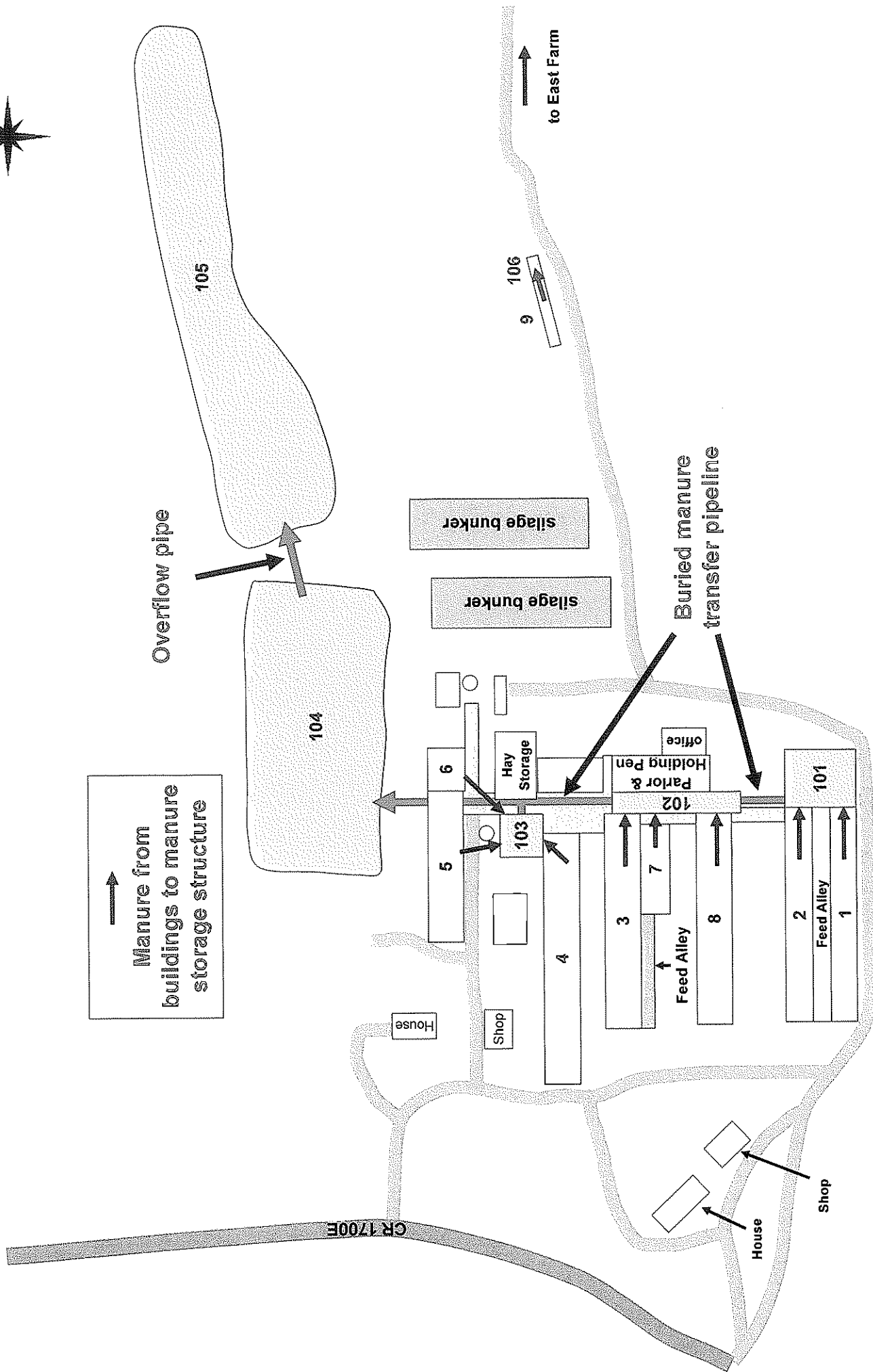


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Westridge Dairy Manure Flow - Main Farm



