ALABAMA SUPPLEMENTS TO THE

NATIONAL ENGINEERING FIELD HANDBOOK

CHAPTER 11. PONDS AND RESERVOIRS

Table of Contents

PART I - GENERAL

3. TYPES OF PONDS AND RESERVOIRS

Classify embankment ponds according to the National Engineering Manual, Alabama Engineering Job Approval Authority, AL-ENG-1. Secure design criteria from NRCS Conservation Practice Standard Code 378, Pond and the following table:

Job Class[1/]	**Principal Spillway (Storm 24 hour) or Detention Storage**	**Design Storm (24 hour) Emergency Spillway**		**Top of Dam or Freeboard Elevation**
	years	years[2/]	years[3/]	feet
I	0.5[4/]	10	50	1
I	1[4/]	25	50	1
II	2	25	50	1
III[5/]	5	50	50	1
IV[6/]	10	50	50	1
V	10	50	50	[6/]

See NRCS Conservation Practice Standard, Code 378 - Pond for Footnotes.

TABLE AL11-1. MINIMUM HYDROLOGIC CRITERIA AND SPILLWAY CAPACITY

PART II - EMBANKMENT PONDS

1. GEOLOGIC INVESTIGATIONS

RECORDS OF SOILS INVESTIGATIONS

A permanent record of all soil boring and test pits made will be maintained in the field office. Form SCS-ENG-538, AL-ENG-17 will be used to record soil borings on earth fill ponds and excavated ponds. Questionable sites and those requiring an engineer's approval will be recorded on SCS-ENG-538.

4. PRINCIPAL SPILLWAYS

DROP INLET SPILLWAYS

Design

The design capacity of a principal spillway will be adequate to discharge long duration, continuous, or frequent design flows without flow through the emergency spillway. Table AL11-2, Figure AL11-1, AL11-2, and AL11-3, or an approved computer design program will be used to size the principal spillway and set the crest of the emergency spillway. For siphon pipes, assume full pipe flow when the reservoir surface elevation is D/3 above the high point of a siphon invert. Outlet slopes must be maintained at design grades until a suitable outlet is reached.

Table AL11-3 and AL11-4 or an approved computer program should be used to determine the buoyant forces on riser pipes.

Exhibit AL11-1, AL11-2, and AL11-3 show typical examples of trash racks and deep water releases. Form AL-ENG-4A may be used (with slight modifications) to design ponds with siphon principal spillways.

5. EMERGENCY SPILLWAYS

Emergency spillways can be designed utilizing Exhibit 11-2, 11-5, or an approved computer design program.

7. DESIGN OF EARTHFILL EMBANKMENTS

The following definition and example shows how to use the tables and exhibits in the design and recording of data on Form AL-ENG-4A, POND DESIGN DATA, Figure AL11-4. Form AL-ENG-4A, or the WinPond, current version, shall be used on all engineering Class I and higher ponds which meet the Technical Guide Standard, Code 378 - Pond criteria.

Job Class - determined from the criteria listed on Form AL-ENG-1, ENGINEERING JOB APPROVAL CLASSIFICATION CHART in the National Engineering Manual. The actual JOB CLASS is determined by the largest controlling factor. Most of these can be determined from office data, with the effective height of dam determined from field surveys.

Soils - obtained from the soils map of the pond area and refers to the soils in the watershed. When several soils and land uses exist, use Form AL-ENG-15, Worksheet for Detention Discharge for Ponds.

Hydro.Gr. - Hydrologic Group - obtained from Chapter 2 or Technical Release 55.

Land Use - refers to the type of land use in the drainage area (Row Crop, Pasture, Woods, etc.).

Trtmt. - refers to the treatment or practice and cover type on the land use.

Condition - Hydraulic condition of the cover in the watershed (poor, fair, good).

Rainfall Dist. Type II or III - Circle the type rainfall distribution used for design.

DA - Drainage Area (acres) - determined by scale or planimeter from stereoscopic or soil maps. Critical drainage areas should be drawn from the contours on U.S.G.S. topographic maps and planimetered.

CN - Curve Number - a numerical value assigned a given soil-cover complex. (See Chapter 2).

W/S Slope - Average Watershed Slope - the average watershed slope (percent) over the entire watershed can be approximated by measuring the slope at several random locations throughout the watershed and averaging the results. The average watershed slope should be in line with slopes identified in the soil survey.

Flow Length – Length in feet along the flow path from the hydraulically most distant point to the pond dam.

Tc – Time of concentration for the watershed.

Rainfall (ps) or Rainfall (ES) - _____ in. _____ yr. - the rainfall amount and duration of event used in the dam design for the principal spillway or emergency spillway. (See Table 7 in NRCS Conservation Practice Standard, Code 378, Pond, for the storm event for the class of pond.)

Ia – Initial abstraction (See Chapter 2).

Ia/P(ps) – Ratio of Initial abstraction to design principal spillway storm.

Qpeak(ps) – Unit peak discharge for the principal spillway storm.

Vr - the volume of runoff in inches from the principal spillway storm that must be stored between the riser crest and emergency spillway crest and/or passed through the principal spillway pipe. Obtain the inches of runoff for the rainfall amount and CN. (See Chapter 2).

Qi (ps) - the peak inflow to the pond from the principal spillway storm.

Vs - the volume of floodwater storage available in the pond between the permanent pool elevation and the emergency spillway crest elevation in Ac-Ft. Obtain by averaging the area at the principal spillway crest and the emergency spillway crest, then multiplying by the elevation differences between the two areas. Surveys for determining pool areas will be documented in the survey notes or case file.

Vs(in.) - the volume of storage in acre-feet converted to inches. To convert, multiply _____ acre-feet x 12, then divide by the drainage area _____ acres, which give _____ inches.

Tab A or B - Circle whether using Table A or B as defined in Figure 1, Exhibit 11-4.

Qo (ps) - The peak discharge for the principal spillway pipe (Table A or B, Exhibit 11-4).

(A) Value from Table x Qi (ps) cfs = _____ cfs (Exhibit 11-4)

(B) Value from Table x DA acres = _____ cfs (Exhibit AL11-4)

H - Head in feet from emergency spillway crest to center of outlet end of barrel pipe or tailwater elevation.

Pipe Size - records the riser and barrel diameters as determined from Table AL11-2 using Qo (ps) and (H) head in feet.

Ia/P(es) – Ratio of initial abstraction to design emergency spillway storm.

Qpeak(es) – Unit peak discharge for the emergency spillway storm.

R.O. (es) – Runoff in inches for the emergency spillway storm.

Qes - The peak flow for the emergency spillway storm.

Qes (design) - The design flow for the emergency spillway.

Erosion Resistant Soil Yes or No, Circle One - Erosion Resistant Soils normally are considered to be hydrologic soil groups C & D and heavy B soils. Easily eroded soils are A and weak B soils.

Cover - Record the vegetation that will be established in the bottom of the emergency spillway.

Conditon Stand - From knowledge of landuser and visual observation of conditions around the farm determine conditions of vegetation to be fair or good.

Height - Determine an expected average height of vegetation. Record the heights for stability and capacity.

Slope - The average slope that can be secured in the emergency spillway exit channel.

Vel. - Determine from Exhibit 11-2, Table 1, the maximum permissible velocity in fps for the vegetated spillway using erosion resistant soil or easily eroded soil, cover vegetation and slope of exit channel.

Retardance: Stability - _____ capacity _____ - determine degree of retardance from Exhibit 11-2, Table 2, using condition of vegetation stand and average length (height) of vegetation.

Control-Section Length - The minimum length is determined from visual observation or determined from a plotted profile of the emergency spillway centerline (minimum 25 ft.).

q/ft - Discharge per foot width of the emergency spillway. For example, using retardance C enter Exhibit 11-2, Table 3A-3E. From left side of Table 3C at maximum velocity V = 7(6), 4% slope (slope range 1-12). Determine discharge of 4 cubic feet per second per foot of width.

S/W BW - The bottom width of the emergency spillway (ft.) is determined by dividing the emergency spillway discharge Qes(design) by q/ft.

Hp - The design depth of water in the reservoir above the crest of the emergency spillway.

SW/SS - The side slopes of the emergency spillway.

Exit Slope Range - Slope range is determined from Exhibit 11-2, Table 3C, as in discharge q/ft. above.

Adequate - Yes or no applies when you have or need to analyze for stability and capacity both using different retardance.

Embankment SS - The side slopes of the embankment.

Freeboard - A safety factor applied as an elevation above the designed elevation of flow (Hp) in the emergency spillway. (See NRCS Conservation Practice Standard Code 378, Pond.)

Flotation - Cubic feet of concrete required to counteract flotation (buoyancy) of the riser pipe. (See Table AL11-3, Table AL11-4, or use approved computer program.)

GENERAL INFORMATION or other information - describes items particular to a specific site and survey. These items are self-explanatory. Earth fill quantities are computed using Exhibit 11-6 or Table AL11-5 or an approved computer program.

The final design to be given to the landowner will include a Plan of Pond (AL-ENG-2 for a Class I or II pond, AL-ENG-3 for a Class III thru V pond), an AL-ECS-1 for critical area planting, and an Operation and Maintenance Plan for all dams. Prior to completing the final design of a Class I or larger embankment pond, Form AL-ENG-27 or 27a must be executed by the landowner. [See NEM, Part AL501.04(a) Exhibit 2.]

Figures AL11-4 present sample sets of construction layout notes for an embankment and earth spillway. Design, layout, and check notes may be recorded on approved standard forms or data sheets.

Figure AL11-5 presents a sample set of construction check survey notes for embankment ponds.

The following worksheets are shown for use as guides in determining class of structure, length of pipe, pipe buoyancy, anti-seep collars, and drawdown time for total pond drainage or drawdown to seinable depth.

FOUNDATION CUTOFFS

The cutoff trench shall have a bottom width of at least 8 feet with side slopes of 1.5:1 or flatter.

WORKSHEET FOR PONDS

DETERMINE CLASS OF STRUCTURE

Effective height of dam*: _____ ft. - _____ ft. = _____ ft. CLASS _____

*(Elev. Crest of emer. Spillway) - (Elev. Low point along centerline)

Conduit size _____ inches CLASS _____

Pipe conduit capacity _____ CFS CLASS _____

Auxilliary spillway flow _____ CFS CLASS _____

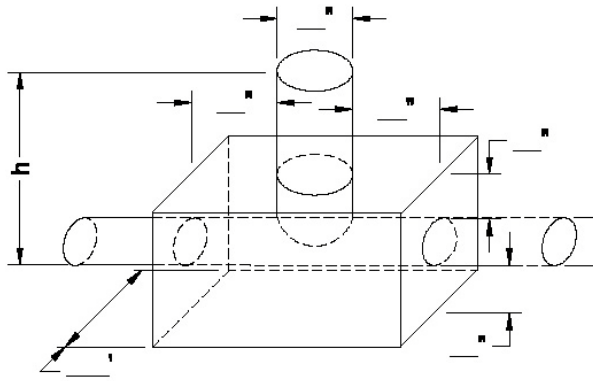
Drainage area _____ ac. CLASS _____

Storage = (0.40) x (_____ acres) x (_____ depth) = _____ ac. ft.

_____ ac.ft. x _____ ft. = _____ ac. ft. CLASS _____
Storage Eff. Height

Total Storage _____ ac.ft. CLASS _____

DETERMINE PIPE BUOYANCY



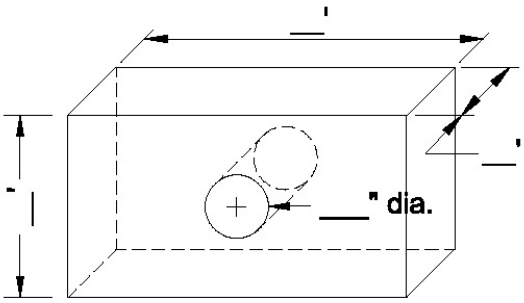
h = _____ ft.
W = _____ lbs./lin.ft.
B = _____ lbs./lin.ft.

Required vol. of concrete for concrete pad.

$$\frac{(B - W)\,h}{87.6} = \frac{(\_\_\_\_ - \_\_\_\_)\ \_\_\_\_'}{87.6}$$

= _____ ft^3

DETERMINE ANTI-SEEP COLLARS.



Fill Ht. = _____ top dam - _____ Invert pipe of dam

ASC's Required = _____ (See Table 6)

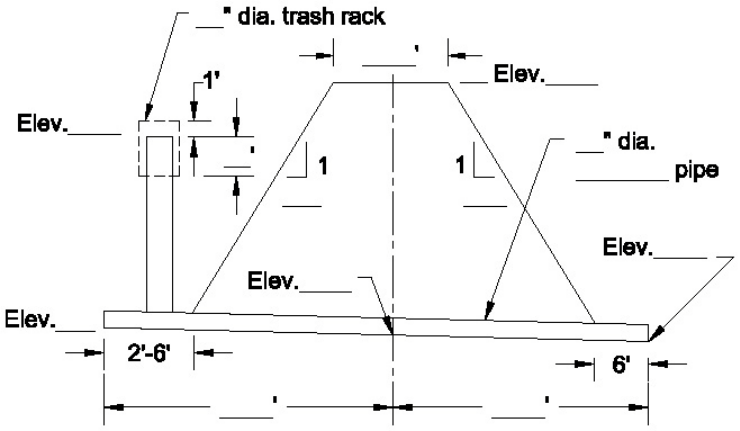
Type Collars _____

If concrete, volume needed = _____

Total Concrete Volume = (Pad) _____ C.F. + Anti-seep Collar _____ C.F. = _____ C.Y.

WORKSHEET FOR PONDS

DRAIN PIPE LENGTH CALCULATIONS



DRAW DOWN TIME FOR TOTAL POND DRAINAGE

(1) Total pond capacity

Hill pond = (0.40) x (_____ acres) x (_____' depth) = _____ ac.ft.

Levee pond = (_____' Max + _____ Min) x (_____ acres) = _____ ac.ft.
2

(2) Avg. depth pond = _____ Max. depth ft. = _____ ft.
2

(3) _____ " ---' + ---' will carry _____ ac.ft./day
2

(4) Time = _____ (1) / _____ (3) = _____ days

DRAWDOWN TIME TO SEINEABLE DEPTH (3 days or less)

(1) Max. depth @ riser = _____ ft.

(2) Pond acres full = _____ ac.

(3) Pond acres @ 7. ft. max. depth = _____ ac.

(4) Depth drained = _____ (1) - 7. ft. = _____ ft.

(5) Volume drained = [(_____ (2) + _____ (3)] x _____ (4) = _____ ac.ft.
2

(6) Avg. head on barrel = [(_____ (1) - 7 ft.] x 7 ft. = _____ ft.
2

(7) _____ " barrel pipe @ (6) will carry _____ ac.ft./day.

(8)Time = _____ (5) / _____ (7) = _____ days

PART III - EXCAVATED PONDS

5. PLANNING AN EXCAVATED POND

SELECTING POND DIMENSIONS

Water needs for cattle, Table AL11-6, and seepage and evaporation losses, Table AL11-7, are used to determine capacity of storage required. Use storage required and appropriate sheets of Table AL11-8 for dimensions of excavated ponds. As an alternative method, Table AL11-4 for dimensions of excavated ponds. As an alternative method, Table AL-4 can be used. This table has seepage and evaporation losses already substracted and the excavated ond size can be determined by the Total Water Needs for the Cattle. Where an excavated pond is fed from ground water, the depth should extend well into the water bearing material. Document in design notes when springs or seepage flow is used to reduce total needs and losses. Use pipe if needed for water level or erosion control.

ESTIMATING THE VOLUME OF AN EXCAVATED POND

The following example shows how to use the tables in the design of excavated ponds (AL-ENG-6) in Figure AL11-6).

Job Class ___I___ - Usually considered Class I unless hazard downstream.

Drainage Area __2__ Ac. - Watershed area draining into pond.

Soil Series Melvin - Soil into which the pond is excavated.

Cattle __30__ - Number of cattle landuser excepts to have on the pasture area.

Days __180__ - Includes possible days in which no return flow is expected.

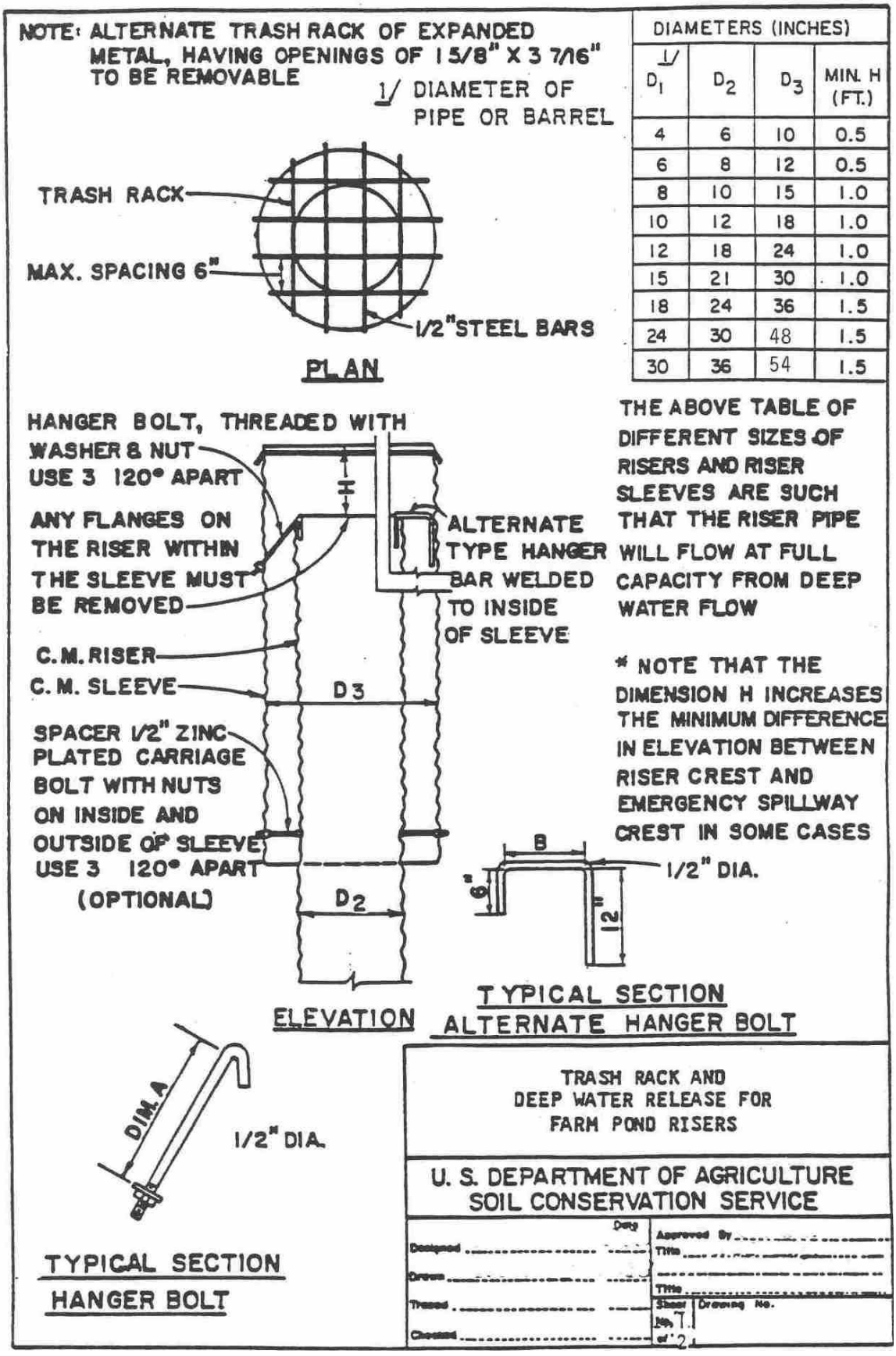
Cattle Needs __0.249__ AF - Enter Table AL11-8 with number of cattle at 30 and water needs at 180 days, at the intersection read 0.249 ac.ft.

