POND CONSTRUCTION

Developing a good fishing pond involves more than just pushing up some dirt to impound water and stocking fish. By building a well designed pond, an environment can be created that will support a multitude of organisms, both plant and animal, important to fish. With proper stocking and management, a pond can produce a quality fishery, benefit terrestrial wildlife, and be relatively maintenance-free.

Pond Types

There are two types of ponds: embankment and excavated. An embankment pond, hereafter referred to simply as a pond, is made by building a dam across a ravine or draw to impound flowing waters. An excavated pond, hereafter referred to as a dugout, is made by digging a pit in a flat area that is usually wet for extended periods of time or near a stream/river, keeping in mind flooding potential. Dugouts are normally sustained by groundwater and/or springs. Water depths must be monitored during the excavation process to ensure sufficient depths for fish and fishing are available when completed. Attaining proper depths may be very difficult in some wet areas. Information for ponds provided throughout the remainder of this handbook, except for dam construction considerations, can also be applied to dugouts.

Site Selection

The success or failure of a pond may depend upon the site you choose. Careful site selection can reduce construction and maintenance costs, and increase the benefits you receive from your pond. Although most potential pond sites have some features that are less than ideal, many deficiencies can be overcome with good planning and design. When thinking about location, don't forget about convenience. A well planned pond that is close to home and easily accessible will be used more often and provide more enjoyment than one that is far away and hard to reach. In addition, it is more likely to be properly maintained.

