B-222

Farm Ponds.....

Their Construction and Maintenance

TEXAS AGRICULTURAL EXTENSION SERVICE

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FOREWORD

A well-built, well-protected pond of sufficient size can be made of more value than any other crop area of the same size on the same farm. Fish, water fowl, minnows, game birds, song birds and useful wild animals all thrive in and around a well-managed pond. The pond also affords opportunities of fishing, swimming and boating.

This circular deals only with the requirements of a well-constructed farm pond and leaves to other publications detailed information regarding the use of stock ponds for water supplies, wild life and recreation. Pertinent local information is essential and consultation with engineers, conservationists and others experienced in the development of farm ponds is advised. This circular is further limited to ponds having dams up to 25 feet in height and thereby limited to relatively small drainage areas.

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Why Build a Farm Pond?

Texas farmers and ranchers are discovering the advantages of farm ponds, not only as being profitable but also offering good recreation. Well-built ponds may be a dependable source of water even in years of severe drouth when properly located, constructed and maintained. Farm ponds often are a key point in the farm soil and water conservation plan. With ponds conveniently located, fuller use can be made of pasture and grazing lands. Frequently, too, ponds may be stocked with fish and thus furnish food, as well as recreation.

Satisfactory ponds can be built with your own farm tractor and equipment. Ponds built with farm equipment are usually of good construction since the dams are built more slowly and the earth becomes well packed.

Plan the Pond

After determining the economic and social needs for a pond on your farm, decide on the size needed. The pond will be of little use unless it is large enough to furnish the amount of water needed at the time it is needed. A pond should be at least 8 feet deep and ¼ acre or more surface area. Since the yearly rate of evaporation reaches five feet or more in some sections of Texas, shallow ponds are not reliable.

In most cases, a dual purpose pond of one to two acres for water supply and recreation is most desirable. A pond of this area with sufficient depth will provide for fish as well as livestock demands in dry periods. If the pond is designed for livestock watering entirely, allowance must be made for daily livestock water consumption in addition to evaporation and seepage. In general, milk-producing cows

require about 30 gallons a day, horses and beef cattle 12 gallons a day, pigs 2 gallons a day and sheep 1½ gallons a day.

Where the pond is located will depend on a number of important features. Of first importance is the drainage area which will supply sufficient water. Of equal importance is the soil type which will make an earth dam reservoir hold water with relatively small seepage loss. Avoid drainage from roads or cultivated areas. Not only is this important from the standpoint of silt filling the pond, but also eroded watersheds often cause the water to be cloudy. Watersheds may be vegetated and sod established before the pond is built.

Investigating Pond Sites

Before final plans are made, several pond sites should be investigated to determine the most suitable site for the kind of pond desired. The watershed above the pond should be large enough to keep water in the pond during dry periods, yet not so large that it will create flood hazards during heavy rain storms. Too large a watershed will also require a large expensive outlet structure to carry off excess water safely. Watersheds between 20 and 40 acres are usually suitable for farm ponds. The size, of course, depends mainly upon the size of the pond and the annual rainfall.

The *filtering* and *silting* problem should be considered. A good vegetative growth just above the tank will tend to catch silt. A silt basin built upstream from the pond furnishes a place from which silt may be removed without disturbing the water in the tank.

The most important part of an earth tank is the spillway. Unless the watershed is small compared with the tank size, the spillway should be one of the most important things to consider. Select a natural spillway if possible. Avoid a spillway that empties along the back side of the dam. A level should be used in selecting a tank site since the chance of the land slope is often deceiving. Figure 1 gives a desirable layout for a farm pond.

The site should be investigated for sand and gravel strata or cracks and rocks which will permit seepage. Occasionally one or the other of these features makes a site impractical.