Westridge Dairy

Manure Calculations

Barn 1

120 Head of Dairy Cow -- Average Weight 1400 pounds

Daily Manure Production each =	Pounds	Lbs/Ft3	Cubic Feet	
Daily Sand Bedding Use each =	120.00	62.0	1.935	
% Confinement =	31.00	102.0	0.304	
Manure Storage and Containment Needs per Animal =	100%			
	151.00	67.4	2.239	
Daily Manure Production =	Cubic Feet	Inventory	Cubic Feet	Tons/Day
	2.239	120	268.73	9.06

Barn 2

120 Head of Dairy Cows -- Average Weight 1400 pounds

Daily Manure Production each =	Pounds	Lbs/Ft3	Cubic Feet	
Daily Sand Bedding Use each =	120.00	62.0	1.935	
% Confinement =	31.00	102.0	0.304	
Manure Storage and Containment Needs per Animal =	100%			
	151.00	67.4	2.239	
Daily Manure Production =	Cubic Feet	Inventory	Cubic Feet	Tons/Day
	2.239	120	268.73	9.06

Barn 3

120 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet
Daily Manure Production each =	120.00	62.0	1.935
Daily Sand Bedding Use each =	31.00	102.0	0.304
% Confinement =	100%		
Manure Storage and Containment Needs per Animal =	151.00	67.4	2.239
Daily Manure Production =	Cubic Feet 2.239	Inventory 120	Cubic Feet Needs/Day 268.73
			Tons/Day 9.06

Barn 4

120 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet
Daily Manure Production each =	120.00	62.0	1.935
Daily Sand Bedding Use each =	31.00	102.0	0.304
% Confinement =	100%		
Manure Storage and Containment Needs per Animal =	151.00	67.4	2.239
Daily Manure Production =	Cubic Feet 2.239	Inventory 120	Cubic Feet Needs/Day 268.73
			Tons/Day 9.06

Barn 5

100 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	120.00	62.0	1.935	
Daily Sand Bedding Use each =	31.00	102.0	0.304	
% Confinement =	100%			
Manure Storage and Containment Needs per Animal =	151.00	67.4	2.239	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	2.239	100	223.94	7.55

Barn 6

60 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	120.00	62.0	1.935	
Daily Sand Bedding Use each =	31.00	102.0	0.304	
% Confinement =	100%			
Manure Storage and Containment Needs per Animal =	151.00	67.4	2.239	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	2.239	60	134.36	4.53

Barn 7

30 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	120.00	62.0	1.935	
Daily Straw Bedding Use each =	6.00	18.0	0.333	
% Confinement =	100%			
Manure Storage and Containment Needs per Animal =	126.00	55.5	2.269	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	2.269	30	68.06	1.89

Barn 8

100 Head of Dry Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	120.00	62.0	1.935	
Daily Straw Bedding Use each =	8.00	102.0	0.078	
% Confinement =	100%			
Manure Storage and Containment Needs per Animal =	128.00	63.6	2.014	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	2.014	100	201.39	6.40

Barn 9

50 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	120.00	62.0	1.935	
Daily Straw Bedding Use each =	0.00	18.0	0.000	
% Confinement =	10%			
Manure Storage and Containment Needs per Animal =	12.00	62.0	0.194	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	0.194	50	9.68	0.30

Barn 10

75 Head of Dairy Calves -- Average Weight 150 pounds

	Pounds	Lbs/Ft3	Cubic Feet	
Daily Manure Production each =	13.00	62.0	0.210	
Daily Straw Bedding Use each =	3.00	18.0	0.167	
% Confinement =	100%			
Manure Storage and Containment Needs per Animal =	16.00	42.5	0.376	
	Cubic Feet	Inventory	Cubic Feet	Tons/Day
Daily Manure Production =	0.376	75	28.23	0.60

Barn 11

75 Head of Dairy Calves -- Average Weight 150 pounds

	Pounds	Lbs/Ft3	Cubic Feet
Daily Manure Production each =	13.00	62.0	0.210
Daily Straw Bedding Use each =	3.00	18.0	0.167
% Confinement =	100%		
Manure Storage and Containment Needs per Animal =	16.00	42.5	0.376
Daily Manure Production =	Cubic Feet 0.376	Inventory 75	Cubic Feet Needs/Day 28.23
			Tons/Day 0.60