Losses 0.821 AF - Enter Table AL11-7 using 180 days and presized pond or acres column to find seepage and evaporation losses at 0.821 ac.ft. (If the alternative design method, Table AL11-9, is used, the losses still should be recorded on the AL-ENG-6 when the surface dimensions have been determined.

Storage Required - 0.249 + 0.821 = 1.070 AF. Total cattle needs, seepage and evaporation losses.

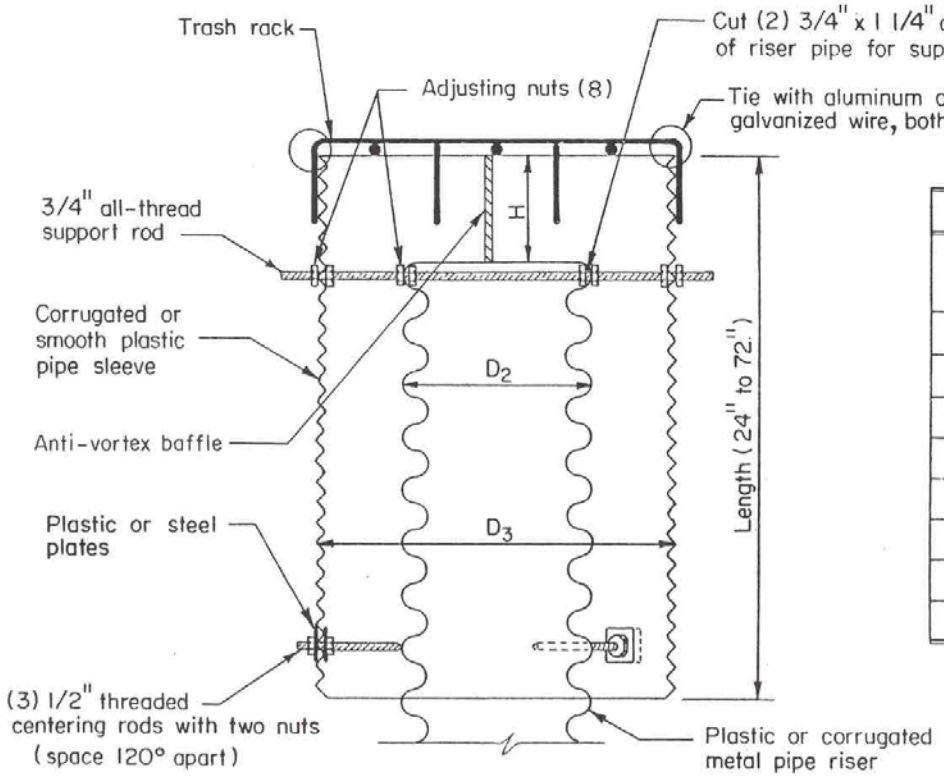
Surface Size - 100 x 100 ft. - Enter Table AL11-8 with desired end and side slopes of pond, 4:1, 3:1, and 2:1, with either the pond size 100 x 100 ft. or storage area feet 1.070 (Sheet 3 of 6) and final depth of 8 ft. with design storage of 1.138 AF, yardage of 1836 C.Y. and bottom size of 68 x 44 feet.

The remaining design parameter are in accordance with standards and specifications and land owners and designers options.



DIAMETERS (INCHES)			
1/ D_1	D_2	D_3	MIN. H (FT.)
4	6	10	0.5
6	8	12	0.5
8	10	15	1.0
10	12	18	1.0
12	18	24	1.0
15	21	30	1.0
18	24	36	1.5
24	30	48	1.5
30	36	54	1.5

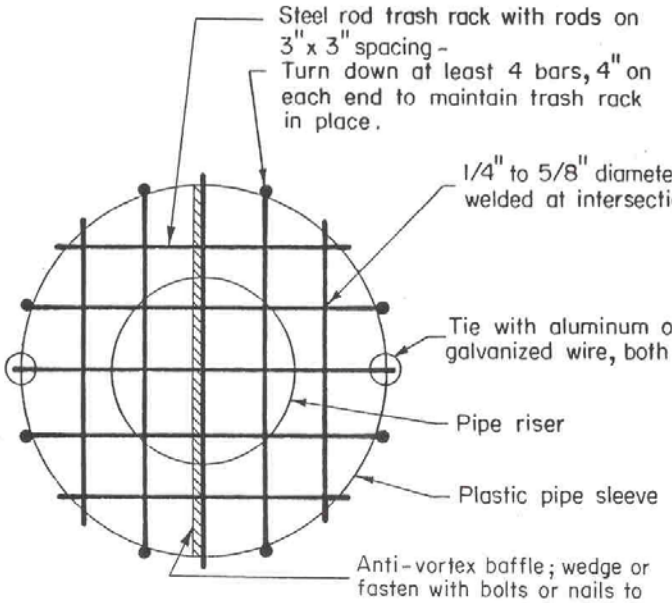
Exhibit AL11-1. Corrugated Metal or Smooth Steel Trash Rack and Deep Water Release Sleeve for Ponds.



SIDE VIEW

DIAMETERS			
D_1 1/	D_2	D_3	MIN. H (FT.)
4"	8"	12"	0.5
6"	10"	15"	0.5
8"	12"	18"	1.0
10"	15"	24"	1.0
12"	18"	27"	1.0
15"	21"	30"	1.0
18"	24"	36"	1.5
24"	30"	48"	1.5

1/Diameter for the barrel or outlet drain



TOP VIEW

NOTES:

(1) Trash rack or sleeve for use on farm ponds.
(2) Use above table to size trash rack or sleeve.
(3) Minimum wall thickness of smooth plastic pipe should be 0.25".
(4) All metal parts to be galvanized, cadmium plated or stainless steel.
(5) All plastic riser pipes will have a support - a treated post or equivalent.
(6) Anti-vortex baffle can be treated timber, durable plastic or metal. Fabricate the baffle to fit tight and upright by wedging or by fastening to the trash rack or sleeve.

PLASTIC SLEEVE AND TRASH RACK FOR FARM POND RISERS

_____ FARM

_____ ALABAMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date
Designed
Drawn
Traced
Checked
Approved by
Title
Title
Sheet No. 2 of 2
Drawing No.

Exhibit AL11-2. Trash Rack and Deep Water Release for Farm Pond Risers.

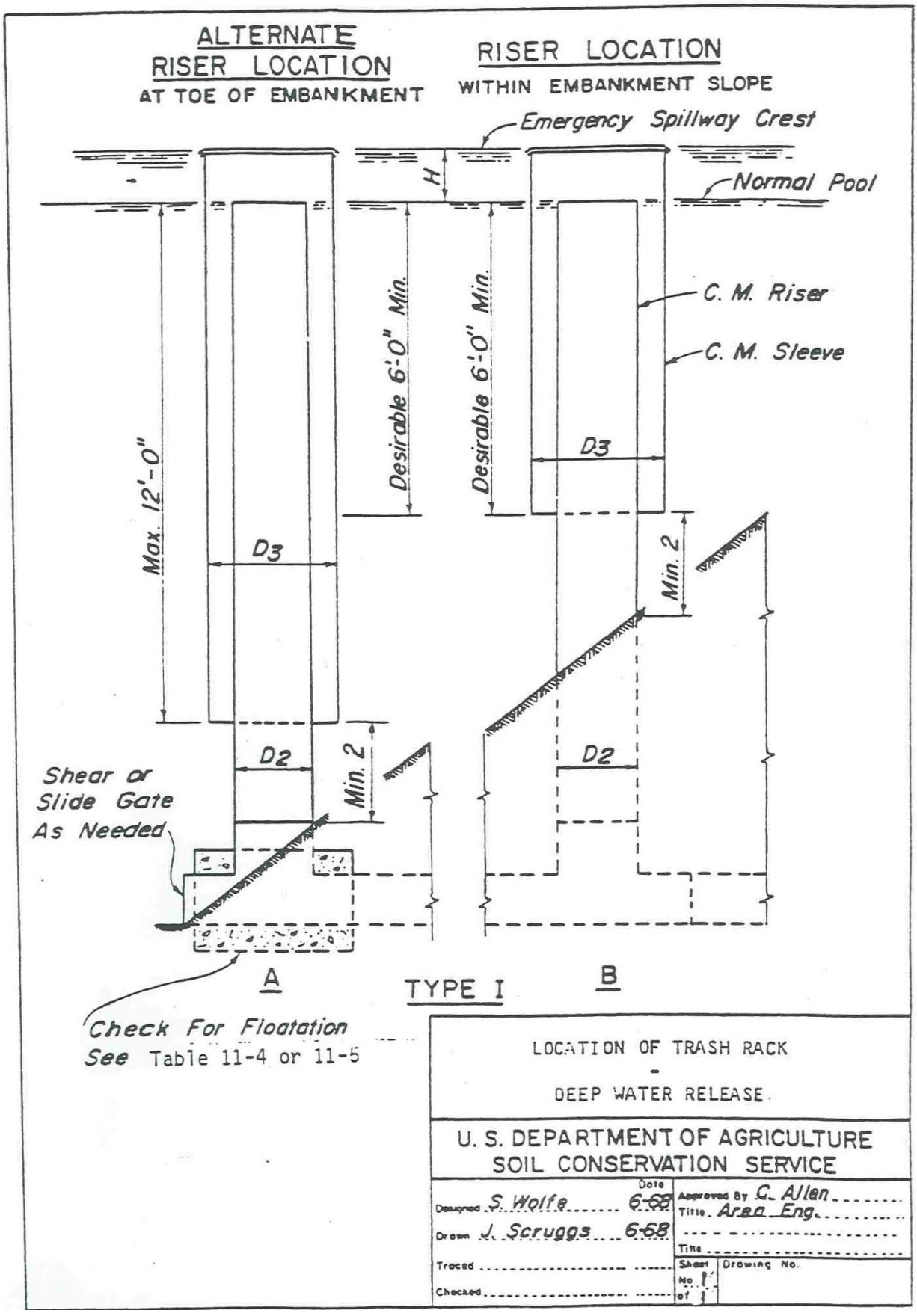


Exhibit AL11-3. Location of trash rack - Deep water release.

RUNOFF IN WATERSHED INCHES.

TABLE B
VALUES OF Qu IN Ft3/S/acre

STORAGE IN WATERSHED INCHES

	Vs																														
Vr	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
1.0	.89	.39	.19	.10	.06	.044	.031	.024	.018																					
1.4		.62	.33	.20	.12	.08	.05	.04	.030	.022																				
1.8			.57	.31	.21	.14	.09	.07	.05	.038	.026																			
2.0				.57	.33	.23	.16	.11	.08	.06	.039	.028																		
2.2					.59	.37	.25	.19	.13	.09	.06	.041	.031																	
2.4						.64	.42	.27	.21	.14	.09	.06	.040									USE								
2.6							.62	.45	.32	.23	.13	.08	.05	.020																
2.8								.65	.49	.34	.20	.12	.08	.05	.03							MINIMUM								
3.0										.49	.28	.17	.11	.08	.05	.04														
3.2	USE									.69	.41	.25	.16	.11	.08	.05						VALUES								
3.4											.55	.34	.22	.15	.11	.08	.05													
3.6	MINIMUM											.49	.31	.20	.14	.10	.08	.05				IN THIS								
3.8												.66	.44	.28	.19	.14	.10	.08	.05											
4.0	VALUES												.56	.39	.26	.19	.14	.10	.08	.05		AREA								
4.2														.49	.34	.23	.16	.13	.10	.08	.05									
4.4	IN THIS													.65	.45	.31	.22	.17	.13	.09	.07	.05								
4.6															.55	.41	.28	.20	.16	.12	.09	.07	.05							
4.8	AREA															.49	.36	.25	.21	.14	.12	.09	.07	.05						
5.0																.62	.45	.33	.27	.19	.15	.12	.09	.07	.06					
5.2																	.55	.43	.33	.23	.19	.14	.11	.08	.06	.05				
5.4		DISCHARGE VALUES TO THE LEFT OF LINE ARE TO BE USED FOR INTERPOLATION ONLY																.49	.39	.31	.23	.18	.14	.11	.09	.07	.05			
5.6		HOWEVER, INTERPOLATED VALUES SHOULD NT EXCEED 0.47 $ft^3/s/acre$.																.58	.45	.35	.28	.22	.17	.14	.11	.09	.07	.06		
5.8																			.55	.42	.34	.27	.21	.17	.14	.11	.09	.07		
6.0																				.51	.41	.32	.25	.20	.16	.13	.11	.09	.07	
6.2		PIPE FLOW STRUCTURES WITH A DISCHARGE 0.47 $ft^3/s/acre$.																		.61	.49	.38	.30	.24	.20	.16	.13	.11	.09	.07
6.4																					.59	.46	.37	.29	.27	.19	.16	.13	.11	.09
6.6																						.55	.44	.35	.29	.24	.20	.16	.13	.11
6.8																							.52	.42	.35	.29	.24	.20	.16	.14
7.2																								.50	.42	.34	.28	.23	.19	.16
7.6																									.50	.40	.33	.27	.23	.18
																										.59	.47	.40	.32	.27
																												.58	.47	.38

Exhibit AL11-4. Table “B

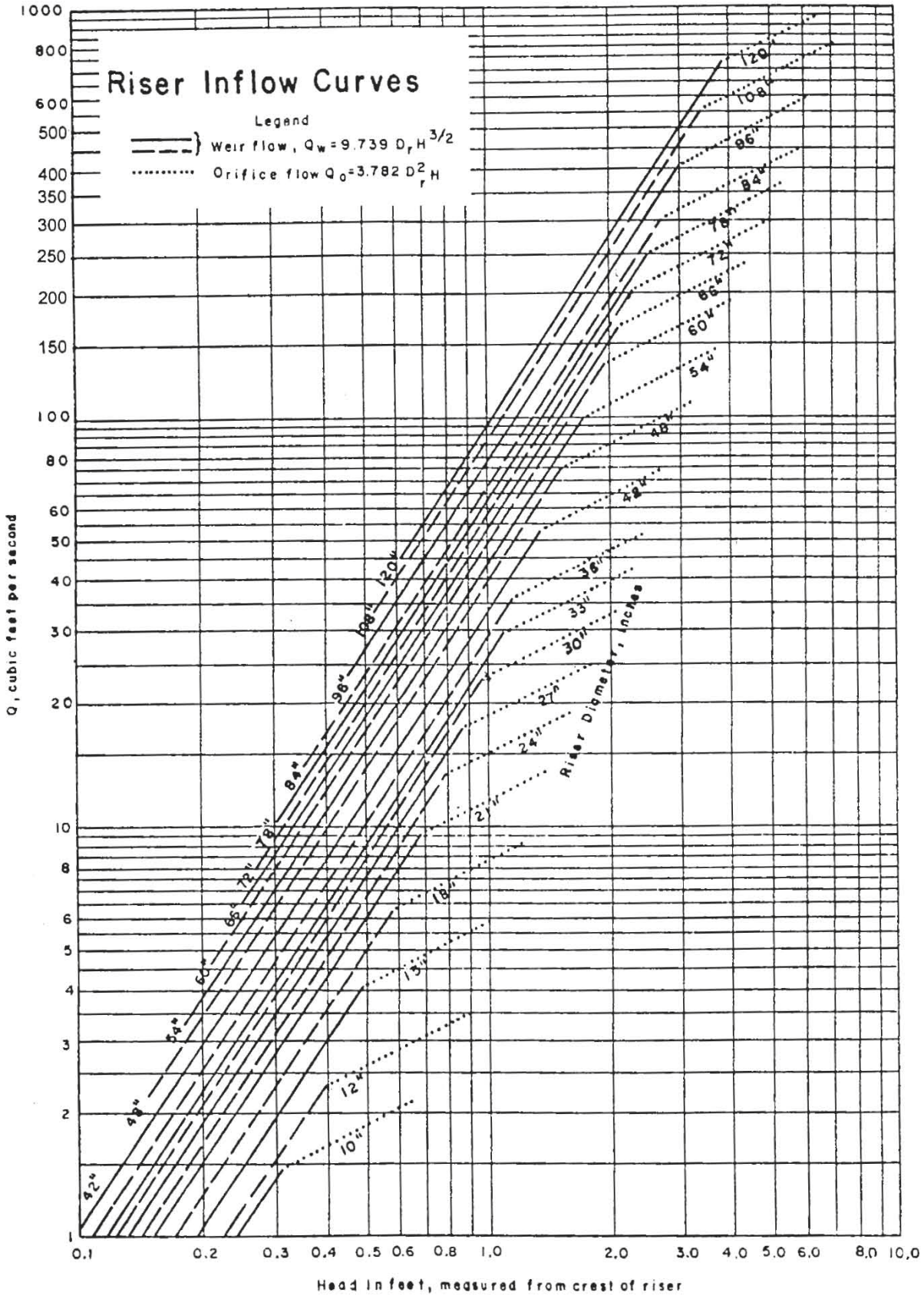


Figure AL11-1. Circular Riser Inflow Curves.