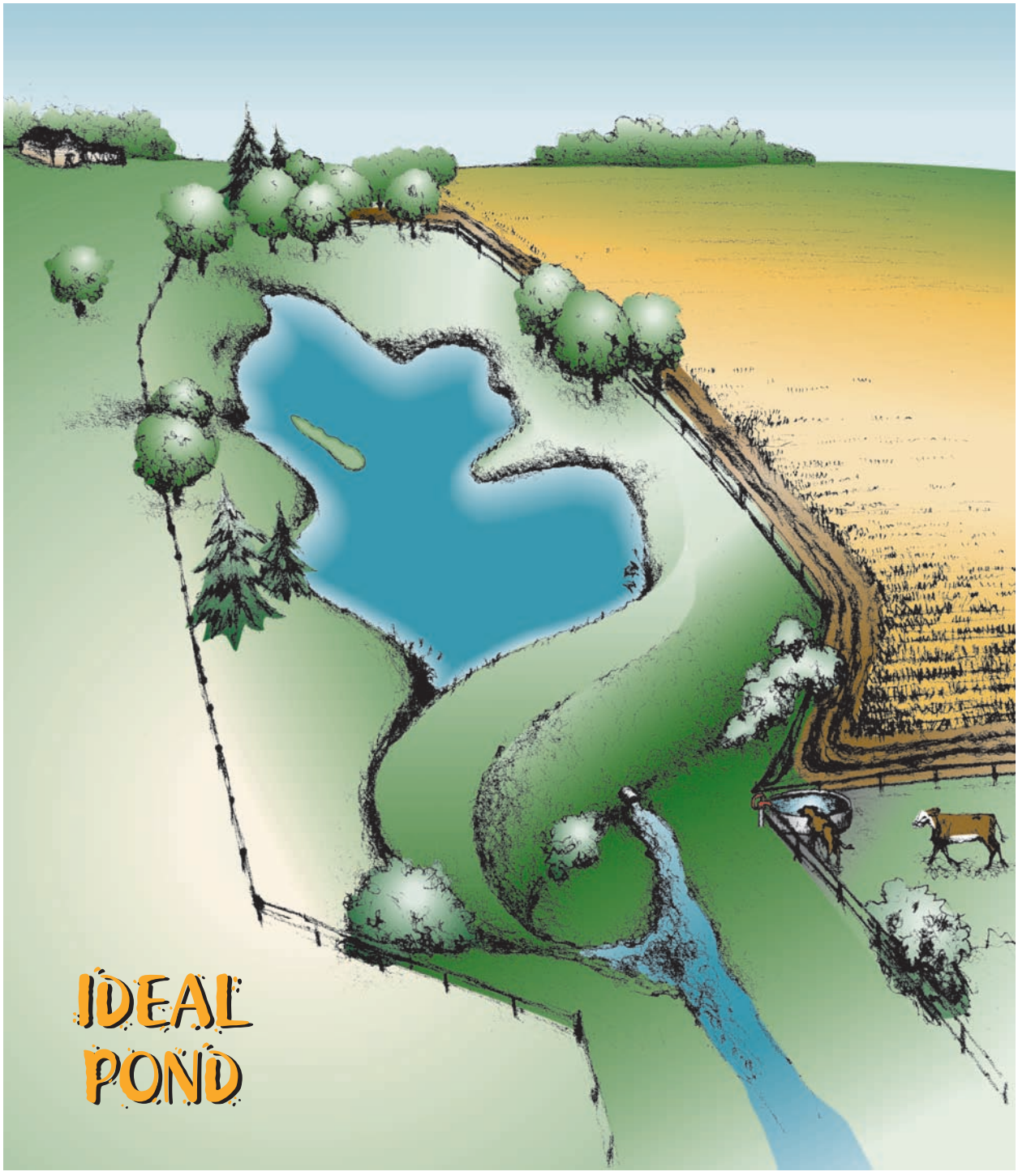
Watershed

The size of the **watershed**, or drainage area, is an important aspect of site selection. The watershed includes the immediate pond site and all land that drains to the pond. This may include land belonging to other people.

The minimum watershed area needed for each acre of pond surface is called the watershed ratio. The ideal watershed ratio varies from 20:1 in southeastern Nebraska to in excess of 50:1 in the Panhandle. This means

Watershed ratios vary across the state. Personnel from the local U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) office can help determine that ratio for a particular site.

a 1-acre pond built in the southeast would require a 20-acre watershed to maintain water levels, while a similar pond in the Panhandle would require a 50-acre watershed. The exact ratio for a specific location depends on annual precipitation, soil type, the amount and types of vegetation in the watershed, pond uses, and the slope of the watershed.


IDEAL
POND

Ponds with large watersheds typically require a larger dam and therefore cost more to build. Ponds with very large watersheds, or very high watershed ratios for their part of the state, are often unsuitable for fish production. Major runoff events from heavy rains may cause flooding and erosion in the pond or spillway area. They may also bring in heavy sediment loads that fill in the pond and muddy the water. The added turbidity, or muddiness of the water, affects fish, their food organisms, and aquatic plants. Even runoff from normal rainfall can slow fish growth by causing temporary food shortages if most of the food items, particularly microscopic plants and animals, are flushed out.

When possible, check dams, terraces, and vegetated buffer areas should be established in the watershed before a pond is built. These practices will slow runoff and allow suspended sediment to settle out before entering the pond, thus reducing sediment problems and prolonging the life of the pond. Terraces can also be used to divert excess water away from the pond.

See page 58 for additional information on effects of muddy water and ways to resolve turbidity problems.

Another potential problem associated with major runoff events is fish movement. Fish may swim out of a pond or enter it from either the watershed or downstream areas during high water. Any undesirable fish in the pond's watershed should be eliminated, if feasible, prior to construction, or they may hamper fishery management efforts. Installation of an overflow drop structure in the dam will prevent most fish movement into the pond from downstream.

It is difficult to maintain good fish populations in ponds with small watersheds. Water levels may drop so low during prolonged hot and dry periods that all aquatic life could be jeopardized. The smaller the volume of water, the faster it warms and the less oxygen it can hold. Less water also means a reduction in the pounds of fish the pond can support. With decreased water levels, aquatic vegetation can become more abundant. If this vegetation dies, its decomposition can reduce oxygen levels and cause a fish kill. Terraces can be used to divert more water to a pond with a small watershed.

An important aspect of site selection is the immediate **topography** (land elevations and slopes). Since earth moving is one of the biggest construction costs, select a pond site that requires the smallest dam to impound the largest amount of water and that has an adequate volume of soil for dam construction on site or close by. An ideal site would be a natural draw, or low area with a moderate slope, that narrows at the dam site. This would result in a pond that contains adequate amounts of deep and shallow water. Steep-sided sites should be avoided because they will not contain sufficient shallow water for fish spawning and nursery areas and may become unstable and slump into the pond once it fills. Sites that have extensive flat areas should also be avoided because they may result in high evaporation rates and excessive aquatic vegetation growth.

To ensure your pond will hold water, it is very important to determine the water holding capacity of the **soils** present at your site prior to construction. This will help you avoid building a pond that doesn't hold water. Soils containing sand or gravel are typically not suitable for dam and spillway construction. Since soils can vary at surface and subsurface levels, a number of core samples must be collected within the site to depths deeper than the expected excavation depth. NRCS personnel should be contacted about soil suitability and testing.