Barn 12

40 Head of Dairy Cows -- Average Weight 1400 pounds

	Pounds	Lbs/Ft3	Cubic Feet
Daily Manure Production each =	120.00	62.0	1.935
Daily Straw Bedding Use each =	0.00	18.0	0.000
% Confinement =	10%		
Manure Storage and Containment Needs per Animal =	12.00	62.0	0.194
Daily Manure Production =	Cubic Feet 0.194	Inventory 40	Cubic Feet Needs/Day 7.74
			Tons/Day 0.24

100 Head of Dairy Calves --- Average Weight 250 pounds

	Pounds	Lbs/Ft3	Cubic Feet
Daily Manure Production each =	22.00	62.0	0.355
Daily Straw Bedding Use each =	3.00	18.0	0.167
% Confinement =	100%		
Manure Storage and Containment Needs per Animal =	25.00	47.9	0.522

Daily Manure Production =	Cubic Feet	Inventory	Cubic Feet	Tons/Day
	0.522	100	52.15	1.25

Manure Calculations Summary

Storage Needs	Daily		Yearly Manure Tons by Storage Type			
	Cubic Feet	Tons	Manure Basins 40%	Holding Pond 50%	Lagoon 10%	Total
Barn 1	268.73	9.06	1,323	1,653	331	3,307
Barn 2	268.73	9.06	1,323	1,653	331	3,307
Barn 3	268.73	9.06	1,323	1,653	331	3,307
Barn 4	268.73	9.06	1,323	1,653	331	3,307
Barn 5	223.94	7.55	1,102	1,378	276	2,756
Barn 6	134.36	4.53	661	827	165	1,653
Barn 7	68.06	1.89	276	345	69	690
Barn 8	201.39	6.40	934	1,168	234	2,336
Daily Total	1,702.68	56.61	8,265	10,331	2,066	20,663

Storage Needs	Daily		Yearly Tons
	Cubic Feet	Tons	
Barn 9	9.68	0.30	109.5
Barn 10	28.23	0.60	219.0
Barn 11	28.23	0.60	219.0
Barn 12	7.74	0.24	87.6
Barn 13	52.15	1.25	456.3
Daily Total	126.02	2.99	1,091.35

Lagoon Liquid Calculations

Annual		Gallons	Critical 270 Days = Sep - May	Gallons
Feedlot Runoff Calculation				
Paved Lot Sq Ft	13,240		Paved Lot Sq Ft	13,240
Annual Precipitation Inches	42.11		Precipitation Inches	30.72
% Runoff	55.08%	191,437	% Runoff	53.08%
Precipitation Gain				
Sq Ft Surface area	195,875		Sq Ft Surface area	195,875
Annual Precipitation Inches	42.11		Precipitation Inches	30.72
Annual Evaporation Inches	36.00		Evaporation Inches	10.56
Annual Precipitation Gain Inches	6.11	746,053	Precip Gain Inches	20.16
Milk House Waste Water				
	Gal/Day			Gal/Day
Cow Prep	1180		Cow Prep	1180
Bulk Tank Washing	60		Bulk Tank Washing	60
Pipeline Washing	125		Pipeline Washing	125
Equipment Washing	30		Equipment Washing	30
Milk House Floor	20		Milk House Floor	20
Parlor Floor	75		Parlor Floor	75
Total	1,490	543,850	Total	1,490
Barns 1-8 Annual Manure	10%	464,896	Barns 1-8 270 Day Manure	10%
Annual Lagoon Inputs		1,946,236	270 Day Lagoon Inputs	

Monthly Precipitation Gain

Month	Historical Waterloo Precipitation (a)	Manure Storage			Concrete Feedlot			Total Gain Lot & Storage Cubic Ft
		% of annual Evaporation	Evaporation Inches (b)	Precipitation Minus Evaporation	Gain Cubic Ft	Runoff %	Runoff Inches	Runoff Gain Cubic Ft
January	2.32	2%	0.72	1.60	26,117	55%	1.28	1,408
February	2.40	3%	1.08	1.32	21,546	50%	1.20	1,324
March	3.73	6%	2.16	1.57	25,627	55%	2.05	2,263
April	4.16	9%	3.24	0.92	15,017	54%	2.25	2,479
May	4.04	13%	4.68	-0.64	-10,447	57%	2.30	2,541
June	4.01	15%	5.40	-1.39	-22,689	60%	2.41	2,655
July	4.25	15%	5.40	-1.15	-18,771	62%	2.64	2,907
August	3.13	14%	5.04	-1.91	-31,177	59%	1.85	2,038
September	3.41	10%	3.60	-0.19	-3,101	62%	2.11	2,333
October	3.05	7%	2.52	0.53	8,651	57%	1.74	1,918
November	4.21	4%	1.44	2.77	45,214	56%	2.36	2,601
December	3.40	2%	0.72	2.68	43,745	30%	1.02	1,125
Total	42.11	100%	36.00	6.11	99,733	55%	23.19	25,591
								125,325