HEAD DISCHARGE TABLE FOR CORRUGATED METAL PIPE
DROP INLETS
(WEIR FLOW CONDITION)

Riser Diameter Inches	Head in Feet												
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15	2.7	3.8	4.9	6.3	ORIFICE								
18	3.2	4.5	5.9	7.6	9.3	10.9	FLOW						
21	3.8	5.3	7.0	8.8	10.7	12.8	15.0	CONDITIONS					
24	4.3	6.0	7.9	10.1	12.3	14.6	17.1	19.7	22.4	CONTROL			
30	5.4	7.5	9.8	12.6	15.4	18.2	21.4	24.6	28.0	31.7	35.5		
36	6.4	9.0	11.8	15.1	18.5	21.8	25.7	29.5	33.6	38.0	42.6	47.2	51.9
42	7.5	10.5	13.8	17.7	21.6	25.5	30.0	34.5	39.3	44.4	49.8	55.1	60.5
48	8.6	12.0	15.7	20.2	24.6	29.1	34.2	39.4	44.8	50.7	56.8	63.0	69.1
54	9.6	13.5	17.7	22.7	27.7	32.8	38.5	44.3	50.5	57.0	64.0	70.9	77.8
60	10.7	15.0	19.7	25.2	30.8	36.4	42.8	49.2	56.1	63.3	71.0	78.7	86.4

Riser Diameter Inches	Head in Feet								
	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
42	66.5	72.5	ORIFICE FLOW						
48	76.0	82.8	89.7	96.9	104.1	CONDITIONS CONTROL			
54	85.5	93.2	100.9	109.0	117.1	125.6	134.5	143.3	
60	95.0	103.6	112.1	121.1	130.1	139.5	149.3	159.2	169.0

NOTES: (1) The discharge capacities shown in this table are based on the formula:

$$Q_2 = C_2 L H_2^{3/2}$$

Q_2 = discharge capacity of weir, in c.f.s.
C_2 = weir coefficient = 3.33
L = length of weir crest, in feet (for circular riser with headwall, L = 2.57 times diameter of riser).
H_2 = distance from crest of riser to water surface in reservoir, in feet.

(2) The diameter of the riser should be at least 1¼ times the diameter of barrel.

(3) Use this table in conjunction with orifice flow and full pipe flow conditions to determine capacity of the drop inlet.

Figure AL11-2. Chart for determining inlet proportions and required head over inlet.

	Siphon Pipe Flow Rates (Q) in CFS (for pipe length = 70 feet)						
Head (H)		Nominal pipe diameter, "D" in inches (Area, sq.ft.)					
in feet	**4**(0.09)	**6**(0.20)	**8**(0.35)	**10**(0.55)	**12**(0.79)	**14***(0.99)	**16***(1.31)
2	0.305	0.833	1.666	2.816	4.290	5.608	7.651
4	0.432	1.178	2.356	3.982	6.066	7.931	10.820
6	0.529	1.443	2.885	4.877	7.430	9.713	13.252
8	0.610	1.666	3.331	5.632	8.579	11.216	15.302
10	0.682	1.863	3.725	6.297	9.592	12.540	17.108
12	0.748	2.040	4.080	6.898	10.507	13.737	18.741
14	0.808	2.204	4.407	7.450	11.349	14.837	20.243
16	0.863	2.356	4.711	7.965	12.133	15.862	21.640
18	0.916	2.499	4.997	8.448	12.869	16.824	22.953
20	0.965	2.634	5.267	8.905	13.565	17.734	24.195
Length (L)		**Correction factors for other pipe lengths.**					
in feet							
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00
75	0.97	0.98	0.98	0.98	0.98	0.99	0.99
80	0.95	0.96	0.96	0.97	0.97	0.97	0.98
85	0.93	0.94	0.94	0.95	0.96	0.96	0.96
90	0.91	0.92	0.93	0.94	0.94	0.95	0.95
95	0.89	0.90	0.91	0.92	0.93	0.94	0.94
100	0.87	0.88	0.90	0.91	0.92	0.92	0.93
105	0.85	0.87	0.88	0.90	0.91	0.91	0.92
110	0.83	0.85	0.87	0.88	0.90	0.90	0.91
115	0.82	0.84	0.86	0.87	0.88	0.89	0.90
120	0.80	0.83	0.84	0.86	0.87	0.88	0.89
125	0.79	0.81	0.83	0.85	0.86	0.87	0.89
130	0.78	0.80	0.82	0.84	0.85	0.86	0.88
135	0.76	0.79	0.81	0.83	0.84	0.86	0.87
140	0.75	0.78	0.80	0.82	0.84	0.85	0.86
145	0.74	0.77	0.79	0.81	0.83	0.84	0.85
150	0.73	0.76	0.78	0.80	0.82	0.83	0.84
160	0.71	0.74	0.76	0.78	0.80	0.81	0.83
	* The actual diameters used in calculating flow rates for these two pipe						
	sizes are 13.5 inches and 15.5 inches, respectively.						
	Assume full pipe flow when pool rises to D/3 above crest of siphon.						
	The design data for Q is based on the following parameters:						
	Q=8.025(A)(H)^0.5/(1+Km+KpL)^0.5 Km=Ke+sum Kb's=2.45						
	Ke=1 n=0.012 (PVC or smooth steel) Kp = 5087n^2/D^1.331						
	Example: For H=16' and D=8", to adjust Q for L=120', find						
	factor of 0.84. Q = (4.711)(0.84)/=3.96 cfs						

Figure AL11-3. Siphon Pipe Flow Rates.

PONDS

A. Engineering Surveys for Design and Construction Layout (SCS-ENG-28 and 29 - Loose Leafs)

1. Complete title page (SCS-ENG-28) with sketch of practice location.
2. Show at beginning of survey: farmer's name, purpose of survey, name of practice, party members, duties, and date.
3. Describe benchmark.
4. Close out survey within allowable limits.
5. Soil borings.
6. Complete design date including placement of spoil and vegetative needs.
7. Include in surveys: cross section, pipe elevations, waterline, and stakes for construction.
8. Design approval and date.
9. Review General Manual 450-407 for all components.

B. Construction and Performance Check (SCS-ENG-29 - Loose Leafs)

1. Use Pond Construction Check Data Form.
2. Make profile along centerline of top of completed dam.
3. Cross-section at one or more locations of the completed dam.
4. Profile and cross section of completed spillway.
5. Elevation of completed riser and invert of barrel at outlet end of pipe spillway.
6. Statement of depth and area of normal pool if part of specifications.
7. Other items as specified by General Manual 450-407.
8. General remarks and certification that practice meets construction plans and specifications.

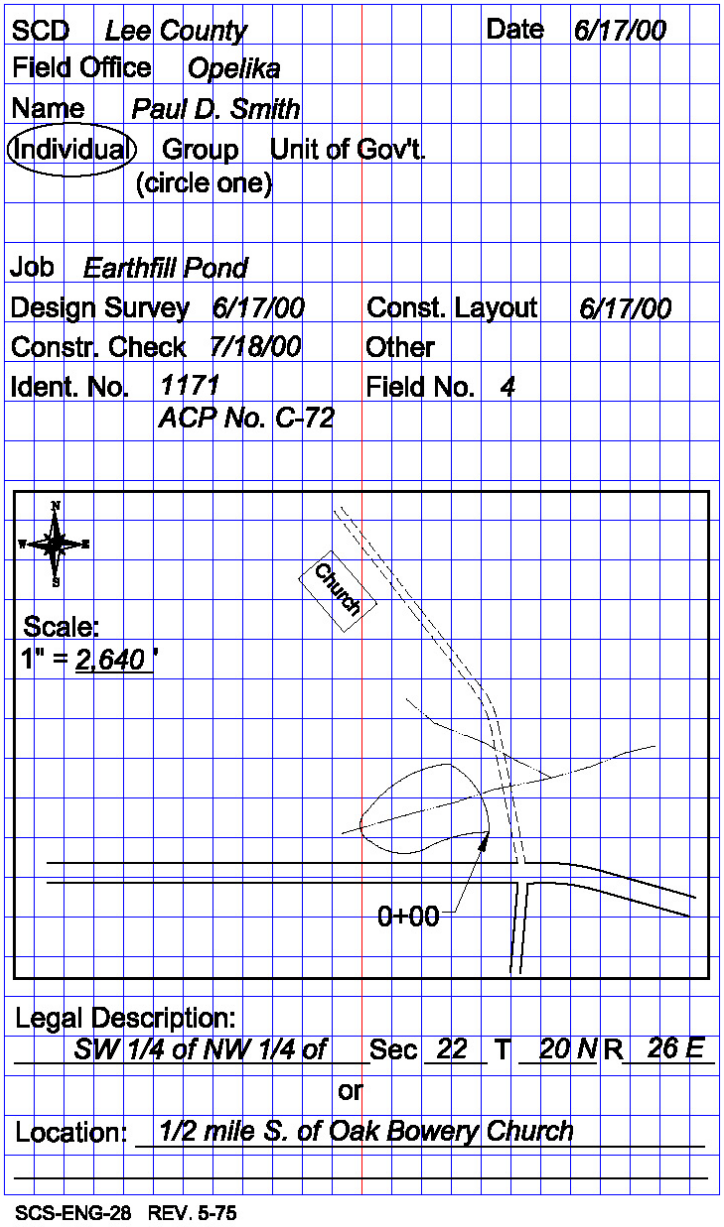


Figure AL11-4. Design and construction layout survey notes for earth fill pond. (Sheet 1 of 4)

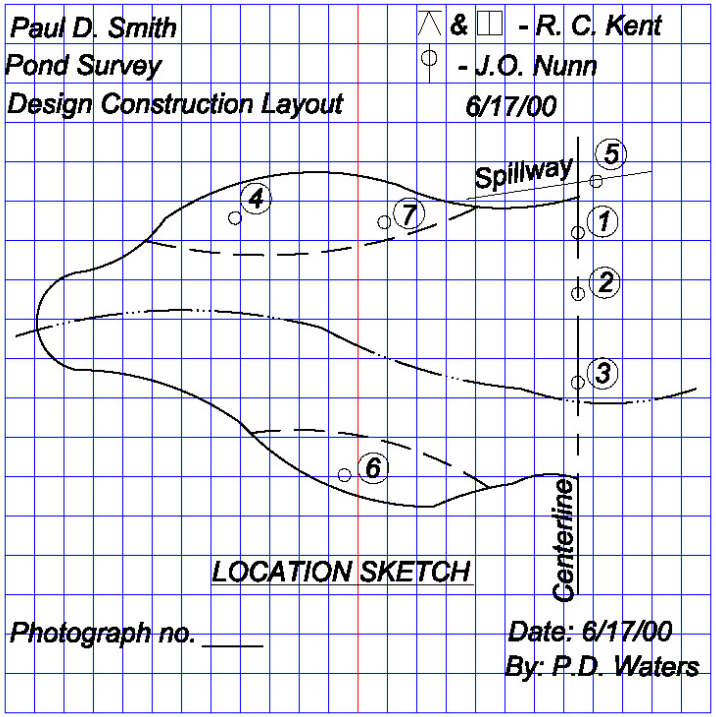
U. S. Dept. of Agriculture
Natural Resources Conservation Service

AL-ENG-4A
July 2007

POND DESIGN DATA

Computer Design Manual Design X

Job Class IV Soils Eutaw Hydro. Gr. D
Land Use Pasture Trtmt. NMT Condition Fair
Rainfall Dist. Type II or (III) DA 230 ac. CN 84
W/S Slope 3 % Flow Length 4,800 ft. Tc 0.94 hrs.
Rainfall (ps) 6.5 in. 10 yr.; Ia 0.381 in.
Ia/P(ps) = 0.06; Qpeak(ps) = 0.48 cfs/ac/in; Vr = 4.7 in.
Qi(ps) = [Qpeak(ps) 0.48 x (DA) 230 x (Vr) 4.7 = 518 cfs
Vs = [(25 ac. + 29 ac.) / 2] x 2.0 ft. = 54 AF
Vs (in.) = [(Vs) 54 AF x 12] / (DA) 230 ac. = 2.8 in.
Use Vs = 2.8 in. & Vr = 4.7 in.
See National Engineering Field Handbook, Chapter 11, Exhibit 11-4.
(TAB A) Qo(ps) = _____ x _____ cfs = _____ cfs
(TAB B) Qo(ps) = 0.30 x 230 ac. = 69 cfs
H = 15 ft.; Pipe Size = 30 in. barrel; 48 in. riser
Rainfall (es) 8.7 in. 50 yr.
Ia/P(es) = 0.04; Qpeak(es) = 0.48 cfs/ac/in; R.O. (es) = 6.8 in.
Qes = [Qpeak(es)] 0.48 x (DA) 230 x [R.O.(es)] 6.8 = 750 cfs
Qes(design) = (Qes) 750 - [Qi(ps)] 518 = 232 cfs
Erosion Resistant Soil: (Yes) No Cover Fescue
Cond. Stand Fair; Height 6 in. to 10 in.; Slope 4 %
Vel. 7 fps; Retardance: Stab. D Capacity D
Control-Section Length = 100 ft.; q/ft.= 4
S/W BW = [Qes(design)] 232 / (q/ft.) 4 = 58 ft.
Use: BW = 2 x 30 ft.; Hp = 1.7 ft.; S/W SS = 3 :1
Exit Slope Range: 1 to 7 Adequate yes
Embankment SS = 3 :1 TW = 14 ft.
Freeboard = 1.5 ft. El Riser 98.0 El Aux. S/W 100.0
El Top of Dam 103.2 Settlement 3 % Pond Use Catfish
Capacity = 0.4 x 25 ac. x 13 ft. = 130 AF
Barrel 149 ft. of 30 in. Smooth Steel Pipe
Riser 13 ft. of 48 in. Smooth Steel Pipe
Valve 30 in.; 3 Collars(ASC) ¼ in. X x 5 ft. x 5 ft.
(Trash Rack) Sleeve 60 in. x 4 ft.
Flotation(ballast) = [(B) 183.7 (W) 117.8] x (H) 13 / 87.6 = 99 CF
Concrete = [(ballast) 99 CF + (ASC) — CF] / 27 = 3.7 CY
Quantity of Fill 25,000 CY Veg. 2.5 ac.
Design By REK Checked By ERJ



LOCATION SKETCH

DATE 1-00
BY JLD

- **PHOTOGRAPH NO.** R-22

SOIL BORINGS

HOLES	1	2	3	4	5	6	7
DEPTH							
1	SM	SM	SM	SM	SM		
2	SC	SC	SM	SM	SP		
3	SC	SC	SC	SC	SM		
4	SC	SC	SC	SC	SC		

REMARKS: Material is good for pond site. Salvage topsoil for reuse.

U.S. Dept. of Agriculture
Natural Resources Conservation Service

AL-ENG-17
Rev. 9/99

Figure AL11-4. Design and Construction layout survey notes for earth fill pond. (Sheet 2 of 4)

Station	B. S.	H. I.	F. S.	Elev.	Elev. Top of Dam
TBM	5.10	106.10		101.00	(Constructed)
0+00			+6.1	100.00	100.00
0+25			+6.1	100.00	100.10
0+50			+6.1	100.00	100.20
0+75			+6.1	100.00	100.30
TP	1.70	96.60	11.20	94.90	
1+00			-3.4	100.00	100.40
1+25	Pipe location		-3.4	100.00	100.70
1+50			-3.4	100.00	100.70
1+75			-3.4	100.00	100.70
2+00			-3.4	100.00	100.50
2+25			-3.4	100.00	100.30
TP_2	11.00	106.40	1.20	95.40	
2+50	End fill		+6.4	100.00	
2+57	Edge spillway		+9.0	97.4	

Designed by: J. Scruggs Checked by: W. O. 6/17/00

Nail in west side of 8" Sweetgum, 100' west of sta. 0+00.

Sta. 0+00

Fill Vol.			
0.00'	6.1 F=0.00-6.0'	6.1 F=0.0'	6.1 F=0.0-6.0'
0.62		7.2 F=1.1'	
1.71		8.5 F=2.4'	
6.67	11.9 F=5.8 -23.4'	12.1 F=6.0'	12.5 F=6.4 - 25.2'
11.57		5.0 F=8.4'	
30.54	11.0 F=14.4 - 49.2'	11.3 F=14.7'	11.4 F=14.8 - 50.4'
30.54		11.3 F=14.7'	
29.81	11.0 F=14.4 - 49.2'	11.1 F=14.5'	11.2 F=14.6 - 49.8'
16.92		7.1 F=10.5'	
6.14		2.3 F=5.7'	
		2.3 F=5.7'	
0.49	7.3 F=0.9 - 8.7'	7.3 F=0.9'	7.3 F=0.9 - 8.7'
		6.6 C=2.4'	

Figure AL11-4. Design and construction layout survey notes for earth fill ponds. (Sheet 3 of 4)

Station	B. S.	H. I.	F. S.	Elev.	
2+79	CL Spillway		+9.0	97.4	
3+01	Edge Spillway		+9.0	97.4	
3+20	End slope Spillway		+4.1	102.3	
		106.04			
Spillway Slope Stakes					
0+00	Waterline		+10.2	96.2	
0+50	Begin Level Section		+9.0	97.4	CL Dam Sta. 2+68
0+80	Control Section		+9.0	97.4	
1+25			+10.7	95.7	
1+75			+12.7	93.7	
TBM_2	4.50	104.50	6.40	100.00	
TBM_1			3.50	101.00	101.00
				Error 0.00	OK R.K.

Paul D. Smith — R. C. Kent

Spillway Survey — J. O. None

Design Const. Layout — 6/17/00

5.8
C=3.2'

5.0
C=4.0'

(135.01) (25) = 3375.25 cu.yd.