The best soils for a pond site are those that allow water to penetrate very slowly. These include clay, silty clay, loams, and sandy clay/loams. When compacted and moistened, particles in these soils swell and seal the bottom. If there isn't enough clay at the site to build a reliable dam, it may have to be imported from a nearby source. Keep in mind, some clay soils are easily suspended in water and do not readily settle out, causing the water to remain turbid.

Soils containing very porous components, such as sand or gravel, or those containing bedded materials, such as shale or limestone, can allow impounded water to flow under or around the dam and should be avoided. Soil suitability can also be determined by checking nearby ponds for clarity and seepage problems.

The quality of the fish community in a pond is a reflection of the quality of the watershed.

Land use in the watershed is another important consideration when selecting a pond site. The vegetative cover in the drainage area greatly influences the quality, quantity, and flow of water that enters a pond. Ideally, the best cover for a drainage area would be undisturbed grassland. Thick vegetation will slow runoff, acting like a sponge to soak up rainfall, and then gradually release clear, filtered water to the pond. Land with grass cover has minor erosion problems. If possible, the pond should be located near established wildlife cover, which would encourage immediate use by various wildlife species. Land with row crops or construction sites can have major erosion and sedimentation problems if proper soil conservation practices or buffer strips are not in place. A pond with watershed disturbances can fill with sediment in just a few years. Sediment-laden runoff from row crops may contain agricultural chemicals and nutrients that can result in fish kills, reduced fish numbers or growth rates, and excessive aquatic vegetation.

If a pond's watershed must include cultivated land, the amount should be as small as possible. Soil conservation practices, such as terracing, minimum or no-till farming, strip-cropping, and buffer strips, should be established before a pond is built in a cultivated watershed. A vegetated buffer strip at least 100 feet wide should be established and maintained between the pond and any nearby cultivated land.

Consult NRCS and Commission Wildlife Division personnel about the various buffer programs that are available. Most of the programs provide cost-share and even payments to establish and maintain buffers.

Another site selection consideration is whether there are potential **pollution sources** in the watershed. The fish community will be negatively affected if a pond constantly receives runoff from high nutrient sources, such as a barnyard or feedlot, domestic sewage, or heavily grazed or fertilized pastures. Runoff from such areas promotes excessive growth of aquatic plants. Any potential sources of pollution should be eliminated prior to pond construction. Cattle should be excluded from the pond and dam to prevent their excrement from entering the pond. An alternative is to construct a check dam large enough to contain the contaminated runoff, or to divert it around the pond, if legal. Contact the Nebraska Department of Environmental Quality (NDEQ) regarding barnyard or feedlot runoff and domestic sewage. Use caution when applying chemicals, particularly insecticides, in the watershed. Misuse could result in contaminated or dead fish.

See page 23 for additional information on livestock related problems and how they can be solved.

Water Sources

The water supply for your pond should be adequate to replenish water lost to evaporation and leakage, but not so excessive that erosion and flooding are problems. Constructing a pond on a perennial (always flowing) stream should usually be avoided, particularly in eastern Nebraska, where most watersheds include cultivated land. Streams and major drainages generally have large watersheds with numerous potential problems, as mentioned earlier.

Damming a stream usually requires an expensive dam and an extensive spillway structure to control the volume of flow during high runoff events. In drier parts of the state, constructing a pond on a small or intermittent (not always flowing) stream may be the only way to obtain sufficient water to maintain a pond. A portion of a stream's flow might be diverted into a pond constructed off-channel, with steps taken to keep out sediment and unwanted fish. Contact your local NRCS office to determine the feasibility of this approach and what permits would be needed.

Dugouts can sometimes be built near a flowing stream or river to utilize groundwater, instead of surface water. The excavated soil can then be used to make a berm around the dugout if the area is prone to flooding, reducing the chance of unwanted fish entering the pond.

Springs may be considered as a potential water source if flows are sufficient. First obtain a flow estimate by measuring the flow volume several times during the year. This estimate, along with estimated seepage and evaporation rates for the site, can then be used to determine what size of pond can be built. NRCS personnel can help determine site feasibility.