(a) <http://mcc.sws.uiuc.edu/Precip/IL/>

(b) AWMFH Table 10C-1 - Urbana

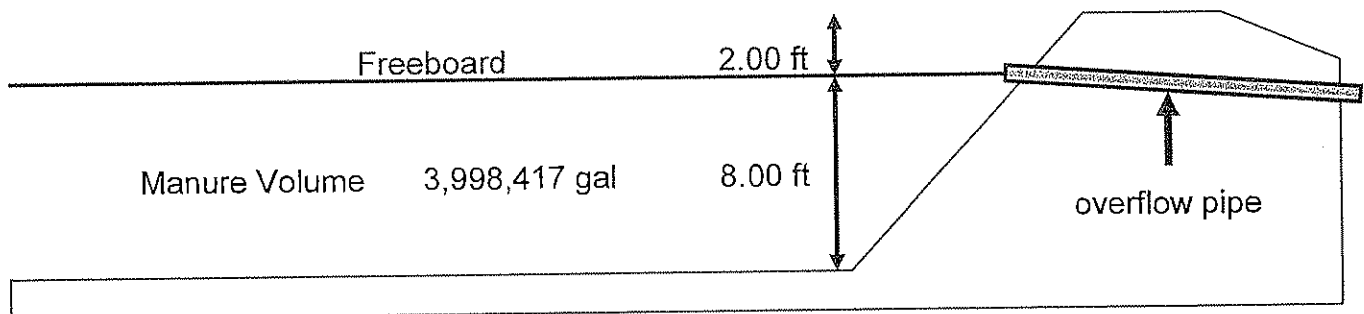
Successive 9 Months of Greatest Precipitation Gain = Sep - May

	Square Feet	Cubic Feet	Gallons
Manure Basin 101	10,000		
Manure Basin 102	5,400		
Manure Basin 103	3,600		
Holding Pond 104	80,000		
Lagoon 105	96,875		
Total	195,875	172,370	1,289,414
paved feedlots	13,240	17,992	134,590
Total precipitation gain going to Lagoon 105	209,115	190,362	1,424,003
25 year/24 hour storm event	5.5 inches	95,844	716,964

Westridge Dairy Holding Pond 104

inside slope 2 to 1
length 400
width 200
depth 10

depth	length	width	Gal/.5 ft	Cum Ft ³	Cum Gal	
10.0	400	200	299,220	690,940	5,168,577	} freeboard
9.5	398	198	294,747	650,940	4,869,357	
9.0	396	196	290,303	611,538	4,574,610	
8.5	394	194	285,890	572,730	4,284,307	
8.0	392	192	281,506	534,512	3,998,417	→ storage capacity = 3,998,417 gal
7.5	390	190	277,153	496,880	3,716,911	534,512 ft ³
7.0	388	188	272,829	459,830	3,439,758	
6.5	386	186	268,535	423,358	3,166,930	
6.0	384	184	264,271	387,460	2,898,395	
5.5	382	182	260,037	352,132	2,634,123	
5.0	380	180	255,833	317,370	2,374,086	
4.5	378	178	251,659	283,170	2,118,253	
4.0	376	176	247,515	249,528	1,866,594	
3.5	374	174	243,401	216,440	1,619,079	
3.0	372	172	239,316	183,902	1,375,679	
2.5	370	170	235,262	151,910	1,136,363	
2.0	368	168	231,237	120,460	901,101	
1.5	366	166	227,243	89,548	669,864	
1.0	364	164	223,278	59,170	442,621	
0.5	362	162	219,343	29,322	219,343	
0.0	360	160	0	0	0	



Worksheet for Sizing Manure Storage Facilities

Operation Name

Westridge Dairy

Facility Type (solid storage, manure tank, lagoon)

Lagoon

Selected manure storage period =

270 days

<u>Animal Type</u>	<u>No. of Animals</u>
dairy - cow dry	100
dairy - cow lactating	680

1. Volume of manure and bedding. Using data in Tables 21C-1 through 21C-9, Table 21-2, and Table 21-3, calculate the volume of manure and bedding for the selected storage period.