7.7 C=2.5 - 29.5'	7.7 C=2.5'	7.7 C=2.5 - 29.5'
4.8 C=4.2 - 33.7'	6.0 C=3.0'	6.8 C=2.2 - 27.7'
4.3 C=4.7 - 35.2'	6.0 C=3.0'	7.4 C=1.7 - 26.2'
7.9 C=2.8 - 30'	9.3 C=1.4'	9.0 C=1.7 - 27.1'
12.7 C=0.0 - 22.0'	12.7 C=0.0'	12.7 C=0.0 - 22.0'

Figure AL11-4. Design and construction layout survey notes for earth fill pond. (Sheet 4 of 4)

7/10/00 Approved cut-off for backfill.					J.O.N.
7/12/00 Completed laying pipe and marked riser for waterline elevation.					J.O.N.
7/18/00 Checked out pond. Construction O.K. Talked with farmer about seeding fescue and clover and mulching dam and spillway. Also recommended temporary fencing to exclude livestock.					J.O.N.
7/30/00 Dam, spillway and borrow area seeded and mulched; dam and spillway fenced.					J.O.N.
T.B.M. 1	0.52	101.52		101.00	
0+00			+1.5	100.00	
0+50			+1.4	100.10	
1+00			+1.1	100.40	
1+25			+0.8	100.70	

U.S. DEPT. OF AGRICULTURE
Natural Resources Conservation Service

AL-ENG-5
Rev. 9/99

POND CONSTRUCTION CHECK DATA

UTILITIES CHECKED BEFORE CONST. Yes
AL-ENG-2 OR 3 ON FILE Yes
CUT-OFF INSPECTION & APPROVAL 7/10/00 J.O.N.
CLEARING AND DISPOSAL IS Satisfactory
SIZE AND TYPE MATERIAL MEETS SPECS: Yes
DRAIN PIPE 100 FT. OF 10 IN. Steel PIPE
RISER 11 FT. OF 15 IN. Steel PIPE
TRASH RACK OR SLEEVE 24 IN. x 7 FT.
VALVE OR GATE 8 IN. A.S.COLLARS 4 x 4 FT.
POND EDGES DEEPENED AS REQUIRED Yes 2+ feet
CREST ELEV. OF RISER & BARREL OUTLET IS O.K.
VEGETATION ON DAM, SPILLWAY, AND BORROW AREA:
TYPE: fescue/clover CONDITION: Very good
J.O.N.

Nail in west side of 8" sweetgum 100' west of sta. 0+00.

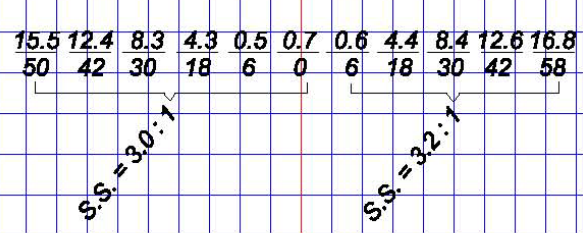


Figure AL11-5. Construction check survey notes for earth fill pond. (Sheet 1 of 3)

Station	B. S.	H. I.	F. S. or grade rod		Elev. or planned elev.
		101.52			
Crest of riser			+5.32		96.20
Invert outlet pipe			16.5		85.0
1+75			+0.8		100.70
2+25			+1.2		100.30
2+58	Edge spillway		+4.1		97.40
2+80	CL spillway		+4.1		97.40
3+02	Edge spillway		+4.1		97.40
TP	4.18	103.24	2.46		99.06
3+22			+0.9		102.30
	Profile spillway				
0+00			+7.0		96.20
0+50	Begin level section		+5.8		97.40
0+80	Control section		+5.0		97.40

Paul D. Smith — J.O. None

Pond Construction Check Survey — R.C. Kent

7-18-00

5.3
0.7
1.0
4.1
4.1
4.1
0.8
7.0
5.8
5.8

Figure AL11-5. Construction check survey notes for earth fill pond. (Sheet 2 of 3)

Station	B. S.	H. I.	F. S.	Elev.	
1+25			+7.5	95.70	
1+70			+9.5	93.70	
TBM_2			3.24	100.00	100.00
				0.00	OK - W.C.

Paul D. Smith — J.O. None

Pond Construction Check Survey — R.C. Kent

7-18-00

7.4

Good outlet conditions 9.5

The pond has 4.8 ac. of waterline. The fill, borrow area and spillway have diversions installed and are to be seeded and mulched today. The construction as checked meets plans and specifications.

J.O. None
Cons. Tech. 7/18/00

Vegetation on dam, spillway and borrow area was found to be adequate and the dam and spillway fenced.

R.C. Kent
Cons. Tech. 8/10/00

Figure AL11-5. Construction check survey notes for earth fill pond. (Sheet 3 of 3)

EXCAVATED PONDS

A. Engineering Surveys for Design and Construction Layout
(SCS-ENG-28 and 29 - Loose Leaf Notes)

1. Complete title page with sketch of practice location.
2. Show at beginning of survey; farmer's name, purpose of survey, name of practice, party members, duties, and date.
3. Describe benchmark.
4. Close out survey within allowable limits.
5. Soil borings.
6. Complete design data including placement of spoil and vegetative needs.
7. Include in surveys; cross sections, bottom elevation, and stake for construction.
8. Design approved and checked.

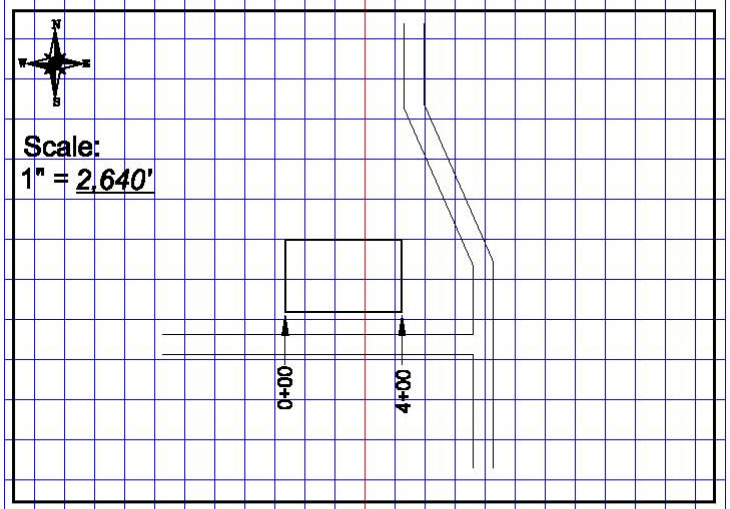
B. Construction and Performance Check
(SCS-ENG-29 - Loose Leaf Notes)

1. Survey cross sections showing side slopes, depth with measurements of length and width of pond.
2. When spoil is placed in a dam, show differential elevations between by-pass and top of dam.
3. Supporting statements.
   a. Placement and disposal of spoil.
   b. Condition of clearing disposal.
   c. Condition of vegetation.
   d. General remarks about construction meeting plans and specifications along with signature, title, and dates.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCD *Cherokee County* Date *3/20/00*
Field Office *Centre*
Name *John Jones*
(Individual) Group Unit of Gov't.
(circle one)

Job *DO Pond*
Design Survey *3/20/91* Const. Layout *3/20/00*
Constr. Check *3/30/91* Other
Ident. No. *ACP-C-72* Field No. *4*



Legal Description:
SE 1/4 of NW 1/4 of Sec *25* T *10 S* R *11 E*
or
Location: *3 miles west of Beltsville*

SCS-ENG-28 REV. 5-75

Figur excavated pond. f 3)

U.S. DEPT. OF AGRICULTURE — **AL-ENG-6**
Natural Resources Conservation Service — **Rev. 9/99**

DUG POND DESIGN DATA

IF STANDARDIZED DESIGN, CHECK HERE
JOB CLASS I **DRAINAGE AREA** 2 **AC.**
SOIL SERIES Melvin
CATTLE 30 **HEAD** 180 **DAYS OR** 6 **MONTHS**
CATTLE NEEDS = 0.249 **AF. LOSSES =** 0.821 **AF.**
STORAGE REQ'D = 0.249 **+** 0.821 **=** 1.070 **AF.**
SURFACE SIZE = 100 **x** 100 **FT. S. SLOPES** 2 **:1**
END SLOPES 4 **:1 &** 3 **:1 DEPTH** 8 **FT.**
DESIGNED STORAGE = 1.138 **AF.**
YARDAGE = 1836 **BOT. SIZE =** 44 **x** 68 **FT.**
SPOIL IS TO BE shaped on 3 sides
SEEDED TO fescue/clover with mulch
DESIGNED BY J.R.S. **CHECKED BY** R.G.H.

LOCATION SKETCH

DATE 1-00
- **PHOTOGRAPH NO.** R-22 **BY** JLD

SOIL BORINGS

HOLES	1	2	3	4	5	6	7
DEPTH							
1	SM	SM	SM	SM	SM		
2	SC	SC	SM	SM	SP		
3	SC	SC	SC	SC	SM		
4	SC	SC	SC	SC	SC		

REMARKS: The site should hold water and is fed by a small underground seep flow.

U.S. Dept. of Agriculture — **AL-ENG-17**
Natural Resources Conservation Service — **Rev. 9/99**

NOTE:
Elev. Ground = 99.82
Depth = 8.0
Bot. Pond = 91.8
Spoil Placement
El. nor. grnd. = 99.82
+Spoil Height = 3.0
El. Top Spoil = 102.82

Station	B. S.	H. I.	F. S.	Elev.	Plan. Elev.	
						John Jones - Dug Pond — J.R. Smith
						Design - Construction Layout — R.G. Hunt
						3/20/00
TBM	4.12	104.12		100.00		Nail in base of 12" Poplar tree, 50' north of sta. 0+00.
0+00			+12.3		91.8	4.3/0 4.4/20 4.5/40 4.3/60 4.3/80 4.0/100 c = 8.0 c = 8.3
Ave. Rod			+4.3	99.82		4.0/0 4.2/20 4.4/40 4.3/60 4.3/80 4.0/100
1+00			+12.3		91.8	Bot. pond c = 8.3 c = 8.3
Top Spoil			+1.3	102.8		Top Spoil (3 ft.)
TBM			4.12	100.00		Bypass at Elev. 99.8
				-100.00	O.K.	
				0.00	J. Smith	

Figure AL11-6. Design - construction layout survey notes for excavated pond. (Sheet 2 of 3)

Station	B. S.	H. I.	F. S. or Grade Rod	Elev. or Planned Elev.	
TBM	4.09	104.09		100.00	
Overflow			+4.3	99.8	
0+20	WL		+4.3	99.8	
0+75	Bottom		+12.3	91.8	
1+25	WL		+4.3	99.8	
TBM			4.09	100.00	
				100.00	O.K.
				0.00	J.S.

John Jones - DO Pond — J.C. Smith

Construction Check — R.C. Hunt

Description p.29 — 12/12/77

4.5*

4.0/0

4.5/20

7.0/30 — 4.1:1

9.0/40

12.3/52

2.2:1 — 2:1

3.9/0 2.8/10 2.4/20 4.5/30 12.5/48 12.4/114 8.6/122 4.5/130 4.0/146

12.4/98

8.0/108

Top: 100' x 105' — 4.5/125 — 3.4:1

Bottom: 66' x 64' — 2.2/140

2.2/158

6.0/180

Clearing and disposal is satisfactory, spoil is spread, shaped and seeded to fescue and clover. Construction meets plans and specs.

J.R. Smith 2/16/77

* Take adequate rod readings to show exact shape of pond and spoil. This must include a shot on the exact waterline, as determined from the constructed overflow, on each of the sides.

Figure AL11-6. Design - Construction layout survey notes for excavated pond.

Smooth Pipe (inches)										Corrugated Pipe (inches)							
Barrel Diam.	4	6	8	10	12	15	18	24	30	6	8	10	12	15	18	24	30
Riser Diam.	6	*Use Figure AL11-8A								8	10	* Use Figure AL11-8a					
Head in Feet																	
6	0.8	1.8	3.4	5.7	8.3	14.1	24.6	40.7	65.0	1.0	2.1	3.7	5.7	10.2	15.7	31.4	53.0
7	0.8	1.8	3.6	5.9	8.6	14.9	24.9	42.8	69.1	1.0	2.1	3.8	5.8	10.5	16.3	32.6	55.2
8	0.9	1.8	3.7	6.1	8.9	15.3	25.3	45.0	73.2	1.1	2.2	3.9	5.9	10.7	16.9	33.8	57.5
9	0.9	1.8	3.8	6.4	9.2	15.8	25.7	46.9	76.5	1.1	2.2	4.0	6.1	11.0	17.3	34.8	59.3
10	1.0	1.9	3.9	6.6	9.6	16.4	26.1	48.7	79.7	1.1	2.3	4.1	6.2	11.3	17.7	35.8	61.1
11	1.0	1.9	4.0	6.8	9.9	17.0	26.6	50.3	82.6	1.1	2.3	4.1	6.4	11.6	18.1	36.7	62.7
12	1.1	2.0	4.1	7.0	10.2	17.6	27.0	52.0	85.1	1.1	2.4	4.2	6.5	11.8	18.5	37.5	64.2
13	1.1	2.0	4.2	7.2	10.5	18.1	27.2	53.3	87.4	1.2	2.4	4.3	6.6	12.0	18.7	38.1	65.4
14	1.2	2.1	4.3	7.5	10.8	18.7	27.5	54.6	89.7	1.2	2.5	4.4	6.8	12.3	19.0	38.7	66.5
15	1.2	2.1	4.4	7.7	11.2	19.3	27.6	57.0	93.8	1.2	2.5	4.5	6.9	12.6	19.7	40.1	69.2
16	1.3	2.2	4.5	7.9	11.5	19.9	27.8	59.4	97.9	1.2	2.6	4.6	7.0	12.9	20.4	41.6	71.9
17	1.3	2.2	4.7	8.1	11.8	20.5	28.1	60.9	100.4	1.3	2.6	4.7	7.1	13.2	20.6	42.3	73.2
18	1.4	2.3	4.8	8.3	12.1	21.0	28.4	62.4	103.0	1.3	2.7	4.8	7.3	13.4	20.9	43.0	74.5
19	1.4	2.3	4.9	8.6	12.4	21.6	28.7	63.6	105.1	1.3	2.7	4.9	7.5	13.7	21.1	43.6	75.0
20	1.5	2.4	5.0	8.8	12.7	22.2	29.0	64.8	107.1	1.4	2.8	4.9	7.6	13.9	21.4	44.2	75.6

* Select riser using procedure outlined in Chapter 6 or Figure AL11-8a.

T (Time) = $12.1 \times Vs/Qo$

Table AL11-2. Discharge in cubic feet per second (CFS) for pipe conduit with different heads.

TABLE OF WEIGHTS AND BUOYANT FORCES FOR CORRUGATED METAIL, STEEL, AND PLASTIC PIPE
Based on U.S. Standard Gages for Sheet and Plate Iron and Steel

Nominal Dia. In inches	WEIGHT (W) - POUNDS PER LINEAR FOOT [1/]								Buoyant Force (B) in lbs. per lin.ft.
	CORRUGATED METAL				SMOOTH STEEL			PVC	
	GAGE				Wall Thickness [2/]			SDR-26 Sch. -40 Sch. -80	
	16	14	12	10	1/8 "	1/4 "	1/2 "		
6	4.0				8.8	14.7	32.8	2.4	12.3
8	7.3/2.3*				11.7	19.6	43.4	3.7	21.8
10	9.0/2.8				14.7	24.5	54.7	5.8	34.0
12	10.5/3.3	12.0/4.1			17.7	29.4	65.6	8.0	49.0
15	12.9/4.1	15.0/5.1			22.1	36.8	82.1	11.2	76.6
18	15.3/4.8	18.0/6.0	24.0/8.4		26.5	44.2	98.5	16.0	110.3
21	17.7/5.6	21.0/7.0	29.0/9.7		30.9	51.5	114.9	21.2	150.1
24	20.0/6.2	25.2/8.0	33.0/11.2		35.3	58.9	131.3	28.5	196.1
30		30.9/9.8	41.0/13.7		44.2	73.6	164.1	43.7	306.3
36			51.0/16.4	62.0/21.1	53.0	88.4	197.0	64.5	441.1
42			59.5/19.2	72.0/24.7	61.8	103.1	229.8	87.2	600.4
48			65.0/22.4	82.0/28.8	70.7	117.8	262.6	110.4	783.7

* Corrugated galvanized steel/corrugated aluminum (pounds per linear foot)
[1/] Use these values when weight is not available from manufacturer.
[2/] For steel pipe wall thickness of 3/16" and 3/8", interpolate weight/foot from table.

Check for riser flotation:

Given: Corrugated steel pipe riser
Diameter = 18 in., 16 gage
h = Height = 15 feet
No fill over outlet pipe

62.4 lb/cu.ft. = unit weight of water

150.0 lb/cu.ft. = unit weight of concrete

From table: W = Weight = 15.3 pounds/linear foot
B = Buoyancy = 110.3 pounds/linear foot

Required volume of concrete: (At riser base)

$$\frac{(B-W)h}{87.6} = \frac{(110.3 - 15.3)15}{87.6} = 16.3 \text{ cu.ft.}$$

NOTES:

(1) Weight of submerged concrete = 150 lb/cu.ft. -62.4 lb/cu.ft. = 87.6 lb/cu.ft. Factor of safety - 1.0. Therefore, 87.6 / 1.0 = 87.6 lb./cu.ft.

(2) Factor of safety of 1.0 was used due to weight of trash rack or sleeve and bending force as the result of barrel being imbedded in the dam. Riser placed in the dam with 5 feet of fill over outlet pipe requires no check of buoyant forces.

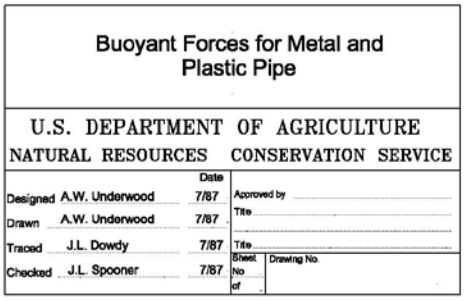


Table AL11-3. Weights and Buoyant Forces for Corrugated Metal, Steel, and Plastic Pipe.