Depending on the surface area and volume of a pond, a well or domestic water source may be used to supplement the water supply. Determine the amount of water needed, and then determine if it is economically feasible to maintain the pond level with a well, particularly during dry periods. When a well is used to fill a pond, the delivered water should be piped to the pond to eliminate erosion problems. Most wells need to be registered with the Nebraska Department of Natural Resources (DNR) and permits may be required by the local Natural Resources District (NRD).

Ponds filled by springs or small, coldwater streams may be able to sustain trout if water temperatures stay below 70 degrees year-round. Water temperature should be monitored before trout are stocked, particularly during the summer months. Such ponds may have water too cool for good growth of largemouth bass, bluegill and channel catfish, but still too warm to sustain trout. Since these types of ponds typically have good water clarity and stable water temperatures, they may have excessive growth of aquatic vegetation, especially if they are shallow. Pond construction on most cold-water streams should be avoided, especially if a naturally-reproducing trout population is present or the stream needs to be an open system to facilitate trout movement.

Pond construction on most coldwater streams should be avoided. Contact a local Commission fisheries biologist for advice.

Pond Size

An ideal fishing pond would cover 1 to 5 surface acres. Although ponds larger than 5 acres would provide fishing for more anglers, they can be more difficult and expensive to manage if problems arise. While fish populations can be managed in properly constructed ponds of any size, smaller ponds, particularly those less than one-half surface acre, have a number of disadvantages. They are more susceptible to water level fluctuations and may even go dry during droughts. Since smaller ponds are also typically shallow, they are likely to have excessive growth of aquatic vegetation and are more susceptible to summer and winter fish kills. Smaller ponds are also easier for anglers to overharvest, so harvest restrictions, especially for bass, will likely have to be applied. For ponds smaller than one-half acre, it is best to allow no fish harvest at all (catch-and-release only). Ponds less than one-half surface acre are also not eligible to receive fish for initial stocking from the Commission.

Pond Depth and Slopes

Ponds need to have both deep and shallow areas to benefit fish and fishing. Deep water

protects fish from winterkill, discourages excessive growth of aquatic vegetation, helps withstand water losses due to evaporation and leakage, and reduces the negative effects of sedimentation. Some shallow water is necessary for fish spawning and nursery areas and to produce food, especially aquatic insects, for fish. As a general rule, 25% of the pond should be at least 10 feet deep in southeastern Nebraska and at least 12 feet deep in western and northern Nebraska. No more than 20% of the pond should contain water less than 2 feet deep. Ponds should also have about 50% of the impounded area at least 8 feet deep to prevent excessive growth of aquatic vegetation, especially those with good water clarity. The slope from the shoreline to a water depth of 4 or 5 feet should be no flatter than 1 foot vertical drop for every 3 horizontal feet. The slope should then taper to at least 8 feet in depth for two-thirds of the distance from the dam to the upper reaches of the pond. Although the shoreline may have to be graded to attain a 3:1 slope, grading may be cheaper than the future costs of aquatic vegetation control. Slopes greater than 2:1 should be avoided because of safety hazards and the likelihood of shoreline slumping into the pond.

Having deeper water doesn't necessarily mean more fish can be produced in a pond because fish production is based primarily on microscopic plant and animal growth occurring in the upper 3 to 5 feet of water. Also, water greater than 15 feet deep may not be used by fish during summer months due to low oxygen levels usually present at those depths.

Site Preparation

Once a site has been selected, all trees, vegetation, roots, stumps, and large rocks must be removed from the dam site. If they aren't, the decay of organic materials will create passages that will allow water to seep through the base of the dam. Large rocks may prevent the soil from being properly compacted, which also could result in seepage. All topsoil containing organic material removed from the pond site should be stockpiled close by. Once construction is completed, the topsoil should then be spread over the dam and spillway to promote grass growth, and over the excavated basin to promote fertility and sealing.

Trees and brush should also be removed from areas that are planned for swimming and wading. Small ponds will likely need to have all brush and trees removed since the majority of the fill material for construction of the dam will likely have to come from the basin.

Catfish-only ponds should have all debris removed and the bottom left smooth to reduce spawning sites and lessen the likelihood of the pond becoming overpopulated with small catfish.

Some of the trees and brush that are removed can be stockpiled and then placed back in the pond basin or the upper reaches when construction is done. They will provide fish habitat, enhance production of fish food items, such as zooplankton and aquatic insects, and help trap sediment and debris. Trees and brush in non-excavated areas of the pond bottom should be left intact, especially in larger ponds. They will also provide fish habitat and become a substrate on which aquatic organisms can grow.