Manure:

ft ³ d/1,000#	x	no. animals	x	average wt.	x	storage period	/	1,000	=		
1.30	x	100	x	1,400	x	270	/	1,000	=	49,140	ft ³ manure
1.30	x	680	x	1,400	x	270	/	1,000	=	334,152	ft ³ manure
0.00	x	0	x		x	270	/	1,000	=	0	ft ³ manure
										Total	383,292
										Percent of manure produced in barns 1-8 going into lagoon	= 10%
										Total	38,329 ft ³ manure

Bedding:

lb Bedding/Kwt-d	x	no. animals	x	average wt.	x	storage period	/	1,000	=		
8	x	100	x	1,400	x	270	/	1,000	=	302,400	lb Bedding
31	x	680	x	1,400	x	270	/	1,000	=	7,968,240	lb Bedding
	x	0	x	0	x	270	/	1,000	=	0	lb Bedding
										Total	8,270,640
										Percent of bedding in barns 1-8 going into lagoon	= 0%
										Total	0 lb Bedding

lb Bedding	x	void factor(.3-.5)	/	bedding density(lb/ft ³)	=		
0	x	0.3	/	102	=	0	ft ³ bedding

38,329	ft ³ manure	+	0	ft ³ bedding	=	38,329	ft ³ manure/bedding
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2. Volume of lot runoff. Using data in Figures 21B-1, -2, -3a, and -3b, calculate the volume of runoff from exposed dirt lots, concrete lots, and unguttered roofs.

dirt lot, ft ²	x	rainfall, in	x	percent runoff /12	/	12	=		
	x		x		/	12	=	0	ft ³ runoff

concrete, unguttered roofs, ft ²	x	rainfall, in	x	percent runoff	/	12	=		
13,240	x	30.72	x	53%	/	12	=	17,926	ft ³ runoff

0	ft ³ dirt lot runoff	+	17,926	ft ³ concrete, roof runoff	=	17,926	ft ³ total runoff
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3. Depth of rainfall-evaporation. Using data from Figures 21B-3a, -3b, and -4, calculate the depth of R-E on the exposed surface of the manure storage facility.

$$\frac{(\text{rainfall, in} - \text{evaporation, in})}{12} = \text{ft R-E} \quad \times \text{Storage facilities sq ft} = \text{ft}^3$$

$$\frac{30.72 - 20.16}{12} = 0.880 \text{ ft R-E} \quad \times 195,875 = 172,370$$

4. Sludge accumulation. Using data in Tables 21C-1 through 21C-10, calculate the volume of sludge accumulation

TS, lb/d/1,000 # x no. animals x average wt. x storage period, / 1,000 =	lbTS	x SAR, ft ³ /lbTS =	ft ³
<u>9.50</u> x <u>100</u> x <u>1,400</u> x <u>270</u> / 1,000 =	<u>359,100</u>	x <u>0.0729</u>	= <u>26,178</u>
<u>10.00</u> x <u>680</u> x <u>1,400</u> x <u>270</u> / 1,000 =	<u>2,570,400</u>	x <u>0.0729</u>	= <u>187,382</u>
<u>0.00</u> x <u>0</u> x <u>0</u> x <u>270</u> / 1,000 =	<u>0</u>	x <u>0</u>	= <u>0</u>
			Total 213,561
Percent of manure produced in barns 1-8 going into lagoon =			10%
			Total 21,356

5. Treatment volume. Using data from Tables 21C-1 through 21C-9 and Figure 21B-5, calculate treatment volume (lagoons only).