Riser Base Size	MAXIMUM RISER HEIGHT (FT.)					
	Riser Diameter (inches)					
	42	36	30	24	21	18
3’ x 3’ x 2’				6.0	7.9	11.1
3 ½ ‘ x 3 ½ ‘ x 2’			5.2	8.1	10.8	15.1
3’ x 3’ x 3’			5.7	9.0	11.9	
4’ x 4’ x 2’			6.8	10.6	14.1	
3’ x 3’ x 4’		5.2	7.6	12.0	15.9	
3 ½ ‘ x 3 ½ ‘ x 3’		5.3	7.8	12.2	16.2	
4’ x 4’ x 3’	5.0	6.9	10.2	16.0		
3 ½ ‘ x 3 ½ ‘ x 4’	5.1	7.1	10.3	16.3		
4’ x 4’ x 4’	6.7	9.3	13.6			
5’ x 5’ x 4’	10.4	14.5				
5’ x 5’ x 5’	13.1					

NOTE: Riser Diameters Less than 18 in. Use Minimum Size Riser Base 3’ x 3’ x 2’.

Resource Engineer may approve smaller riser bases for riser diameter less than 18 in. according to actual on-site conditions and buoyance calculations.

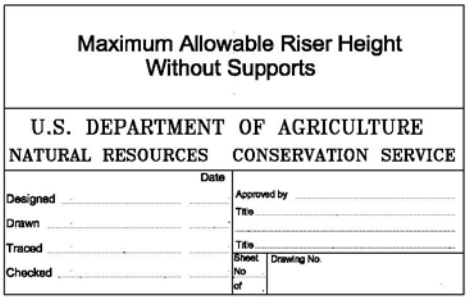


Table AL11-4. Minimum Riser Base Size to Prevent Flotation.

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)			
	8	10	12	14
0.1	0.03	0.04	0.05	0.05
0.2	0.06	0.08	0.09	0.11
0.3	0.09	0.12	0.14	0.16
0.4	0.13	0.16	0.19	0.22
0.5	0.17	0.21	0.25	0.28
0.6	0.21	0.26	0.30	0.34
0.7	0.25	0.30	0.36	0.41
0.8	0.30	0.36	0.41	0.47
0.9	0.35	0.41	0.47	0.54
1.0	0.39	0.46	0.54	0.61
1.1	0.44	0.52	0.60	0.68
1.2	0.49	0.58	0.67	0.76
1.3	0.54	0.64	0.73	0.83
1.4	0.60	0.70	0.80	0.91
1.5	0.66	0.76	0.87	0.99
1.6	0.71	0.83	0.95	1.07
1.7	0.77	0.90	1.02	1.15
1.8	0.83	0.97	1.10	1.23
1.9	0.90	1.04	1.18	1.32
2.0	0.96	1.11	1.26	1.41
2.1	1.03	1.19	1.34	1.50
2.2	1.10	1.26	1.43	1.59
2.3	1.17	1.34	1.51	1.68
2.4	1.24	1.42	1.60	1.78
2.5	1.32	1.50	1.69	1.87
2.6	1.40	1.59	1.78	1.97
2.7	1.48	1.67	1.87	2.07
2.8	1.56	1.76	1.97	2.18
2.9	1.64	1.85	2.07	2.28
3.0	1.72	1.94	2.17	2.39
3.1	1.81	2.04	2.27	2.50
3.2	1.90	2.13	2.37	2.61
3.3	1.99	2.23	2.47	2.72
3.4	2.08	2.33	2.58	2.83
3.5	2.17	2.43	2.69	2.95
3.6	2.27	2.53	2.80	3.07
3.7	2.36	2.64	2.91	3.19
3.8	2.46	2.74	3.03	3.31
3.9	2.56	2.85	3.14	3.43
4.0	2.67	2.96	3.26	3.56
4.1	2.78	3.07	3.38	3.68
4.2	2.88	3.19	3.50	3.81
4.3	2.99	3.30	3.62	3.94
4.4	3.10	3.42	3.75	4.07
4.5	3.21	3.54	3.87	4.21
4.6	3.32	3.66	4.00	4.34
4.7	3.44	3.79	4.13	4.48
4.8	3.56	3.91	4.27	4.62
4.9	3.68	4.04	4.40	4.76
5.0	3.80	4.17	4.54	4.91

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)			
	8	10	12	14
5.1	3.92	4.30	4.67	5.05
5.2	4.04	4.43	4.81	5.20
5.3	4.17	4.56	4.96	5.35
5.4	4.30	4.70	5.10	5.50
5.5	4.43	4.84	5.25	5.65
5.6	4.56	4.98	5.39	5.81
5.7	4.69	5.12	5.54	5.96
5.8	4.83	5.26	5.69	6.12
5.9	4.97	5.41	5.85	6.28
6.0	5.11	5.56	6.00	6.44
6.1	5.25	5.70	6.16	6.61
6.2	5.40	5.86	6.31	6.77
6.3	5.54	6.01	6.47	6.94
6.4	5.69	6.16	6.64	7.11
6.5	5.84	6.32	6.80	7.28
6.6	5.99	6.48	6.97	7.46
6.7	6.14	6.64	7.13	7.63
6.8	6.30	6.80	7.30	7.81
6.9	6.46	6.96	7.47	7.99
7.0	6.61	7.13	7.65	8.17
7.1	6.77	7.30	7.82	8.35
7.2	6.93	7.47	8.00	8.53
7.3	7.10	7.64	8.18	8.72
7.4	7.26	7.81	8.36	8.91
7.5	7.43	7.99	8.54	9.10
7.6	7.60	8.16	8.73	9.29
7.7	7.77	8.34	8.91	9.48
7.8	7.94	8.52	9.10	9.68
7.9	8.12	8.70	9.29	9.87
8.0	8.30	8.89	9.48	10.07
8.1	8.48	9.07	9.67	10.27
8.2	8.66	9.26	9.87	10.48
8.3	8.84	9.45	10.07	10.68
8.4	9.02	9.64	10.27	10.89
8.5	9.21	9.84	10.47	11.10
8.6	9.40	10.03	10.67	11.31
8.7	9.59	10.23	10.87	11.52
8.8	9.78	10.43	11.08	11.73
8.9	9.97	10.63	11.29	11.95
9.0	10.17	10.83	11.50	12.17
9.1	10.36	11.04	11.71	12.39
9.2	10.56	11.24	11.93	12.61
9.3	10.76	11.45	12.14	12.83
9.4	10.97	11.66	12.36	13.06
9.5	11.18	11.87	12.58	13.29
9.6	11.38	12.09	12.80	13.51
9.7	11.59	12.30	13.02	13.74
9.8	11.80	12.52	13.25	13.97
9.9	12.01	12.74	13.47	14.21
10.0	12.22	12.96	13.70	14.44

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
10.1	13.19	13.93	14.68
10.2	13.41	14.17	14.92
10.3	13.64	14.40	15.16
10.4	13.87	14.64	15.41
10.5	14.10	14.87	15.65
10.6	14.33	15.11	15.90
10.7	14.56	15.36	16.15
10.8	14.80	15.60	16.40
10.9	15.04	15.85	16.65
11.0	15.28	16.09	16.91
11.1	15.52	16.34	17.16
11.2	15.76	16.59	17.42
11.3	16.01	16.85	17.68
11.4	16.26	17.10	17.94
11.5	16.50	17.36	18.21
11.6	16.76	17.61	18.47
11.7	17.01	17.87	18.74
11.8	17.26	18.14	19.01
11.9	17.52	18.40	19.28
12.0	17.78	18.67	19.56
12.1	18.04	18.93	19.83
12.2	18.30	19.20	20.11
12.3	18.56	19.47	20.39
12.4	18.83	19.75	20.67
12.5	19.10	20.02	20.95
12.6	19.37	20.30	21.23
12.7	19.64	20.58	21.52
12.8	19.91	20.86	21.81
12.9	20.19	21.14	22.10
13.0	20.46	21.43	22.39
13.1	20.74	21.71	22.68
13.2	21.02	22.00	22.98
13.3	21.30	22.29	23.27
13.4	21.59	22.58	23.57
13.5	21.87	22.87	23.87
13.6	22.16	23.17	24.18
13.7	22.45	23.47	24.48
13.8	22.74	23.77	24.79
13.9	23.04	24.07	25.10
14.0	23.33	24.37	25.41
14.1	23.63	24.67	25.72
14.2	23.93	24.98	26.03
14.3	24.23	25.29	26.35
14.4	24.53	25.60	26.67
14.5	24.84	25.91	26.99
14.6	25.14	26.23	27.31
14.7	25.45	26.54	27.63
14.8	25.76	26.86	27.96
14.9	26.07	27.18	28.28
15.0	26.39	27.50	28.61

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
15.1	26.70	27.82	28.94
15.2	27.02	28.15	29.27
15.3	27.34	28.47	29.61
15.4	27.66	28.80	29.94
15.5	27.99	29.13	30.28
15.6	28.31	29.47	30.62
15.7	28.64	29.80	30.96
15.8	28.97	30.14	31.31
15.9	29.30	30.47	31.65
16.0	29.63	30.81	32.00
16.1	29.96	31.16	32.35
16.2	30.30	31.50	32.70
16.3	30.64	31.85	33.05
16.4	30.98	32.19	33.41
16.5	31.32	32.54	33.76
16.6	31.66	32.89	34.12
16.7	32.01	33.25	34.48
16.8	32.36	33.60	34.84
16.9	32.70	33.96	35.21
17.0	33.06	34.31	35.57
17.1	33.41	34.67	35.94
17.2	33.76	35.04	36.31
17.3	34.12	35.40	36.68
17.4	34.48	35.77	37.06
17.5	34.84	36.13	37.43
17.6	35.20	36.50	37.81
17.7	35.56	36.87	38.19
17.8	35.93	37.25	38.57
17.9	36.30	37.62	38.95
18.0	36.67	38.00	39.33
18.1	37.04	38.38	39.72
18.2	37.41	38.76	40.11
18.3	37.79	39.14	40.50
18.4	38.16	39.53	40.89
18.5	38.54	39.91	41.28
18.6	38.92	40.30	41.88
18.7	39.30	40.69	42.07
18.8	39.69	41.08	42.47
18.9	40.07	41.47	42.87
19.0	40.46	41.87	43.28
19.1	40.85	42.27	43.88
19.2	41.24	42.67	44.09
19.3	41.64	43.07	44.50
19.4	42.03	43.47	44.91
19.5	42.43	43.87	45.32
19.6	42.83	44.28	45.73
19.7	43.23	44.69	46.15
19.8	43.63	45.10	46.57
19.9	44.04	45.51	46.99
20.0	44.44	45.93	47.41

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
20.1	44.85	46.34	47.83
20.2	45.26	46.76	48.26
20.3	45.67	47.18	48.68
20.4	46.09	47.60	49.11
20.5	46.50	48.02	49.54
20.6	46.92	48.45	49.97
20.7	47.34	48.87	50.41
20.8	47.76	49.30	50.84
20.9	48.19	49.73	51.28
21.0	48.61	50.17	51.72
21.1	49.04	50.60	52.16
21.2	49.47	51.04	50.61
21.3	49.90	51.47	53.05
21.4	50.33	51.91	53.50
21.5	50.76	52.36	53.95
21.6	51.20	52.80	54.40
21.7	51.64	53.25	54.85
21.8	52.08	53.69	55.31
21.9	52.52	54.14	55.76
22.0	52.96	54.59	56.22
22.1	53.41	55.05	56.68
22.2	53.86	55.50	57.14
22.3	54.30	55.96	57.61
22.4	54.76	56.41	58.07
22.5	55.21	56.87	58.54
22.6	55.66	57.34	59.01
22.7	56.12	57.80	59.48
22.8	56.58	58.27	59.96
22.9	57.04	58.73	60.43
23.0	57.50	59.20	60.91
23.1	57.96	59.67	61.39
23.2	58.43	60.15	61.87
23.3	58.90	60.62	62.35
23.4	59.37	61.10	62.83
23.5	59.84	61.58	63.32
23.6	60.31	62.06	63.81
23.7	60.79	62.54	64.30
23.8	61.26	63.03	64.79
23.9	61.74	63.51	65.28
24.0	62.22	64.00	65.78
24.1	62.70	64.49	66.27
24.2	63.19	64.98	66.77
24.3	63.67	65.47	67.27
24.4	64.16	65.97	67.78
24.5	64.65	66.47	68.28
24.6	65.14	66.97	68.79
24.7	65.64	67.47	69.30
24.8	66.13	67.97	69.81
24.9	66.63	68.47	70.32
25.0	67.13	68.98	70.83

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
25.1	67.63	89.49	71.35
25.2	68.13	70.00	71.87
25.3	68.64	70.51	72.39
25.4	69.14	71.03	72.91
25.5	69.65	71.54	73.43
25.6	70.16	72.06	73.96
25.7	70.67	72.58	74.48
25.8	71.19	73.10	75.01
25.9	71.70	73.62	75.54
26.0	72.22	74.15	76.07
26.1	72.74	74.67	76.61
26.2	73.26	75.20	77.14
26.3	73.79	75.73	77.68
26.4	74.31	76.27	78.22
26.5	74.84	76.80	78.76
26.6	75.37	77.34	79.31
26.7	75.90	77.87	79.85
26.8	76.43	78.41	80.40
26.9	76.96	78.96	80.95
27.0	77.50	79.50	81.50
27.1	78.04	80.05	82.05
27.2	78.58	80.59	82.61
27.3	79.12	81.14	93.16
27.4	79.66	81.69	83.72
27.5	80.21	82.25	84.28
27.6	80.76	82.80	84.84
27.7	81.30	83.36	85.41
27.8	81.86	83.91	85.97
27.9	82.41	84.47	86.54
28.0	82.96	85.04	87.11
28.1	83.52	85.60	87.68
28.2	84.08	86.17	88.26
28.3	84.64	86.73	88.83
28.4	85.20	87.30	89.41
28.5	85.76	87.87	89.99
28.6	86.33	88.45	90.57
28.7	86.90	89.02	91.15
28.8	87.47	89.60	91.73
28.9	88.04	90.18	92.32
29.0	88.61	90.76	92.91
29.1	89.19	91.34	93.50
29.2	89.76	91.93	94.09
29.3	90.34	92.51	94.68
29.4	90.92	93.10	95.28
29.5	91.50	93.69	95.87
29.6	92.09	94.28	96.47
29.7	92.67	94.87	97.07
29.8	93.26	95.47	97.68
29.9	93.85	96.07	98.28
30.0	94.44	96.67	98.89

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
30.1	95.04	97.27	99.50
30.2	95.63	97.87	100.11
30.3	96.23	98.47	100.72
30.4	96.83	99.08	101.33
30.5	97.43	99.69	101.95
30.6	98.03	100.30	102.57
30.7	98.64	100.91	103.19
30.8	99.24	101.53	103.81
30.9	99.85	102.14	104.43
31.0	100.46	102.76	105.06
31.1	101.07	103.38	105.68
31.2	101.69	104.00	106.31
31.3	102.30	104.62	106.94
31.4	102.92	105.25	107.57
31.5	103.54	105.87	108.21
31.6	104.16	106.50	108.84
31.7	104.79	107.13	109.48
31.8	105.41	107.77	111.12
31.9	106.04	108.40	111.76
32.0	106.67	109.04	111.41
32.1	107.30	109.67	112.05
32.2	107.93	110.31	112.70
32.3	108.56	110.96	113.35
32.4	109.20	111.60	114.00
32.5	109.84	112.25	114.65
32.6	110.48	112.89	115.31
32.7	111.12	113.54	115.96
32.8	111.76	114.19	116.62
32.9	112.41	114.85	117.28
33.0	113.06	115.50	117.94
33.1	113.70	116.16	118.61
33.2	114.36	116.81	119.27
33.3	115.01	117.47	119.94
33.4	115.66	118.14	120.61
33.5	116.32	118.80	121.28
33.6	116.98	119.47	121.96
33.7	117.64	120.13	122.63
33.8	118.30	120.80	123.31
33.9	118.96	121.47	123.99
34.0	119.63	122.15	124.67
34.1	120.30	122.82	125.35
34.2	120.97	123.50	126.03
34.3	121.64	124.18	126.72
34.4	122.31	124.86	127.41
34.5	122.99	125.54	128.10
34.6	123.66	126.23	128.79
34.7	124.34	126.91	129.48
34.8	125.02	127.60	130.18
34.9	125.70	128.29	130.87
35.0	126.39	128.98	131.57

FILL HEIGHT	SIDE SLOPES 2 ½ : 1 AND 2 ½ : 1 TOP WIDTH (feet)		
	10	12	14
35.1	127.07	129.67	132.27
35.2	127.76	130.37	132.98
35.3	128.45	131.07	133.68
35.4	129.14	131.77	134.39
35.5	129.84	132.47	135.10
35.6	130.53	133.17	135.81
35.7	131.23	133.87	136.52
35.8	131.93	134.58	137.23
35.9	132.63	135.29	137.95
36.0	133.33	136.00	138.67
36.1	134.04	136.71	139.39
36.2	134.74	137.43	140.11
36.3	135.45	138.14	140.83
36.4	136.16	138.86	141.56
36.5	136.87	139.58	142.28
36.6	137.59	140.30	143.01
36.7	138.30	141.02	143.74
36.8	139.02	141.75	144.47
36.9	139.74	142.47	145.21
37.0	140.46	143.20	145.94
37.1	141.19	143.93	146.88
37.2	141.91	144.67	147.42
37.3	142.64	145.40	148.16
37.4	143.37	146.14	148.91
37.5	144.10	146.87	149.65
37.6	144.83	147.61	150.40
37.7	145.56	148.36	151.15
37.8	146.30	149.10	151.90
37.9	147.04	149.85	152.65
38.0	147.78	150.59	153.41
38.1	148.52	151.34	154.18
38.2	149.26	152.09	154.92
38.3	150.01	152.85	155.68
38.4	150.76	153.60	156.44
38.5	151.50	154.36	157.21
38.6	152.26	155.11	157.97
38.7	153.01	155.87	158.74
38.8	153.76	156.64	159.51
38.9	154.52	157.40	160.28
39.0	155.28	158.17	161.06
39.1	156.04	158.93	161.83
39.2	156.80	159.70	162.61
39.3	157.56	160.47	163.39
39.4	158.33	161.25	164.17
39.5	159.10	162.02	164.95
39.6	159.87	162.80	165.73
39.7	160.64	163.58	166.52
39.8	161.41	164.36	167.31
39.9	162.19	165.14	168.10
40.0	162.96	165.93	168.89