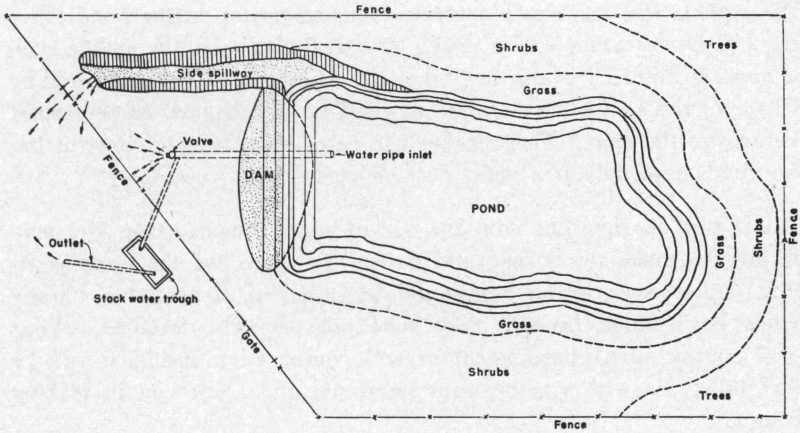


Figure 1. Farm pond layout.

Final Survey of Proposed Site

Always have soil tests made to make sure your pond will hold water. Several test holes should be bored to find the types of subsoil and the depth of each layer at the pond site. The best type of soil is deep to bed rock and has a heavy, slowly permeable subsoil that contains lots of clay. Avoid sites with rock outcropping along the bank or where rock or shale ledges are near the surface. Do not select sites having sand, gravel, peat or marl through which the water might seep. If you build your pond on shallow soil don't borrow dirt for the fill from the pond area. Make your fill dirt from a burrow pit nearby.

It is wise to have a topographic survey made of the watershed and pond area. A map should then be made from the survey showing contours at 1-foot intervals. From this map, plans giving detailed dimensions of the dam and other features may be made.

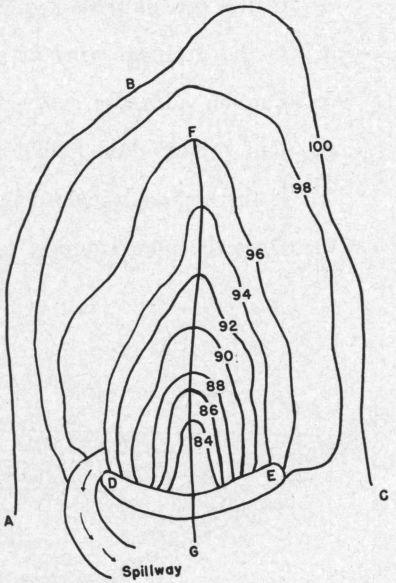


Figure 2. An area survey should give the boundary of the drainage area (A-B-C), the crest of the dam (D-E) and the center channel (F-G).

These plans will serve as blueprints for construction of the pond. Figure 2 gives an example of a rough drainage area map. A profile such as given in figure 3 is also helpful in the dam design. Stakes should be driven in the ground to outline the pond area and mark all important features of the dam. These stakes will be of great help in constructing the pond, especially if a great deal of excavation is necessary.

If you are familiar with the use of survey instruments, you may be able to make the survey and design the plans for the pond yourself. However, a technician should be called in, if available. Many ponds have failed because they were not properly designed. Your local county agricultural agent or soil conservation specialist will be glad to advise with you on your pond site and assist you in making a survey.

The final survey and plan should answer the following questions to your satisfaction:

1. Does this site give adequate water-holding capacity at low cost?
2. Does it utilize a protected drainage area?
3. Is the soil suitable for holding water?
4. Is the drainage area of such size to avoid flooding?
5. Can an adequate spillway for the pond be provided?
6. Can proper dam height be achieved economically?
7. Is there enough pond depth to assure continuous water supply?
8. Does the plan conform to easy maintenance?