VS, lb/d/1,000 # x no. animals x average wt. / 1,000 =	lb VS/d	/ lb VS/1,000 ft ³ /d x 1,000 =	ft ³
<u>8.10</u> x <u>100</u> x <u>1,400</u> / 1,000 =	<u>1,134</u>	/ <u>4.75</u> x 1,000 =	<u>238,737</u>
<u>8.50</u> x <u>680</u> x <u>1,400</u> / 1,000 =	<u>8,092</u>	/ <u>4.75</u> x 1,000 =	<u>1,703,579</u>
<u>0.00</u> x <u>0</u> x <u>0</u> / 1,000 =	<u>0</u>	/ <u>4.75</u> x 1,000 =	<u>0</u>
			Total 1,942,316
Percent of manure produced in barns 1-8 going into lagoon =			10%
			Total 194,232

6. Volume/depth of 25 year, 24 hour storm. Using data in Figure 21B-6, calculate the depth of the 25-year, 24-hour storm on the manure storage facility surface and associated runoff from exposed lot and roof areas.

$$\text{Depth} = \frac{25\text{-yr, 24-hr storm, in}}{12} = \frac{5.5}{12} = 0.4583 \text{ ft}$$

$$25\text{-yr, 24-hr storm, ft} \times \text{exposed lot/roof area, ft}^2$$

$$0.4583 \times 209,115 = 95,844 \text{ ft}^3$$

7. Volume of washwater. Using water use data for the operation of estimating water use from similar operations, calculate the volume of washwater used during the selected storage period.

$$\text{Washwater use, gal/day} \times \text{storage period, days} / 7.48$$

$$1,490 \times 270 / 7.48 = 53,783 \text{ ft}^3$$

8. Total volume of manure storage facility. Sum the applicable volumes from Steps 1 through 7 above to obtain total manure storage facility volume.

manure/bedding	lot runoff	precip gain	sludge	treatment	25yr/24hr storm
<u>38,329</u>	<u>17,926</u>	<u>172,370</u>	<u>21,356</u>	<u>194,232</u>	<u>95,844</u>
+ washwater					
<u>53,783</u>	= <u>ft³ total volume</u>				
	<u>421,471</u>				

Westridge Dairy Lagoon 105

inside slope 2 to 1
length 775
width 125
depth 12

Usable Storage Capacity
422,938 ft³
3,163,788 gallons

depth	length	width	Per 1/2 foot		Cumulative	
			Feet ³	Gallons	Feet ³	Gallons
12.0	775	125	48,438	362,340	922,748	6,902,600
11.5	773	123	47,540	355,620	874,311	6,540,260
11.0	771	121	46,646	348,930	826,771	6,184,640
10.5	769	119	45,756	342,270	780,126	5,835,710
10.0	767	117	44,870	335,650	734,370	5,493,440
9.5	765	115	43,988	329,050	689,501	5,157,790
9.0	763	113	43,110	322,480	645,513	4,828,740
8.5	761	111	42,236	315,940	602,404	4,506,260
8.0	759	109	41,366	309,430	560,168	4,190,320
7.5	757	107	40,500	302,960	518,803	3,880,890
7.0	755	105	39,638	296,510	478,303	3,577,930
6.5	753	103	38,780	290,090	438,666	3,281,420
6.0	751	101	37,926	283,700	399,886	2,991,330
5.5	749	99	37,076	277,340	361,961	2,707,630
5.0	747	97	36,230	271,010	324,885	2,430,290
4.5	745	95	35,388	264,720	288,656	2,159,280
4.0	743	93	34,550	258,450	253,268	1,894,560
3.5	741	91	33,716	252,210	218,719	1,636,110
3.0	739	89	32,886	246,000	185,003	1,383,900
2.5	737	87	32,060	239,820	152,118	1,137,900
2.0	735	85	31,238	233,670	120,058	898,080
1.5	733	83	30,420	227,550	88,821	664,410
1.0	731	81	29,606	221,460	58,401	436,860
0.5	729	79	28,796	215,400	28,796	215,400
0.0	727	77	0	0	0	0

2' freeboard
188,378 ft³

24hr/25yr storm event
95,844 ft³

additional storage
194,312 ft³

270 days
manure & precip
228,626 ft³

treatment volume
194,232 ft³

sludge accumulation
21,356 ft³