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)			
	8	10	12	14
0.1	0.03	0.04	0.05	0.05
0.2	0.06	0.08	0.09	0.11
0.3	0.10	0.12	0.14	0.17
0.4	0.14	0.17	0.20	0.23
0.5	0.18	0.21	0.25	0.29
0.6	0.22	0.26	0.31	0.35
0.7	0.26	0.31	0.37	0.42
0.8	0.31	0.37	0.43	0.49
0.9	0.36	0.42	0.49	0.56
1.0	0.41	0.48	0.56	0.63
1.1	0.46	0.54	0.62	0.70
1.2	0.52	0.60	0.69	0.78
1.3	0.57	0.67	0.77	0.86
1.4	0.63	0.74	0.84	0.94
1.5	0.69	0.81	0.92	1.03
1.6	0.76	0.88	1.00	1.11
1.7	0.83	0.95	1.08	1.20
1.8	0.89	1.03	1.16	1.29
1.9	0.96	1.10	1.25	1.39
2.0	1.04	1.19	1.33	1.48
2.1	1.11	1.27	1.42	1.58
2.2	1.19	1.35	1.52	1.68
2.3	1.27	1.44	1.61	1.78
2.4	1.35	1.53	1.71	1.88
2.5	1.43	1.62	1.81	1.99
2.6	1.52	1.71	1.91	2.10
2.7	1.61	1.81	2.01	2.21
2.8	1.70	1.91	2.12	2.32
2.9	1.79	2.01	2.22	2.44
3.0	1.89	2.11	2.33	2.56
3.1	1.99	2.22	2.45	2.68
3.2	2.09	2.32	2.56	2.80
3.3	2.10	2.43	2.68	2.92
3.4	2.30	2.54	2.80	3.05
3.5	2.40	2.66	2.92	3.18
3.6	2.51	2.77	3.04	3.31
3.7	2.62	2.89	3.17	3.44
3.8	2.73	3.01	3.29	3.57
3.9	2.85	3.13	3.42	3.71
4.0	2.96	3.26	3.56	3.85
4.1	3.08	3.39	3.69	3.99
4.2	3.20	3.52	3.83	4.14
4.3	3.32	3.65	3.97	4.28
4.4	3.45	3.78	4.11	4.43
4.5	3.58	3.92	4.25	4.58
4.6	3.71	4.05	4.40	4.74
4.7	3.84	4.20	4.54	4.89
4.8	3.98	4.34	4.69	5.05
4.9	4.12	4.48	4.85	5.21
5.0	4.26	4.63	5.00	5.37

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)			
	8	10	12	14
5.1	4.40	4.78	5.16	5.53
5.2	4.55	4.93	5.32	5.70
5.3	4.70	5.08	5.48	5.87
5.4	4.84	5.24	5.64	6.04
5.5	4.99	5.40	5.81	6.21
5.6	5.14	5.56	5.97	6.39
5.7	5.30	5.72	6.14	6.57
5.8	5.46	5.89	6.32	6.75
5.9	5.62	6.05	6.49	6.93
6.0	5.78	6.22	6.67	7.11
6.1	5.94	6.39	6.85	7.30
6.2	6.11	6.57	7.03	7.49
6.3	6.29	6.74	7.21	7.68
6.4	6.48	6.92	7.40	7.87
6.5	6.64	7.10	7.58	8.06
6.6	6.80	7.28	7.77	8.26
6.7	6.97	7.47	7.97	8.46
6.8	7.15	7.66	8.16	8.66
6.9	7.34	7.85	8.36	8.87
7.0	7.52	8.04	8.56	9.07
7.1	7.71	8.23	8.76	9.28
7.2	7.89	8.43	8.96	9.49
7.3	8.08	8.62	9.17	9.71
7.4	8.28	8.83	9.37	9.92
7.5	8.47	9.03	9.58	10.14
7.6	8.67	9.23	9.80	10.36
7.7	8.87	9.44	10.01	10.58
7.8	9.07	9.65	10.23	10.80
7.9	9.28	9.86	10.45	11.03
8.0	9.48	10.07	10.67	11.26
8.1	9.69	10.29	10.89	11.49
8.2	9.90	10.51	11.12	11.72
8.3	10.11	10.73	11.34	11.96
3.4	10.33	10.95	11.57	12.20
8.5	10.55	11.18	11.81	12.44
8.6	10.77	11.40	12.04	12.68
8.7	10.99	11.63	12.28	12.92
8.8	11.21	11.86	12.52	13.17
8.9	11.44	12.10	12.76	13.42
9.0	11.67	12.33	13.00	13.67
9.1	11.90	12.57	13.25	13.92
9.2	12.13	12.81	13.49	14.17
9.3	12.36	13.05	13.74	14.43
9.4	12.60	13.30	14.00	14.69
9.5	12.84	13.55	14.25	14.95
9.6	13.08	13.80	14.51	15.22
9.7	13.33	14.05	14.77	15.48
9.8	13.57	14.30	15.03	15.75
9.9	13.82	14.56	15.29	16.02
10.0	14.07	14.81	15.56	16.30

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
10.1	15.08	15.82	16.57
10.2	15.34	16.09	16.85
10.3	15.60	16.37	17.13
10.4	15.87	16.64	17.41
10.5	16.14	16.92	17.69
10.6	16.41	17.20	17.98
10.7	16.68	17.48	18.27
10.8	16.96	17.76	18.56
10.9	17.24	18.05	18.85
11.0	17.52	18.33	19.15
11.1	17.80	18.62	19.45
11.2	18.09	18.92	19.75
11.3	18.37	19.21	20.05
11.4	18.66	19.51	20.35
11.5	18.95	19.81	20.66
11.6	19.25	20.11	20.97
11.7	19.54	20.41	21.28
11.8	19.84	20.72	21.59
11.9	20.14	21.02	21.90
12.0	20.44	21.33	22.22
12.1	20.75	21.65	22.54
12.2	21.06	21.96	22.86
12.3	21.37	22.28	23.19
12.4	21.68	22.60	23.51
12.5	21.99	22.92	23.84
12.6	22.31	23.24	24.17
12.7	22.62	23.57	24.51
12.8	22.95	23.89	24.84
12.9	23.27	24.22	25.18
13.0	23.59	24.56	25.52
13.1	23.92	24.89	25.86
13.2	24.25	25.23	26.20
13.3	24.58	25.57	26.55
13.4	24.91	25.91	26.90
13.5	25.25	26.25	27.25
13.6	25.59	26.60	27.60
13.7	25.93	26.94	27.96
13.8	26.27	27.29	28.32
13.9	26.62	27.65	28.68
14.0	26.96	28.00	29.04
14.1	27.31	28.36	29.40
14.2	27.66	28.72	29.77
14.3	28.02	29.08	30.14
14.4	28.37	29.44	30.51
14.5	28.73	29.81	30.88
14.6	29.09	30.17	31.25
14.7	29.45	30.54	31.63
14.8	29.82	30.92	32.01
14.9	30.19	31.29	32.39
15.0	30.56	31.67	32.78

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
15.1	30.93	32.05	33.16
15.2	31.30	32.43	33.55
15.3	31.68	32.81	33.94
15.4	32.05	33.20	34.34
15.5	32.44	33.58	34.73
15.6	32.82	33.97	35.13
15.7	33.20	34.37	35.53
15.8	33.59	34.76	35.93
15.9	33.98	35.16	36.33
16.0	34.37	35.56	36.74
16.1	34.76	35.96	37.15
16.2	35.16	36.36	37.56
16.3	35.56	36.77	37.97
16.4	35.96	37.17	38.39
16.5	36.36	37.58	38.81
16.6	36.77	38.00	39.23
16.7	37.17	38.41	39.65
16.8	37.58	38.83	40.07
16.9	37.99	39.25	40.50
17.0	38.41	39.67	40.93
17.1	38.82	40.09	41.36
17.2	39.24	40.52	41.79
17.3	39.66	40.94	42.22
17.4	40.08	41.37	42.66
17.5	40.51	41.81	43.10
17.6	40.94	42.24	43.54
17.7	41.37	42.68	43.99
17.8	41.80	43.12	44.43
17.9	42.23	43.56	44.88
18.0	42.67	44.00	45.33
18.1	43.10	44.45	45.79
18.2	43.55	44.89	46.24
18.3	43.99	45.34	46.70
18.4	44.43	45.80	47.16
18.5	44.88	46.25	47.62
18.6	45.33	46.71	48.08
18.7	45.78	47.17	48.55
18.8	46.23	47.63	49.02
18.9	46.69	48.09	49.49
19.0	47.15	48.56	49.96
19.1	47.61	49.02	50.44
19.2	48.07	49.49	50.92
19.3	48.54	49.97	51.40
19.4	49.00	50.44	51.88
19.5	49.47	50.92	52.36
19.6	49.94	51.40	52.85
19.7	50.42	51.88	53.34
19.8	50.89	52.36	53.83
19.9	51.37	52.85	54.32
20.0	51.85	53.33	54.81

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
20.1	52.33	53.82	55.31
20.2	52.82	54.32	55.81
20.3	53.31	54.81	56.31
20.4	53.80	55.31	56.82
20.5	54.29	55.81	57.32
20.6	54.78	56.31	57.83
20.7	55.28	56.81	58.34
20.8	55.77	57.32	58.86
20.9	56.28	57.82	59.37
21.0	56.78	58.33	59.89
21.1	57.28	58.85	60.41
21.2	57.79	59.36	60.93
21.3	58.30	59.88	61.45
21.4	58.81	60.40	61.98
21.5	59.32	60.92	62.51
21.6	59.84	61.44	63.04
21.7	60.36	61.97	63.57
21.8	60.88	62.49	64.11
21.9	61.40	63.02	64.65
22.0	61.93	63.56	65.19
22.1	62.45	64.09	65.73
22.2	62.98	64.63	66.27
22.3	63.51	65.17	66.82
22.4	64.05	65.71	67.37
22.5	64.58	66.25	67.92
22.6	65.12	66.80	68.47
22.7	65.66	67.34	69.02
22.8	66.20	67.89	69.58
22.9	66.75	68.45	70.14
23.0	67.30	69.00	70.70
23.1	67.85	69.56	71.27
23.2	68.40	70.12	71.83
23.3	68.95	70.68	72.40
23.4	69.51	71.24	72.97
23.5	70.06	71.81	73.55
23.6	70.63	72.37	74.12
23.7	71.19	72.94	74.70
23.8	71.75	73.52	75.28
23.9	72.32	74.09	75.86
24.0	72.89	74.67	76.44
24.1	73.46	75.25	77.03
24.2	74.03	75.83	77.62
24.3	74.61	76.41	78.21
24.4	75.19	77.00	78.80
24.5	75.77	77.58	79.40
24.6	76.35	78.17	80.00
24.7	76.94	78.77	80.60
24.8	77.52	79.36	81.20
24.9	78.11	79.96	81.80
25.0	78.70	80.56	82.41

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
25.1	79.30	81.16	83.02
25.2	79.89	81.76	83.63
25.3	80.49	82.37	84.24
25.4	81.09	82.97	84.85
25.5	81.69	83.58	85.47
25.6	82.30	84.20	86.09
25.7	82.91	84.81	86.71
25.8	83.52	85.43	87.34
25.9	84.13	86.05	87.96
26.0	84.74	86.67	88.59
26.1	85.36	87.29	89.22
26.2	85.97	87.92	89.86
26.3	86.60	88.54	90.49
26.4	87.22	89.17	91.13
26.5	87.84	89.81	91.77
26.6	88.47	90.44	92.41
26.7	89.10	91.08	93.05
26.8	89.73	91.72	93.70
26.9	90.36	92.36	94.35
27.0	91.00	93.00	95.00
27.1	91.64	93.65	95.65
27.2	92.28	94.29	96.31
27.3	92.92	94.94	96.97
27.4	93.57	95.60	97.63
27.5	94.21	96.25	98.29
27.6	94.88	96.91	98.95
27.7	95.51	97.57	99.62
27.8	96.17	98.23	100.29
27.9	96.82	98.89	100.96
28.0	97.48	99.56	101.63
28.1	98.14	100.22	102.30
28.2	98.80	100.89	102.98
28.3	99.47	101.57	103.66
28.4	100.14	102.24	104.34
28.5	100.81	102.92	105.03
28.6	101.48	103.60	105.71
28.7	102.15	104.28	106.40
28.8	102.83	104.96	107.09
28.9	103.50	105.65	107.79
29.0	104.19	106.33	108.48
29.1	104.87	107.02	109.18
29.2	105.55	107.72	109.88
29.3	106.24	108.41	110.58
29.4	106.93	109.11	111.28
29.5	107.62	109.81	111.99
29.6	108.31	110.51	112.70
29.7	109.01	111.21	113.41
29.8	109.71	111.92	114.12
29.9	110.41	112.62	114.84
30.0	111.11	113.33	115.56

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
30.1	111.32	114.05	116.28
30.2	112.52	114.76	117.00
30.3	113.23	115.48	117.72
30.4	113.94	116.20	118.45
30.5	114.66	116.92	119.18
30.6	115.37	117.64	119.91
30.7	116.09	118.37	120.64
30.8	116.81	119.09	121.37
30.9	117.53	119.82	122.11
31.0	118.26	120.56	122.85
31.1	118.99	121.29	123.59
31.2	119.72	122.03	124.34
31.3	120.45	122.77	125.08
31.4	121.18	123.51	125.83
31.5	121.92	124.25	126.58
31.6	122.65	125.00	127.34
31.7	123.40	125.74	128.09
31.8	124.14	126.49	128.85
31.9	124.88	127.25	129.61
32.0	125.63	128.00	130.37
32.1	126.38	128.76	131.13
32.2	127.13	129.52	131.90
32.3	127.88	130.28	132.67
32.4	128.64	131.04	133.44
32.5	129.40	131.81	134.21
32.6	130.16	132.57	134.99
32.7	130.92	133.34	135.77
32.8	131.69	134.12	136.54
32.9	132.45	134.89	137.33
33.0	133.22	135.67	138.11
33.1	133.99	135.45	138.90
33.2	134.77	137.23	139.69
33.3	135.54	138.01	140.48
33.4	136.32	138.80	141.27
33.5	137.10	139.58	142.06
33.6	137.88	140.37	142.86
33.7	138.67	141.17	143.66
33.8	139.46	141.96	144.46
33.9	140.25	142.76	145.27
34.0	141.04	143.56	146.07
34.1	141.83	144.36	146.88
34.2	142.63	145.16	147.69
34.3	143.42	145.97	148.51
34.4	144.22	146.77	149.32
34.5	145.03	147.58	150.14
34.6	145.83	148.40	150.96
34.7	146.64	149.21	151.78
34.8	147.45	150.03	152.60
34.9	148.26	150.85	153.43
35.0	149.07	151.67	154.26

FILL HEIGHT	SIDE SLOPES 3:1 AND 3:1 TOP WIDTH (feet)		
	10	12	14
35.1	149.89	152.49	155.09
35.2	150.71	153.32	155.92
35.3	151.53	154.14	156.76
35.4	152.35	154.97	157.60
35.5	153.18	155.81	158.43
35.6	154.00	156.64	159.28
35.7	154.83	157.48	160.12
35.8	155.66	158.32	160.97
35.9	156.50	159.16	161.82
36.0	157.33	160.00	162.67
36.1	158.17	160.85	163.52
36.2	159.01	161.69	164.37
36.3	159.85	162.54	165.23
36.4	160.70	163.40	166.09
36.5	161.55	164.25	166.95
36.6	162.40	165.11	167.82
36.7	163.25	165.97	168.68
36.8	164.10	166.83	169.55
36.9	164.96	167.69	170.42
37.0	165.81	168.56	171.30
37.1	166.87	169.42	172.17
37.2	167.54	170.29	173.05
37.3	168.40	171.17	173.93
37.4	169.27	172.04	174.81
37.5	170.14	172.92	175.69
37.6	171.01	173.80	176.58
37.7	171.88	174.68	177.47
37.8	172.76	175.56	178.36
37.9	173.64	176.45	179.25
38.0	174.52	177.33	180.15
38.1	175.40	178.22	181.05
38.2	176.29	179.12	181.94
38.3	177.17	180.01	182.85
38.4	178.06	180.91	183.75
38.5	178.95	181.81	184.66
38.6	179.85	182.71	185.57
38.7	180.74	183.61	186.48
38.8	181.64	184.52	187.39
38.9	182.54	185.42	188.30
39.0	183.44	186.33	189.22
39.1	184.35	187.25	190.14
39.2	185.26	188.16	191.06
39.3	186.17	189.08	191.99
39.4	187.08	190.00	192.91
39.5	187.99	190.92	193.84
39.6	188.91	191.84	194.77
39.7	189.82	192.77	195.71
39.8	190.74	193.69	196.64
39.9	191.67	194.62	197.58
40.0	192.59	195.56	198.52

Table AL11-5. End area tables for earthfill dams cubic yards per foot for embankment.

NO. OF CATTLE	WATER NEEDS FOR CATTLE IN ACRE FEET PER				
	60 Days	90 Days	120 Days	180 Days	270 Days
5	0.014	0.021	0.028	0.041	0.062
10	0.028	0.042	0.055	0.083	0.124
15	0.042	0.062	0.083	0.124	0.186
20	0.055	0.083	0.110	0.166	0.249
25	0.069	0.104	0.138	0.207	0.311
30	0.083	0.124	0.166	0.249	0.373
35	0.097	0.145	0.193	0.290	0.435
40	0.110	0.166	0.221	0.331	0.497
45	0.124	0.186	0.248	0.373	0.559
50	0.138	0.207	0.276	0.414	0.621
60	0.166	0.249	0.331	0.497	0.746
70	0.193	0.290	0.387	0.580	0.870
80	0.221	0.331	0.442	0.663	0.994
90	0.249	0.373	0.497	0.746	1.119
100	0.276	0.414	0.552	0.829	1.243
120	0.331	0.497	0.663	0.994	1.491
140	0.387	0.580	0.773	1.160	1.740
160	0.442	0.663	0.884	1.326	1.988
180	0.497	0.746	0.994	1.491	2.237

Formula for needs for cattle: Acre Feet = _____ Head x 15 Gal. x _____ days

325,848

Table AL11-6. Water needs for cattle.