To minimize impacts to wildlife, existing cover in draws and waterways leading into the pond site should also be left undisturbed. This will also help to enhance water clarity and lessen shoreline erosion and sediment problems as the pond fills. Decomposition of flooded vegetation will also improve water clarity by facilitating settling of suspended soil particles.

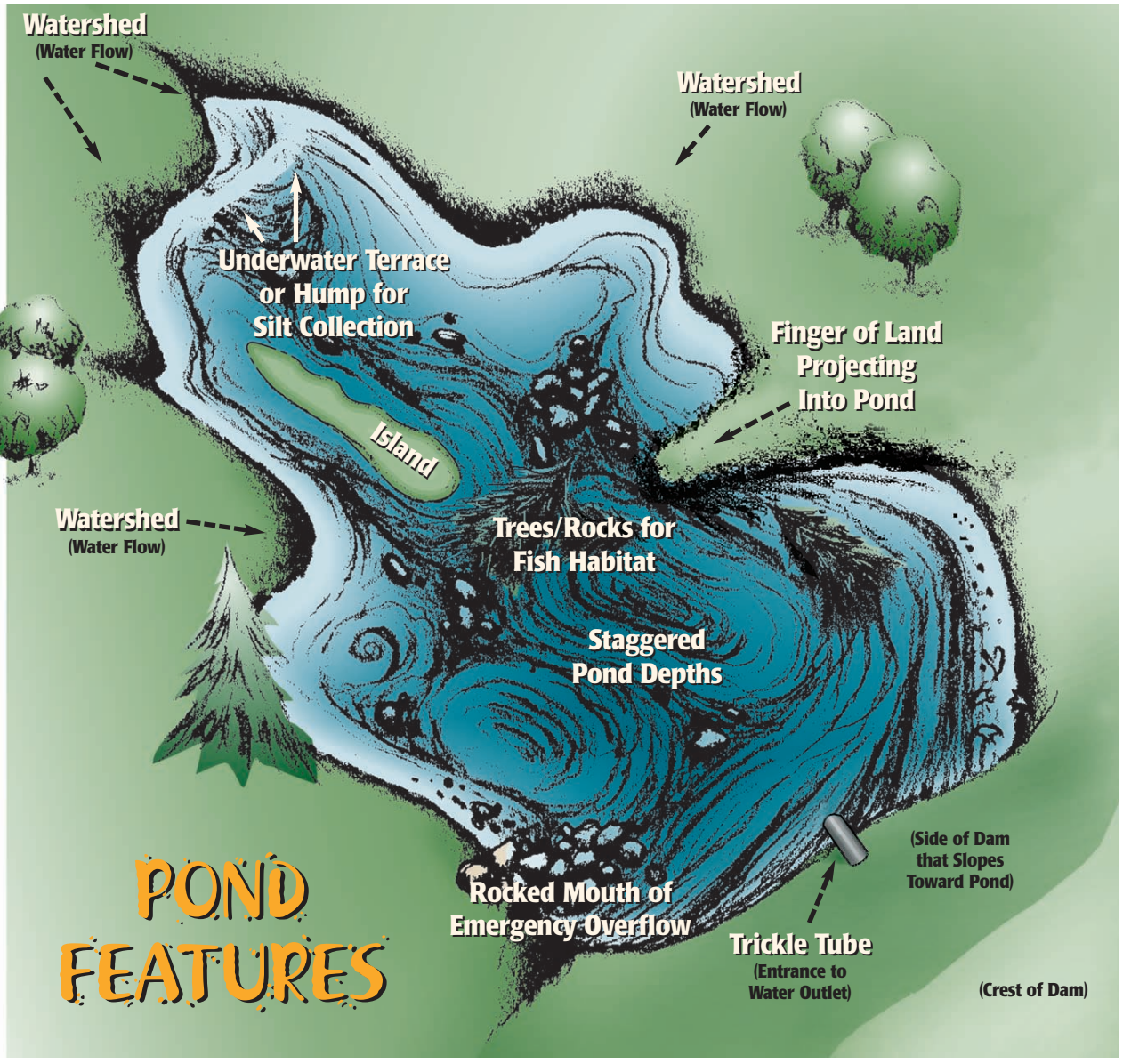
See page 39 for additional information on establishing and improving fish habitat.