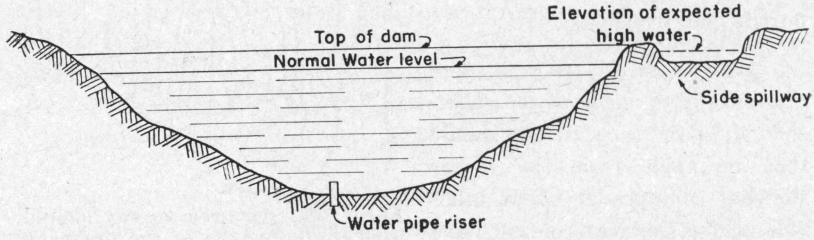
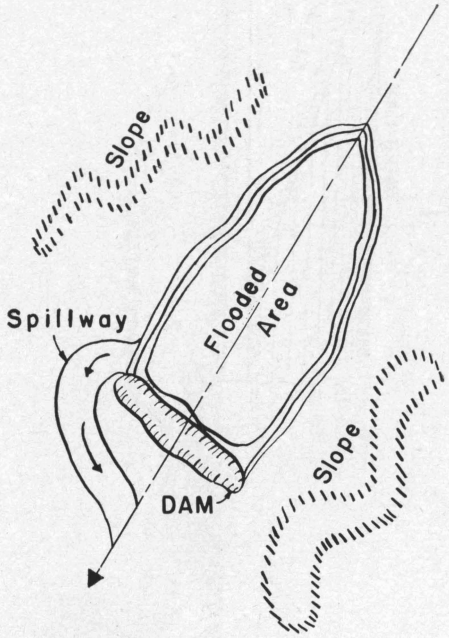


Figure 3. Profile of water at dam showing spillway and top of dam.

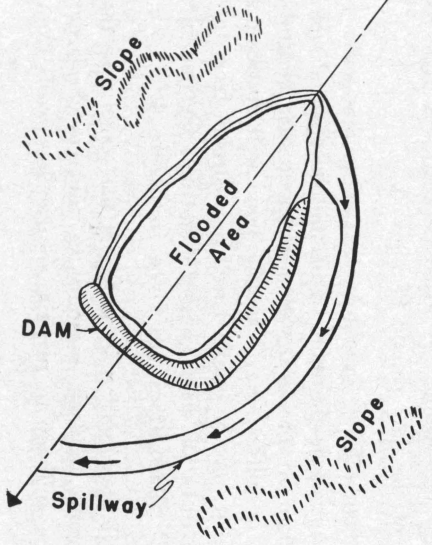
Figure 4. Relation of Spillway to Dam.

(A) Usual type. Spillway at lower end of flooded area.



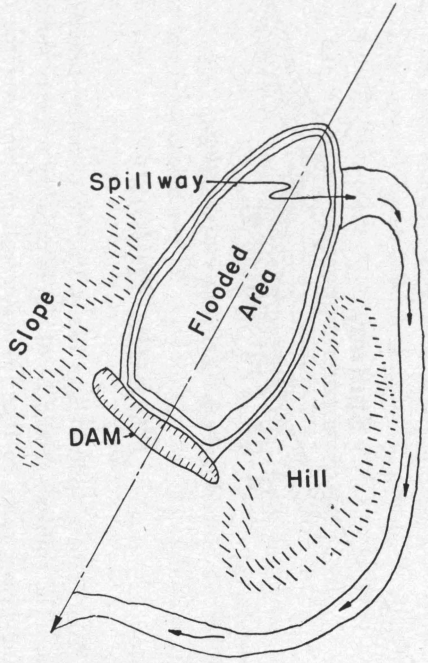
Poor from silting standpoint.

(B) Occasional type. Spillway at upper end of flooded area.



Better from silting standpoint but more expensive than type A.

(C) Preferred type. Spillway entirely apart from dam.



Also better from silting standpoint but best of three because it is cheapest.

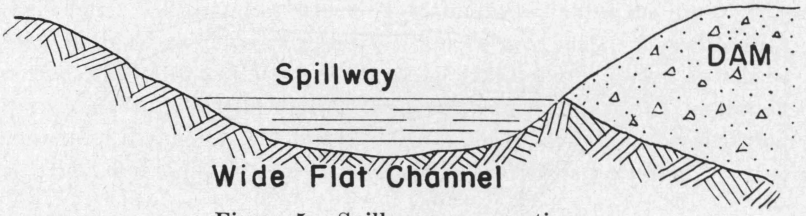


Figure 5. Spillway cross section.