Surface Area of Pond		Seepage and Evaporation Losses in Acre Feet per days				
Dimensions (Sq. Ft.)	**Acres**	**60**	**90**	**120**	**180**	**270**
40 X 40 (1,600)	0.037	0.044	0.066	0.088	0.132	0.197
40 x 60 (2,400)	0.055	0.066	0.099	0.132	0.197	0.296
40 x 75 (3,000)	0.069	0.082	0.123	0.165	0.247	0.370
40 x 100 (4,000)	0.092	0.110	0.165	0.219	0.329	0.494
50 x 60 (3,000)	0.069	0.082	0.123	0.165	0.247	0.370
50 x 75 (3,750)	0.086	0.103	0.154	0.206	0.308	0.463
50 x 90 (4,500)	0.103	0.123	0.185	0.247	0.370	0.555
60 x 80 (4,800)	0.110	0.132	0.197	0.263	0.395	0.592
60 x 90 (5,400)	0.124	0.148	0.222	0.296	0.444	0.666
60 x 100 (6,000)	0.138	0.165	0.247	0.329	0.494	0.740
65 x 105 (6,825)	0.156	0.187	0.281	0.374	0.561	0.842
70 x 100 (7,000)	0.161	0.193	0.288	0.384	0.576	0.864
80 x 100 (8,000)	0.184	0.219	0.329	0.439	0.658	0.987
90 x 100 (9,000)	0.207	0.247	0.370	0.494	0.740	1.111
80 x 125 (10,000)	0.230	0.274	0.411	0.548	0.823	1.234
100 x 100 (10,000)	0.230	0.274	0.411	0.548	0.823	1.234
100 x 125 (12,500)	0.287	0.343	0.514	0.686	1.028	1.542
120 x 125 (15,000)	0.344	0.411	0.617	0.823	1.234	1.851
(21,780)	0.500	0.597	0.896	1.194	1.792	2.688
(32,670)	0.750	0.896	1.344	1.792	2.688	4.031
(43,560)	1.000	1.194	1.792	2.389	3.583	5.375
(65,340)	1.500	1.792	2.688	3.583	5.375	8.063
(87.120)	2.000	2.389	3.583	4.778	7.167	10.750

Formula for Evaporation and Seepage Losses: = _____ Acres (___ Months x 50 + ___ Months x 3) = _____A.F.

12

= _____ Acres x 0.597 _____ Months = Acre Feet.

Table AL11-7. Seepage and evaporation losses.

Storage - Acre Feet and Surface Area - Acres
4:1 and 2:1 End Slopes and 1:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
40 x 40 (1600)	4 5 6	32 x 16 30 x 10 28 x 4	151.7 166.7 174.2	0.094 0.103 0.108	0.037
40 x 60 (2400)	4 5 6 7	32 x 36 30 x 30 28 x 24 26 x 18	258.4 296.3 325.3 346.4	0.160 0.183 0.202 0.215	0.055
40 x 75 (3000)	4 5 6 7 8	32 x 51 30 x 45 28 x 39 26 x 33 24 x 27	338.4 393.5 438.7 474.7 502.5	0.210 0.244 0.272 0.294 0.311	0.069
40 x 100 (4000)	4 5 6 7 8	32 x 76 30 x 70 28 x 64 26 x 58 24 x 52	471.7 555.5 627.6 688.6 739.6	0.292 0.344 0.389 0.427 0.458	0.092
50 x 60 (3000)	4 5 6 7	42 x 36 40 x 30 38 x 24 36 x 18	329.5 379.6 418.7 447.5	0.204 0.235 0.259 0.277	0.069
50 x 75 (3750)	5 6 7 8	40 x 45 38 x 39 36 x 33 34 x 27	504.6 565.3 614.7 653.6	0.313 0.350 0.381 0.405	0.086
50 x 90 (4500)	5 6 7 8	40 x 60 38 x 54 36 x 48 34 x 42	629.6 712.0 781.9 840.3	0.390 0.441 0.485 0.521	0.103
60 x 80 (4800)	5 6 7 8	50 x 50 48 x 44 46 x 38 44 x 32	666.7 752.0 823.4 881.8	0.413 0.466 0.510 0.546	0.110
60 x 90 (5400)	5 6 7 8	50 x 60 48 x 54 46 x 48 44 x 42	768.5 872.0 960.8 1035.8	0.476 0.540 0.595 0.642	0.124

Table AL11-8. Yardage tables - excavated ponds. (Sheet 1 of 6)

Storage - Acre Feet and Surface Area - Acres
4:1 and 2:1 End Slopes and 1:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
60 x 100 (6000)	5 6 7 8	50 x 70 48 x 64 46 x 58 44 x 52	870.4 992.0 1098.2 1189.9	0.539 0.615 0.681 0.737	0.138
65 x 105 (6825)	5 6 7 8	55 x 75 53 x 69 51 x 63 49 x 57	1004.9 1148.7 1275.8 1387.0	0.623 0.712 0.791 0.860	0.156
70 x 100 (7000)	5 6 7 8	60 x 70 58 x 64 56 x 58 54 x 52	1027.8 1174.2 1303.0 1415.1	0.637 0.728 0.808 0.877	0.161
80 x 100 (8000)	5 6 7 8	70 x 70 68 x 64 66 x 58 64 x 52	1185.2 1356.4 1507.8 1640.3	0.735 0.841 0.934 1.017	0.184
90 x 100 (9000)	5 6 7 8 9	80 x 70 78 x 64 76 x 58 74 x 52 72 x 46	1342.6 1538.7 1712.7 1865.5 1998.0	0.832 0.954 1.062 1.156 1.238	0.207
100 x 100 (10,000)	5 6 7 8 9	90 x 70 88 x 64 86 x 58 84 x 52 82 x 46	1500.0 1720.9 1917.5 2090.7 2241.3	0.930 1.067 1.188 1.296 1.389	0.230
80 x 125 (10,000)	5 6 7 8 9	70 x 95 68 x 89 66 x 83 64 x 77 62 x 71	1532.4 1767.6 1981.0 2173.6 2346.3	0.950 1.096 1.228 1.347 1.454	0.230
100 x 125 (12.500)	6 7 8 9 10	88 x 89 86 x 83 84 x 77 82 x 71 80 x 65	2243.1 2520.3 2772.1 2999.7 3203.7	1.390 1.562 1.718 1.859 1.986	0.287
120 x 125 (15,000)	6 7 8 9 10	108 x 89 106 x 83 104 x 77 102 x 71 100 x 65	2718.7 3059.5 3370.7 3653.0 3907.4	1.685 1.896 2.089 2.264 2.422	0.344

Table AL11-8. Yardage tables - excavated ponds. (Sheet 2 of 6)

Storage - Acre Feet and Surface Area - Acres
4:1 and 3:1 End Slopes and 2:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
40 x 40 (1600)	4 5	24 x 12 20 x 5	128.8 135.8	0.080 0.084	0.037
40 x 60 (2400)	4 5 6 7	24 x 32 20 x 25 16 x 18 12 x 11	223.6 246.9 261.3 268.0	0.139 0.153 0.162 0.166	0.055
40 x 75 (3000)	4 5 6 7 8	24 x 47 20 x 40 16 x 33 12 x 26 8 x 19	294.7 330.2 354.7 370.0 378.5	0.183 0.205 0.220 0.229 0.235	0.069
40 x 100 (4000)	4 5 6 7 8	24 x 72 20 x 65 16 x 58 12 x 51 8 x 44	413.2 469.1 510.2 538.6 556.2	0.256 0.291 0.316 0.334 0.345	0.092
50 x 60 (3000)	4 5 6 7	34 x 32 30 x 25 26 x 18 22 x 11	291.8 325.6 348.0 361.0	0.181 0.202 0.216 0.224	0.069
50 x 75 (3750)	5 6 7 8	30 x 40 26 x 33 22 x 26 18 x 19	436.7 474.7 501.0 517.7	0.271 0.294 0.311 0.321	0.086
50 x 90 (5400)	5 6 7 8	30 x 55 26 x 48 22 x 41 18 x 34	547.8 601.3 641.0 668.8	0.340 0.373 0.397 0.415	0.103
60 x 80 (4800)	5 6 7 8	40 x 45 36 x 38 32 x 31 28 x 24	589.5 648.0 691.5 722.2	0.365 0.402 0.429 0.448	0.110
60 x 90 (5400)	5 6 7 8	40 x 55 36 x 48 32 x 41 28 x 34	682.1 754.7 810.8 852.5	0.423 0.468 0.503 0.528	0.124

Table AL11-8. Yardage tables - excavated ponds. (Sheet 3 of 6)

Storage - Acre Feet and Surface Area - Acres
4:1 and 3:1 End Slopes and 2:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
60 x 100 (6000)	5	40 x 65	774.7	0.480	0.138
	6	36 x 58	861.3	0.534	
	7	32 x 51	930.0	0.576	
	8	28 x 44	982.9	0.609	
65 x 105 (6825)	5	45 x 70	902.0	0.559	0.157
	6	41 x 63	1008.0	0.625	
	7	37 x 56	1094.0	0.678	
	8	33 x 49	1162.2	0.720	
70 x 100 (7000)	5	50 x 65	927.5	0.575	0.161
	6	46 x 58	1036.9	0.643	
	7	42 x 51	1125.8	0.698	
	8	38 x 44	1196.2	0.741	
80 x 100 (8000)	5	60 x 65	1080.2	0.670	0.184
	6	56 x 58	1212.4	0.751	
	7	52 x 51	1321.5	0.819	
	8	48 x 44	1409.6	0.874	
90 x 100 (9000)	5	70 x 65	1233.0	0.764	0.207
	6	66 x 58	1388.0	0.860	
	7	62 x 51	1517.3	0.940	
	8	58 x 44	1622.9	1.006	
	9	54 x 37	1707.0	1.058	
100 x 100 (10,000)	5	80 x 65	1385.8	0.859	0.230
	6	76 x 58	1563.6	0.969	
	7	72 x 51	1713.0	1.062	
	8	68 x 44	1836.2	1.138	
	9	64 x 37	1935.3	1.199	
80 x 125 (10,000)	5	60 x 90	1404.3	0.870	0.230
	6	56 x 83	1590.2	0.986	
	7	52 x 76	1749.3	1.084	
	8	48 x 69	1883.6	1.167	
	9	44 x 62	1995.3	1.237	
100 x 125 (12.500)	6	76 x 83	2052.4	1.272	0.287
	7	72 x 76	2270.4	1.407	
	8	68 x 69	2458.5	1.524	
	9	64 x 62	2618.7	1.623	
	10	60 x 55	2753.1	1.706	
120 x 125 (15,000)	6	96 x 83	2514.7	1.559	0.344
	7	92 x 76	2791.5	1.730	
	8	88 x 69	3033.3	1.880	
	9	84 x 62	3242.0	2.009	
	10	80 x 55	3419.8	2.120	

Table AL11-8. Yardage tables - excavated ponds. (Sheet 4 of 6)

Storage - Acre Feet and Surface Area - Acres
4:1 and 3:1 End Slopes and 3:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
40 x 40 (1600)	4 5	16 x 12 10 x 5	116.1 120.4	0.072 0.075	0.037
40 x 60 (2400)	4 5 6	16 x 32 10 x 25 4 x 18	199.1 213.0 218.7	0.123 0.132 0.136	0.055
40 x 75 (3000)	4 5 6	16 x 47 10 x 40 4 x 33	261.3 282.4 292.0	0.162 0.175 0.181	0.069
40 x 100 (4000)	4 5 6	16 x 72 10 x 65 4 x 58	365.0 398.1 414.2	0.226 0.247 0.257	0.092
50 x 60 (3000)	4 5 6 7	26 x 32 20 x 25 14 x 18 8 x 11	267.3 291.7 305.3 311.4	0.166 0.181 0.189 0.193	0.069
50 x 75 (3750)	5 6 7	20 x 40 14 x 33 8 x 26	388.9 412.0 424.1	0.241 0.255 0.263	0.086
50 x 90 (4500)	5 6 7	20 x 55 14 x 48 8 x 41	486.1 518.7 536.9	0.301 0.321 0.333	0.103
60 x 80 (4800)	5 6 7 8	30 x 45 24 x 38 18 x 31 12 x 24	537.0 578.7 605.6 621.0	0.333 0.359 0.375 0.385	0.110
60 x 90 (5400)	5 6 7 8	30 x 55 24 x 48 18 x 41 12 x 34	620.4 672.0 706.7 727.7	0.385 0.417 0.438 0.451	0.124
60 x 100 (6000)	5 6 7 8	30 x 65 24 x 58 18 x 51 12 x 44	703.7 765.3 807.9 834.4	0.436 0.474 0.501 0.517	0.138
65 x 105 (6825)	5 6 7 8	35 x 70 29 x 63 23 x 56 17 x 49	826.4 905.3 962.3 1001.8	0.512 0.561 0.597 0.621	0.157
70 x 100 (7000)	5 6 7 8	40 x 65 34 x 58 28 x 51 22 x 44	856.5 940.9 1003.6 1047.7	0.531 0.583 0.622 0.649	0.161

Table AL11-8. Yardage tables - excavated ponds. (Sheet 5 of 6)

Storage - Acre Feet and Surface Area - Acres
4:1 and 3:1 End Slopes and 3:1 Side Slopes

TOP DIMENSIONS (Feet) (Square Feet)	DEPTH (Feet)	BOTTOM DIMENSIONS (Feet)	VOLUME (Cubic Yards)	STORAGE (Acre Feet)	SURFACE AREA (Acres)
80 x 100 (8000)	5 6 7 8	50 x 65 44 x 58 38 x 51 32 x 44	1009.2 1116.4 1199.3 1261.0	0.626 0.692 0.743 0.782	0.184
90 x 100 (9000)	5 6 7 8 9	60 x 65 54 x 58 48 x 51 42 x 44 36 x 37	1162.0 1292.0 1395.1 1474.4 1533.0	0.720 0.801 0.865 0.914 0.950	0.207
100 x 100 (10,000)	5 6 7 8 9	70 x 65 64 x 58 58 x 51 52 x 44 46 x 37	1314.8 1467.6 1590.8 1687.7 1761.3	0.815 0.910 0.986 1.046 1.092	0.230
80 x 125 (10,000)	5 6 7 8 9	50 x 90 44 x 83 38 x 76 32 x 69 26 x 62	1310.2 1460.9 1581.7 1675.8 1746.3	0.812 0.905 0.980 1.039 1.082	0.230
100 x 125 (12.500)	6 7 8 9 10	64 x 83 58 x 76 52 x 69 46 x 62 40 x 55	1923.1 2102.9 2250.7 2369.7 2463.0	1.192 1.303 1.395 1.469 1.527	0.287
120 x 125 (15,000)	6 7 8 9 10	84 x 83 78 x 76 72 x 69 66 x 62 60 x 55	2385.3 2624.0 2825.5 2993.0 3129.6	1.478 1.626 1.751 1.855 1940	0.344

$V = \frac{d\,(A_1 = 4A_m + A_2)}{162}$

V = Volume - Cubic Yards

d = Depth - Feet

A_1 = Top Area - Square Feet

A_2 = Bottom Area - Square Feet

A_m = Area of Cross-section halfway between A_1 and A_1 - Sq. Ft.

NOTE: The following formula may be used to compute quantities for excavated ponds not included in this table:

$V = 1/3 \quad (A_1 + A_2 + \sqrt{A_1 \times A_2})\ \ d/27$

VOLUME OF EXCAVATION FOR INCREMENTS OF DEPTH OTHER THAN SHOWN MAY BE OBTAINED BY STRAIGHT LINE EXTRAPOLATION.

VOLUMES FOUND BY EXTRAPOLATION ARE WITHIN 0.5% OF TRUE COMPUTED VALUES.