Dam Construction

It is important that the material in the dam be tied to the soil in the foundation. A cutoff or core trench should be cut lengthwise, along the dam's centerline. This trench should be deep enough that all soil, sand, gravel, and loose rock is removed down to either solid rock or clay. The trench should extend a minimum of 3 feet into impervious subsoil or be anchored into solid rock the length of the dam and into the valley walls at each end of the dam. It should have a minimum base width of 8 feet. This trench should be backfilled with clay, compacted in layers to the top of the dam, creating a clay wall within the dam. Failure to install a core trench and wall can result in seepage through or even loss of a dam.

The dam should be constructed of impervious moist material that is compacted in continuous horizontal layers as it is installed. Dams pushed up with a bulldozer and not compacted have a greater chance of failing. All material should be compacted by either a sheepsfoot roller or an earthmover with rubber tires.

The recommended dam top width is 10 feet for a dam less than 20 feet high. For taller dams,



the width should be increased an extra 2 feet for each additional 5 feet of height. The actual dam height depends on pond size, along with the size, slope and usage of the watershed. All dams should have at least 3 feet of extra height, or freeboard, to prevent flood waters and waves from overtopping them.

The dam should be constructed with slopes that will not slump or slide. The steepness of the slope on the pond side of the dam should not exceed 3:1 and the steepness of the slope on the downstream side should not exceed 2.5:1.

Muskrats and beavers sometimes burrow into a dam. These holes may eventually cause the dam to fail due to erosion. An adequate freeboard and width is needed to eliminate leakage or dam failure. Since beavers and especially muskrats prefer steeper slopes for burrowing, another option is to construct steeper banks on the nearby pond banks than those found along the dam. Lining the dam face with rock 2 feet above and 3 feet below the water surface will also deter burrowers.

Additional information on beavers and muskrats is provided on page 78.

Pond Bottom Design

The least desirable design for a bass-bluegill-catfish pond is one with a bowl-shaped bottom, with no irregular features. If core samples indicate soil is suitable (will not leak), bottom features can be made that will benefit fish production as well as angling opportunities. Trenches and drop-offs can be built to diversify basin fish habitat. Deeper water near shore will benefit fish and shoreline anglers, but should be avoided in wading and swimming areas. Underwater terraces and humps can also be incorporated, particularly in the upper reaches of the pond. They will provide additional structure and slow incoming water, allowing sediment to settle out in the upper reaches of the pond. Those underwater structures should be considered when it isn't feasible to install sediment/nutrient entrapment structures above the pond. Excess fill soil can be used to create additional shoreline by building fingers of land that extend into the pond, or small islands. This will increase shoreline access and produce additional fish habitat. Make sure adequate depth is present adjacent to these structures to prevent excessive growth of aquatic vegetation.

Water Control Structures

Ideally, the pond owner should have complete control of the water entering and leaving the pond. Inlet and outlet structures are two of the most important structural features of a pond. When incorporated into new pond designs, they will help prevent and control many common problems. An outlet structure enables the owner to drain the pond to make repairs, manage fish populations, control nuisance aquatic plants, and encourage desirable aquatic plants. Most waterfowl management efforts require some water level manipulation and a flooded food source, so a water control structure needs to be included in the pond design. Installing only an earthen overflow spillway not only prevents water control, it can also result in erosion and dam failure if it is not properly designed and maintained.

An inflow or inlet control structure may be necessary to prevent waters containing pollutants or undesirable fish from entering the pond. When streams are used as a water supply, the stream should be diverted around the pond and an inlet pipe, which can be screened or closed as needed, should be installed.

One type of outlet control structure is a trickle tube. The upper opening is installed at the planned water level. The tube is then sloped downward with the lower opening at or near ground level at the back of the dam. The tube should be large enough to carry most of the runoff, or at least large enough to draw the water level down in a short period of time once storm flows subside.