Plan the Spillway

Too small a spillway can easily lead to complete failure of your pond. The spillway should be of ample capacity to carry surplus water during heavy rains so that the water will not run over the dam and destroy it. Ample freeboard between the high water level and the crest of the dam should be allowed.

The spillway should be located so that water running through it will not erode the dam. It should be emptied well downstream from the dam, if practical. Sometimes a very desirable situation exists when a spillway may leave the pond well upstream from the dam and where it may be emptied well downstream from the dam or even into some draw or water-course other than the one in which the dam is built. Illustrations are given in Figure 4.

If the situation is such that the water runs through the spillway frequently, a rock, masonry or concrete check dam may be needed in the spillway to prevent an overflow wash from eating back into

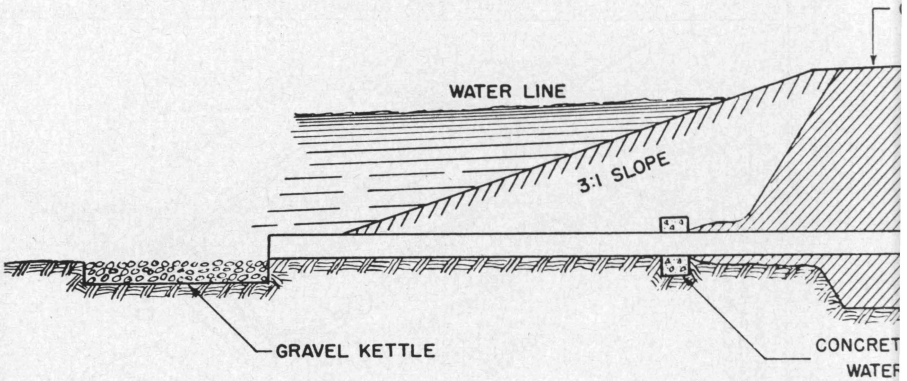


Figure 6.

the pond. This need is most likely to arise if the bottom sides of the spillway channel cannot be covered with growing grass. If the lower end of the spillway channel is in a sandy loam soil, sometimes a loose rock check dam or riprap will prevent serious erosion.

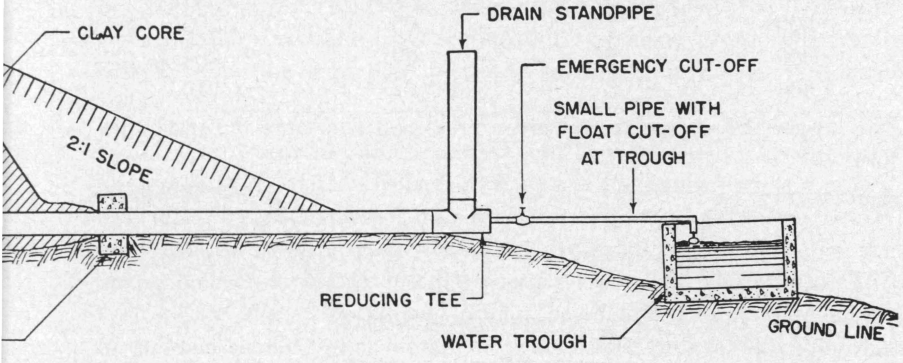
Broad, shallow spillway channels are less likely to erode than narrow deep ones. Where a natural spillway at the proper elevation is not available, one must be cut. The cutting should be through earth that has not been disturbed previously. An illustration is given in Figure 5.

If running water coming out of the pond's spillway flows around the end of the dam, riprapping should be used to prevent washing off the end of the dam.

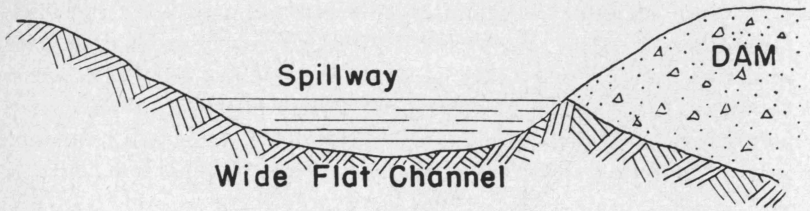
Sometimes a terrace having 4 or 5 inches of fall per 100 feet may be extended from one end of the dam to serve as a spillway that will not wash seriously. Where such an arrangement is used, an emergency spillway of greater capacity and at slightly higher elevation should also be made, possibly at the other end of the dam.