Table 11-8. Yardage tables - excavated ponds. (Sheet 6 of 6)

4:1 and 2:1 End Slopes and 1:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
40 x 40 (1600) "0.037"	4 5 6	32 x 16 30 x 10 28 x 4	151.7 166.7 174.2	0.050 0.059 0.064	0.028 0.037 0.042	0.006 0.016 0.020	- -	- -
40 x 60 (2400) "0.055"	4 5 6 7	32 x 36 30 x 30 28 x 24 26 x 18	258.4 296.3 325.3 346.4	0.094 0.118 0.136 0.149	0.061 0.085 0.103 0.116	0.029 0.052 0.070 0.083	- - - - - - - - - - - - - - 0.004 0.017	- -
40 x 75 (3000) "0.069"	4 5 6 7 8	32 x 51 30 x 45 28 x 39 26 x 33 24 x 27	338.4 393.5 438.7 474.7 502.5	0.127 0.162 0.190 0.212 0.229	0.086 0.121 0.149 0.171 0.188	0.045 0.079 0.107 0.130 0.147	- - - - - - - - - - - - - - 0.025 0.047 0.065	- -
40 x 100 (4000) "0.092"	4 5 6 7 8	32 x 76 30 x 70 28 x 64 26 x 58 24 x 52	471.7 555.5 627.6 688.6 739.6	0.183 0.235 0.279 0.317 0.349	0.128 0.180 0.224 0.262 0.294	0.073 0.125 0.170 0.207 0.239	- - - - - - - 0.015 0.060 0.098 0.129	- -
50 x 60 (3000) "0.069"	4 5 6 7	42 x 36 40 x 30 38 x 24 36 x 18	329.5 379.6 418.7 447.5	0.122 0.153 0.177 0.195	0.081 0.112 0.136 0.154	0.040 0.071 0.095 0.113	- - - - - - - - - - - - - - 0.013 0.031	- -
50 x 75 (3750) "0.086"	5 6 7 8	40 x 45 38 x 39 36 x 33 34 x 27	504.6 565.3 614.7 653.6	0.210 0.248 0.278 0.302	0.159 0.196 0.227 0.251	0.107 0.145 0.175 0.199	0.004 0.042 0.073 0.097	- -

Table AL11-9. Excavated pond - alternative design table. (Sheet 1 of 9)

4:1 and 2:1 End Slopes and 1:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
50 x 90 (4500) "0.103"	5 6 7 8	40 x 60 38 x 54 36 x 48 34 x 42	629.6 712.0 781.9 840.3	0.267 0.318 0.361 0.397	0.205 0.256 0.300 0.336	0.143 0.195 0.238 0.274	0.020 0.071 0.114 0.151	- - - - - - - - - - - - - - - - - - - - -
60 x 80 (4800) "0.110"	5 6 7 8	50 x 50 48 x 44 46 x 38 44 x 32	666.7 752.0 823.4 881.8	0.282 0.334 0.379 0.415	0.216 0.269 0.313 0.349	0.150 0.203 0.247 0.283	0.018 0.071 0.116 0.152	- -
60 x 90 (5400) "0.124"	5 6 7 8	50 x 60 48 x 54 46 x 48 44 x 42	768.5 872.0 960.8 1035.9	0.328 0.392 0.447 0.494	0.254 0.318 0.373 0.420	0.180 0.244 0.299 0.346	0.032 0.096 0.151 0.198	- -
60 x 100 (6000) "0.138"	5 6 7 8	50 x 70 48 x 64 46 x 58 44 x 52	870.4 992.0 1098.2 1189.9	0.375 0.450 0.516 0.573	0.293 0.368 0.434 0.491	0.210 0.286 0.352 0.409	0.046 0.121 0.187 0.244	- -
65 x 105 (6825) "0.156"	5 6 7 8	55 x 75 53 x 69 51 x 63 49 x 57	1004.6 1148.7 1275.8 1387.0	0.436 0.525 0.604 0.673	0.342 0.431 0.510 0.579	0.248 0.338 0.417 0.485	0.061 0.151 0.229 0.298	- 0.018
70 x 100 (7000) "0.161"	5 6 7 8	60 x 70 58 x 64 56 x 58 54 x 52	1027.8 1174.2 1303.0 1415.1	0.445 0.536 0.616 0.685	0.349 0.440 0.520 0.589	0.253 0.344 0.424 0.493	0.061 0.152 0.232 0.301	- 0.013

Table AL11-9. Excavated pond - alternative design table.

4:1 and 2:1 End Slopes and 1:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
80 x 100 (8000) "0.184"	5 6 7 8	70 x 70 68 x 64 66 x 58 64 x 52	1185.2 1356.4 1507.8 1640.3	0.515 0.621 0.715 0.797	0.406 0.512 0.606 0.688	0.296 0.402 0.496 0.578	0.077 0.183 0.277 0.359	- 0.030
90 x 100 (9000) "0.207"	5 6 7 8 9	80 x 70 78 x 64 76 x 58 74 x 52 72 x 46	1342.6 1538.7 1712.7 1865.5 1998.0	0.585 0.707 0.815 0.910 0.992	0.462 0.584 0.691 0.786 0.868	0.339 0.460 0.568 0.663 0.745	0.092 0.213 0.321 0.416 0.498	- 0.046 0.128
100 x 100 (10,000) "0.230"	5 6 7 8 9	90 x 70 88 x 64 86 x 58 84 x 52 82 x 46	1500.0 1720.9 1917.5 2090.7 2241.3	0.656 0.792 0.914 1.022 1.115	0.518 0.655 0.777 0.885 0.978	0.381 0.518 0.640 0.747 0.841	0.107 0.244 0.366 0.473 0.567	- 0.062 0.155
80 x 125 (10,000) "0.230"	5 6 7 8 9	70 x 95 68 x 89 66 x 83 64 x 77 62 x 71	1532.4 1767.6 1981.0 2173.6 2346.3	0.676 0.821 0.954 1.073 1.180	0.539 0.684 0.817 0.936 1.043	0.401 0.547 0.679 0.799 0.906	0.127 0.273 0.405 0.525 0.632	- 0.113 0.220
100 x 125 (12,500) "0.287"	6 7 8 9 10	88 x 89 86 x 83 84 x 77 82 x 71 80 x 65	2243.1 2520.3 2772.1 2999.7 3203.7	1.048 1.219 1.376 1.517 1.643	0.876 1.048 1.204 1.345 1.472	0.705 0.877 1.033 1.174 1.300	0.362 0.534 0.690 0.831 0.957	- - - - - - - 0.020 0.176 0.317 0.443
120 x 125 (15,000) "0.344"	6 7 8 9 10	108 x 89 106 x 83 104 x 77 102 x 71 100 x 65	2718.7 3059.5 3370.7 3653.0 3907.4	1.274 1.485 1.678 1.853 2.011	1.068 1.279 1.472 1.647 1.805	0.863 1.074 1.267 1.442 1.599	0.451 0.662 0.855 1.030 1.188	- - - - - - - 0.046 0.238 0.413 0.517

Table AL11-9. Excavated pond - alternative design table. (Sheet 3 of 9)

4:1 and 3:1 End Slopes and 2:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
40 x 40 (1600) "0.037"	4 5	24 x 12 20 x 5	128.8 135.8	0.036 0.040	0.014 0.018	- - - - - - - - - - - - - -	- - - - - - - - - - - - - -	- - - - - - - - - - - - - -
40 x 60 (2400) "0.055"	4 5 6 7	24 x 32 20 x 25 16 x 18 12 x 11	223.6 246.9 261.3 268.9	0.073 0.087 0.096 0.101	0.040 0.054 0.063 0.068	0.007 0.021 0.030 0.035	- -	- -
40 x 75 (3000) "0.069"	4 5 6 7 8	24 x 47 20 x 40 16 x 33 12 x 26 8 x 19	294.7 330.2 354.7 370.0 378.5	0.100 0.122 0.138 0.147 0.152	0.059 0.081 0.096 0.106 0.111	0.018 0.040 0.055 0.065 0.070	- -	- -
40 x 100 (4000) "0.092"	4 5 6 7 8	24 x 72 20 x 65 16 x 58 12 x 51 8 x 44	413.2 469.1 510.2 538.6 556.2	0.146 0.181 0.207 0.224 0.235	0.092 0.126 0.152 0.169 0.180	0.037 0.071 0.097 0.114 0.125	- 0.005 0.016	- -
50 x 60 (3000) "0.069"	4 5 6 7	34 x 32 30 x 25 26 x 18 22 x 11	291.8 325.6 348.0 361.0	0.099 0.120 0.133 0.141	0.057 0.078 0.092 0.100	0.016 0.037 0.051 0.059	- -	- -
50 x 75 (3750) "0.086"	5 6 7 8	30 x 40 26 x 33 22 x 26 18 x 19	436.7 474.7 501.0 517.7	0.168 0.191 0.208 0.218	0.116 0.140 0.156 0.167	0.065 0.089 0.105 0.115	- - - - - - - - - - - - - - 0.002 0.012	- -

Table AL11-9. Excavated pond - alternative design table.

4:1 and 3:1 End Slopes and 2:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
50 x 90 (4500) "0.103"	5 6 7 8	30 x 55 26 x 48 22 x 41 18 x 34	547.8 601.3 641.0 668.8	0.216 0.249 0.274 0.291	0.154 0.188 0.212 0.229	0.093 0.126 0.151 0.168	- - - - - - - 0.003 0.027 0.044	- - - - - - - - - - - - - - - - - - - - -
60 x 80 (4800) "0.110"	5 6 7 8	40 x 45 36 x 38 32 x 31 28 x 24	589.5 648.0 691.5 722.2	0.234 0.270 0.297 0.316	0.168 0.204 0.231 0.250	0.102 0.138 0.165 0.184	- - - - - - - 0.007 0.034 0.053	- -
60 x 90 (5400) "0.124"	5 6 7 8	40 x 55 36 x 48 32 x 41 28 x 34	682.1 754.7 810.8 852.5	0.275 0.320 0.354 0.380	0.201 0.246 0.280 0.306	0.127 0.172 0.206 0.232	- - - - - - - 0.024 0.058 0.084	- -
60 x 100 (6000) "0.138"	5 6 7 8	40 x 65 36 x 58 32 x 51 28 x 44	774.7 861.3 930.0 982.9	0.316 0.369 0.412 0.445	0.233 0.287 0.330 0.362	0.151 0.205 0.247 0.280	- - - - - - - 0.040 0.083 0.116	- -
65 x 105 (6825) "0.156"	5 6 7 8	45 x 70 41 x 63 37 x 56 33 x 49	902.0 1008.0 1094.0 1162.2	0.372 0.438 0.491 0.533	0.278 0.344 0.397 0.440	0.185 0.251 0.304 0.346	- - - - - - - 0.063 0.117 0.159	- -
70 x 100 (7000) "0.161"	5 6 7 8	50 x 65 56 x 58 52 x 51 48 x 44	927.5 1036.9 1125.8 1196.2	0.383 0.451 0.506 0.550	0.287 0.355 0.410 0.454	0.191 0.259 0.314 0.358	- - - - - - - 0.067 0.122 0.166	- -

Table AL11-9. Excavated pond - alternative design table.

4:1 and 3:1 End Slopes and 2:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
80 x 100 (8000) "0.184"	5 6 7 8	60 x 65 56 x 58 52 x 51 48 x 44	1080.2 1212.4 1321.5 1409.6	0.450 0.532 0.600 0.654	0.341 0.422 0.490 0.545	0.231 0.313 0.380 0.435	0.011 0.093 0.161 0.216	- -
90 x 100 (9000) "0.207"	5 6 7 8 9	70 x 65 66 x 58 62 x 51 58 x 44 54 x 37	1233.0 1388.0 1517.3 1622.9 1707.0	0.517 0.614 0.694 0.759 0.811	0.394 0.490 0.570 0.636 0.688	0.271 0.367 0.447 0.512 0.564	0.024 0.120 0.200 0.266 0.318	- -
100 x 100 (10,000) "0.230"	5 6 7 8 9	80 x 65 76 x 58 72 x 51 68 x 44 64 x 37	1385.8 1563.6 1713.0 1836.2 1935.3	0.585 0.695 0.788 0.864 0.925	0.448 0.558 0.650 0.727 0.788	0.311 0.421 0.513 0.590 0.651	0.036 0.147 0.239 0.316 0.377	- -
80 x 125 (10,000) "0.230"	5 6 7 8 9	60 x 90 56 x 83 52 x 76 48 x 69 44 x 62	1404.3 1590.2 1749.3 1883.7 1995.3	0.596 0.711 0.810 0.893 0.963	0.459 0.574 0.673 0.756 0.825	0.322 0.437 0.536 0.619 0.688	0.048 0.163 0.262 0.345 0.414	- 0.003
100 x 125 (12,500) "0.287"	6 7 8 9 10	76 x 83 72 x 76 68 x 69 64 x 62 60 x 55	2052.4 2270.4 2458.5 2618.7 2753.1	0.929 1.065 1.181 1.280 1.364	0.758 0.893 1.010 1.109 1.192	0.587 0.722 0.838 0.938 1.021	0.244 0.379 0.496 0.595 0.678	- 0.081 0.164
120 x 125 (15,000) "0.344"	6 7 8 9 10	96 x 83 92 x 76 88 x 69 84 x 62 80 x 55	2514.7 2791.5 3033.3 3242.0 3419.8	1.147 1.319 1.469 1.598 1.708	0.942 1.113 1.263 1.393 1.503	0.736 0.908 1.058 1.187 1.297	0.325 0.496 0.646 0.776 0.886	- - - - - - - - - - - - - - 0.029 0.159 0.269

Table AL11-9. Excavated pond - alternative design table. (Sheet 6 of 9)

4:1 and 3:1 End Slopes and 3:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
40 x 40 (1600) "0.037"	4 5	16 x 12 10 x 5	116.1 120.4	0.028 0.031	0.006 0.009	- - - - - - - - - - - - - -	- - - - - - - - - - - - - -	- - - - - - - - - - - - - -
40 x 60 (2400) "0.055"	4 5 6	16 x 32 10 x 25 4 x 18	199.1 213.0 218.7	0.058 0.066 0.070	0.025 0.033 0.037	- - - - - - - - - - - - - - 0.004	- -	- -
40 x 75 (3000) "0.069"	4 5 6	16 x 47 10 x 40 4 x 33	261.3 282.4 292.0	0.080 0.093 0.099	0.039 0.052 0.058	- - - - - - - 0.011 0.016	- -	- -
40 x 100 (4000) "0.092"	4 5 6	16 x 72 10 x 65 4 x 58	365.0 398.1 414.2	0.117 0.137 0.147	0.062 0.082 0.092	0.007 0.027 0.037	- -	- -
50 x 60 (3000) "0.069"	4 5 6 7	26 x 32 20 x 25 14 x 18 8 x 11	267.3 291.7 305.3 311.4	0.083 0.099 0.107 0.111	0.042 0.057 0.066 0.070	0.001 0.016 0.025 0.028	- -	- -
50 x 75 (3750) "0.086"	5 6	20 x 40 14 x 33 8 x 26	388.9 412.0 424.1	0.138 0.153 0.160	0.087 0.101 0.109	0.035 0.050 0.057	- -	- -
50 x 90 (4500) "0.103"	5 6 7	20 x 55 14 x 48 8 x 41	486.1 518.7 536.9	0.178 0.198 0.209	0.116 0.136 0.148	0.055 0.075 0.086	- -	- -
60 x 80 (4800) "0.110"	5 6 7 8	30 x 45 24 x 38 18 x 31 12 x 24	537.0 578.7 605.6 621.0	0.201 0.227 0.244 0.253	0.135 0.161 0.178 0.188	0.070 0.095 0.112 0.122	- -	- -

Table AL11-9. Excavated pond - alternative design table. (Sheet 7 of 9)

4:1 and 3:1 End Slopes and 3:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
60 x 90 (5400) "0.124"	5 6 7 8	30 x 55 24 x 48 18 x 41 12 x 34	620.4 672.0 706.7 727.7	0.236 0.268 0.290 0.303	0.162 0.194 0.216 0.229	0.088 0.120 0.142 0.155	- 0.007	- -
60 x 100 (6000) "0.138"	5 6 7 8	30 x 65 24 x 58 18 x 51 12 x 44	703.7 765.3 807.9 834.4	0.272 0.310 0.336 0.353	0.189 0.228 0.254 0.270	0.107 0.145 0.172 0.188	- - - - - - - - - - - - - - 0.007 0.024	- -
65 x 105 (6825) "0.157"	5 6 7 8	35 x 70 29 x 63 23 x 56 17 x 49	826.4 905.3 962.8 1001.8	0.325 0.374 0.410 0.434	0.232 0.280 0.316 0.340	0.138 0.187 0.222 0.247	- - - - - - - - - - - - - - 0.035 0.059	- -
70 x 100 (7000) "0.161"	5 6 7 8	40 x 65 34 x 58 28 x 51 22 x 44	856.5 940.9 1003.6 1047.7	0.339 0.391 0.430 0.457	0.243 0.295 0.334 0.361	0.147 0.199 0.238 0.266	- - - - - - - 0.007 0.046 0.074	- -
80 x 100 (8000) "0.184"	5 6 7 8	50 x 65 44 x 58 38 x 51 32 x 44	1009.2 1116.4 1199.3 1261.0	0.406 0.473 0.524 0.562	0.297 0.363 0.414 0.453	0.187 0.253 0.305 0.343	- - - - - - - 0.034 0.085 0.124	- -
90 x 100 (9000) "0.207"	5 6 7 8 9	60 x 65 54 x 58 48 x 51 42 x 44 36 x 37	1162.0 1292.0 1395.1 1474.4 1533.0	0.473 0.554 0.618 0.667 0.703	0.350 0.431 0.495 0.544 0.580	0.227 0.307 0.371 0.420 0.457	- - - - - - - 0.060 0.124 0.174 0.210	- -

Table AL11-9. Excavated pond - alternative design table.

4:1 and 3:1 End Slopes and 3:1 Side Slopes

TOP DIM. FT. (sq. ft.) "ac."	DEPTH (ft.)	BOTTOM DIM. (ft.)	VOLUME (cu. yd.)	TOTAL WATER NEEDS FOR CATTLE (ac.-ft.)				
				60 days	90 days	120 days	180 days	270 days
100 x 100 (10,000) "0.230"	5	70 x 65	1314.8	0.541	0.404	0.267	- - - - - - -	- - - - - - -
	6	64 x 58	1467.6	0.635	0.498	0.361	0.087	- - - - - - -
	7	58 x 51	1590.8	0.712	0.575	0.438	0.163	- - - - - - -
	8	52 x 44	1687.7	0.772	0.635	0.498	0.223	- - - - - - -
	9	46 x 37	1761.3	0.818	0.680	0.543	0.269	- - - - - - -
80 x 125 (10,000) "0.230"	5	50 x 90	1310.2	0.538	0.401	0.264	- - - - - - -	- - - - - - -
	6	44 x 83	1460.9	0.631	0.494	0.357	0.083	- - - - - - -
	7	38 x 76	1581.7	0.706	0.569	0.432	0.158	- - - - - - -
	8	32 x 69	1675.8	0.765	0.627	0.490	0.216	- - - - - - -
	9	26 x 62	1746.3	0.808	0.671	0.534	0.260	- - - - - - -
100 x 125 (12,500) "0.287"	6	64 x 83	1923.1	0.849	0.678	0.506	0.164	- - - - - - -
	7	58 x 76	2102.9	0.961	0.789	0.618	0.275	- - - - - - -
	8	52 x 69	2250.7	1.052	0.881	0.710	0.367	- - - - - - -
	9	46 x 62	2369.7	1.126	0.955	0.783	0.441	- - - - - - -
	10	40 x 55	2463.0	1.184	1.012	0.841	0.498	- - - - - - -
120 x 125 (15,000) "0.344"	6	84 x 83	2385.3	1.067	0.862	0.656	0.245	- - - - - - -
	7	78 x 76	2624.0	1.215	1.009	0.804	0.392	- - - - - - -
	8	72 x 69	2825.5	1.340	1.134	0.929	0.517	- - - - - - -
	9	66 x 62	2993.0	1.444	1.238	1.033	0.621	0.004
	10	60 x 55	3129.6	1.529	1.323	1.117	0.706	0.089

Table AL11-9. Excavated pond - alternative design table. (Sheet 9 of 9)