Determine Size of Spillway Channel

The size of the spillway determines largely whether or not heavy rains will cause the dam to be overtopped and destroyed. It is desirable to make the spillway larger than minimum requirements. Suggested dimensions given in table 1 are only an approximation since



ion of dam.



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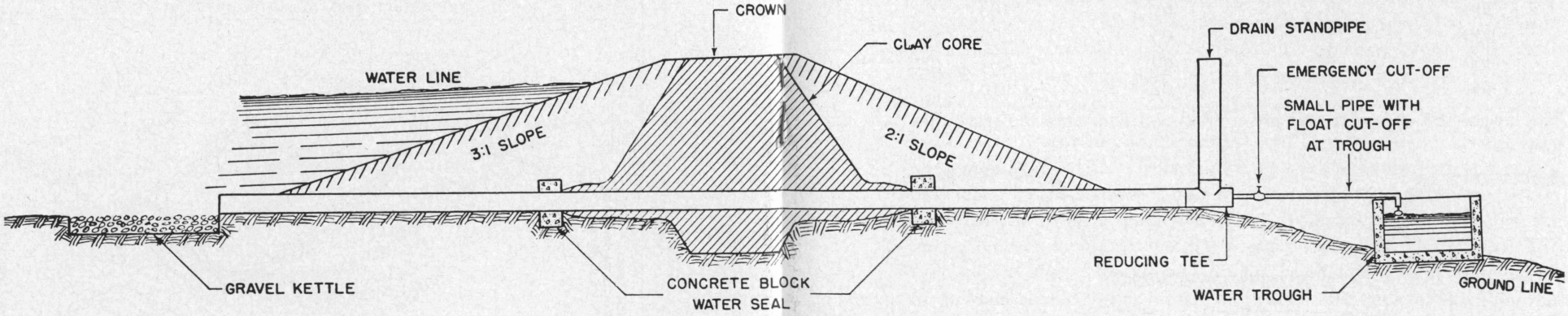

Figure 6. Cross section of dam.

the shape, slope, acreage, and covering of the watershed as well as the rainfall intensity and duration affect the rate of runoff.

Suggested dimensions as given in Figure 7 and Table 1 are intended as a minimum section of the spillway ditch or channel. It is also assumed that the slope down the channel is ample for the cross section given. The entrance for the water from the pond into the spillway should be tapered outward toward the pond and sharp turns to the spillway should be avoided.

Table 1. Pond spillway sizes for watershed areas.

Acres in watershed area	(d) Depth in feet	(w) Width in feet	Area of cross section in sq. ft.
5	1½	6	9
10	1½	9	13½
15	1½	12	18
20	1½	14	21
25	1½	16	24
30	1½	18	27
40	2	14	28
50	2	16	32
75	2	23	46
100	2	28	56
200	2	48	96
300	2½	48	120
400	2½	60	150
500	2½	68	170
600	3	58	174
700	3	61	183
800	3	65	195
900	3	69	207
1,000	3	72	216

The deeper the water for any given cross sectional area the faster the flow.

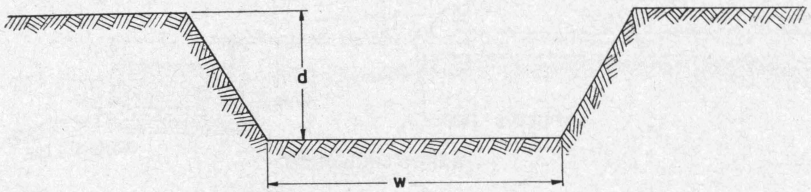

Figure 7. Cross section of channel.

Look for high water marks in the draw or channel leading into the pond. The pond spillway channel should be approximately twice as large in cross section as the stream was in its full flood stage. Probable velocity in the stream was greater than it will be in the pond spillway and therefore the spillway channel will have to be larger to take care of an equal flow at a lower velocity.

If at all possible build the spillway before the dam is constructed. In some cases the spillway may be cut, graded and sodded before it is expected to carry any of the water. Although this method usually requires some watering of the sod, it is valuable insurance for a good farm pond.

Plan Earthen Dam

From the survey, the desired waterline may be determined and staked out. The earthen dam which must hold the water may then be designed. It is usually desirable to put a pipe through the dam to let water out into a watering trough and for drainage purposes. The pipe should not be less than 2 inches in diameter, preferably larger. Concrete collars should be built around the pipe to prevent seepage between the pipe and soil. Plan to have a cut-off on the pipe just inside of the dam to eliminate leaking and freezing hazards.

The drain pipe should project into the pond at the lowest point on the upstream side of the dam. This point is often called "the keetle." In draining the pond, fish collect at this point. The water level may be lowered for weed control or drained by opening the valve. Figure 6 gives details of a dam cross section with drainage pipe. The water trough below the dam may be made automatic by means of a float control in the trough.

The crown or top of the dam should be 5 feet wide plus one-fifth the height of the dam. Thus, a dam 15 feet high should have a crown of 8 feet. In some cases, it may need to be wider so that heavy equipment can be used to build the dam. The downstream slope of the dam should be 2 to 1 (2 feet horizontally and 1 foot vertically). The upstream or water slope should usually be around 3 to 1. The height of the dam should be the water line, plus 3 feet, plus 10 to 15 percent to allow for settling.

Table 2. Dimensions for earth dams.

(See Figure 8.)

h	w	f	i	o	a	b	a×w×b	c.s.
4	4	3	2:1	1½:1	8	6	18	44
5	4	3	2:1	1½:1	10	7½	21½	64
6	4	3	2:1	1½:1	12	9	25	87
7	4	3	2:1	1½:1	14	10½	28½	114
8	5	3	2:1	1½:1	16	12	33	152
9	5	4	2:1	1½:1	18	13½	36½	187
10	6	4	2:1	1½:1	20	15	41	235
11	6	4	2½:1	2:1	27½	22	55½	338
12	7	4	2½:1	2:1	30	24	61	408
13	7	4	2½:1	2:1	32½	26	65½	471
14	7	4	2½:1	2:1	35	28	70	539
15	7	5	3:1	2:1	45	30	82	668
16	7	5	3:1	2:1	48	32	87	752
17	8	5	3:1	2:1	51	34	93	859
18	8	5	3:1	2:1	54	36	98	954
19	8	5	3:1	2:1	57	38	103	1055
20	8	5	3:1	2:1	60	40	108	1160

h=height of dam in feet
w=top width of dam in feet
f=height of dam in feet above bottom of spillway channel, after allowance is made for settling
i=inner or water side slope
o=outer slope
a=width of inner slope in feet
b=width of outer slope in feet
a×w×b=total bottom width of dam in feet
c.s.=cross section of dam in square feet

A rough estimate of the volume of dirt required to build the dam in a certain location can be made by dividing the proposed dam into sections according to height. The length of the section of an even height is multiplied by the cross sectional area for the height as given in Table 2. The volumes of the sections are then added together to get the total volume of the dam. Figure 8 gives details on cross sections of earthen dams as indicated by the table.

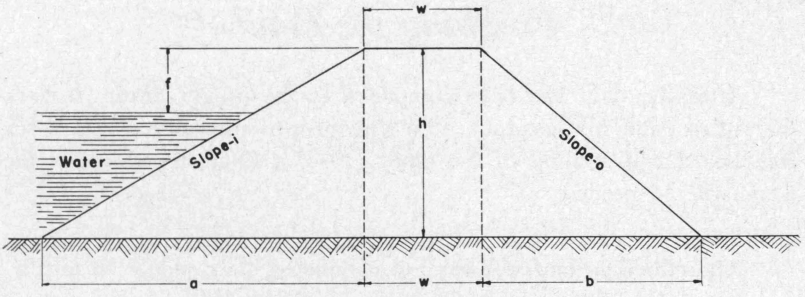

Figure 8. Dimensions of earth dams.

Building the Earthen Dam

All foreign material should be removed from the area where the earthen dam will be. Remove all roots of brush and trees from this area. A trench at least 4 to 8 feet wide, depending on the height of the dam should be dug the length of the dam. The trench should be 1 foot or more in depth or down to a fairly impervious subsoil. Dirt from the trench may be used in the outer side of the dam. The area to be under the dam should be plowed or disked for a good bond between the ground and fill dirt. The core of the dam should be made up of a clay soil with a high percentage of sand and small gravel in it. Build up the dam in layers less than 1 foot thick. Use moist dirt as you cannot pack dry soil satisfactorily. On the other hand, if you can squeeze water out of the soil it is too wet to spread and compact properly.

The dam should be started at its widest section and tapered inward as the fill builds up. This will help to compact thoroughly the slopes. If rain halters your dam-building operations, wait until the surface of the partially built dam is dry before you resume. Then disc the surface of the partly built dam before adding more dirt to it to prevent forming of a seepage channel between the rain-packed surface and the new fill.

If the soil for your dam is very stoney place stones in the lower third of the fill but, do not allow them to accumulate in piles.

Finishing the Pond

After the dam has been completed to the proper grade, recheck the entire pond for accuracy. Be sure proper allowance is made for free board and settling of the dam. Also, a final smoothing of the work will be needed.

After the dam and spillway are completed, they should be fertilized and seeded with a good grass mixture. Usually manure or straw will be satisfactory. Until a good cover has been established in the spillway, do not let the pond fill with water. By sodding the dam and spillway, the pond can be used in a shorter period than by seeding.

You may want to grade all edges of the pond before it is filled with water. The edges should have a 2 to 1 slope and the grading should extend about 3 feet below the normal water level.

A fence will protect the pond, spillway and dam from livestock. It may enclose a strip of ground 30 to 50 feet around the pond. Livestock can damage seriously a fresh-filled pond in a short time. You may want to plant grass, shrubs and other vegetation around the shore line. A grass or shrub border around the pond protects it from erosion, silting and scuffing-off. It also helps to insure a clean supply of water and provides a home for desirable wildlife.

Subsoils in some parts of Texas permit excessive seepage and, therefore ponds are not practical. Porous soils, gravel and rock layers are particularly undesirable. Sometimes excessive seepage can be prevented by covering the porous areas with a layer of clay to depths of 3 or 4 inches. This layer of clay should be packed and puddled thoroughly before the pond is filled with water. Livestock may be induced to tramp the soil.

Bentonite clay may be used for new and water-filled ponds which are expected to have excessive seepage. Bentonite can be purchased commercially and spread in thin layers over seepage areas. Directions for sealing ponds with bentonite clay are available from your county agricultural agent. Ask for MS-914.

Protect and Maintain the Pond

All ponds require management and maintenance. Inspect your pond often. Any damage from silting, wave action, erosion, burrowing animals, livestock, undercutting or overflow should be corrected promptly.

To prevent your pond from filling up with silt and eventually becoming useless you must install adequate soil conservation measures on the land in the drainage area above.

Large ponds likely will have waves when the wind blows. The dam can be protected against erosion from waves by means of rock, riprap, brush, logs or lumber staked in place. In some localities the outer slope of the top of the dam may be protected against erosion from rainfall by planting grass over them.

For ordering fish or for pond treatments you will need to determine the volume of water the pond contains. To get the approximate acre-feet capacity of a pond measure the surface area in acres as it will stand when the pond is full and multiply this acreage by one-third of the maximum depth of the water in feet. This rule will be correct only when the volume of the water is in the shape of an inverted cone or pyramid.

If water is piped out of a tank to a trough it is well to run a fence entirely around the dam, the tank, and a small silt catching area above the tank. If livestock are permitted to the tank, the dam may be fenced to protect it and the small silt catching area above the tank may be fenced separately. Too large or too small a drainage area may be corrected even after a pond is built by adding diversion terraces.

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