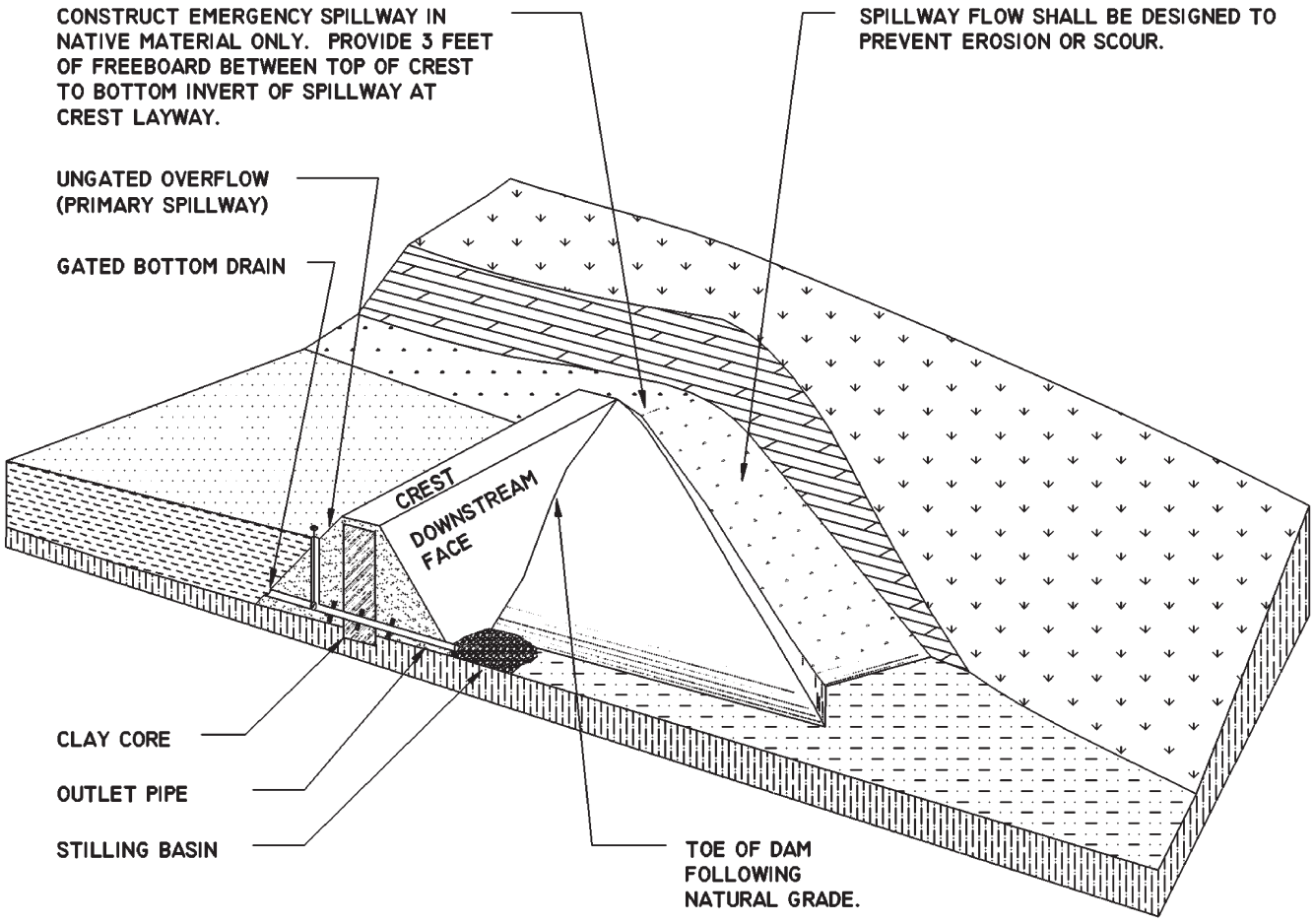
NOTES:

GOOD POND CONSTRUCTION REQUIRES PROPER SITE SELECTION, SOILS TESTING, POND DESIGN, PERMITTING, AND CONSTRUCTION MANAGEMENT. OWNER SHOULD CONSULT WITH A PROFESSIONAL ENGINEER WHEN CONSTRUCTING A DAM.

THESE DRAWINGS ONLY SHOW CONCEPTS. ACTUAL DESIGN MUST CONSIDER SUCH ITEMS AS RUNOFF EVENTS, GEOLOGY, POND CAPACITY, OUTLET CONTROL, SPILLWAY REQUIREMENT, DRAINAGE, ETC. THERE ARE SEVERAL TYPES OF VALVE AND GATE DRAIN STRUCTURE CONFIGURATIONS. CONSULT WITH AN ENGINEER TO DETERMINE THE TYPE OF DRAIN STRUCTURE NEEDED.

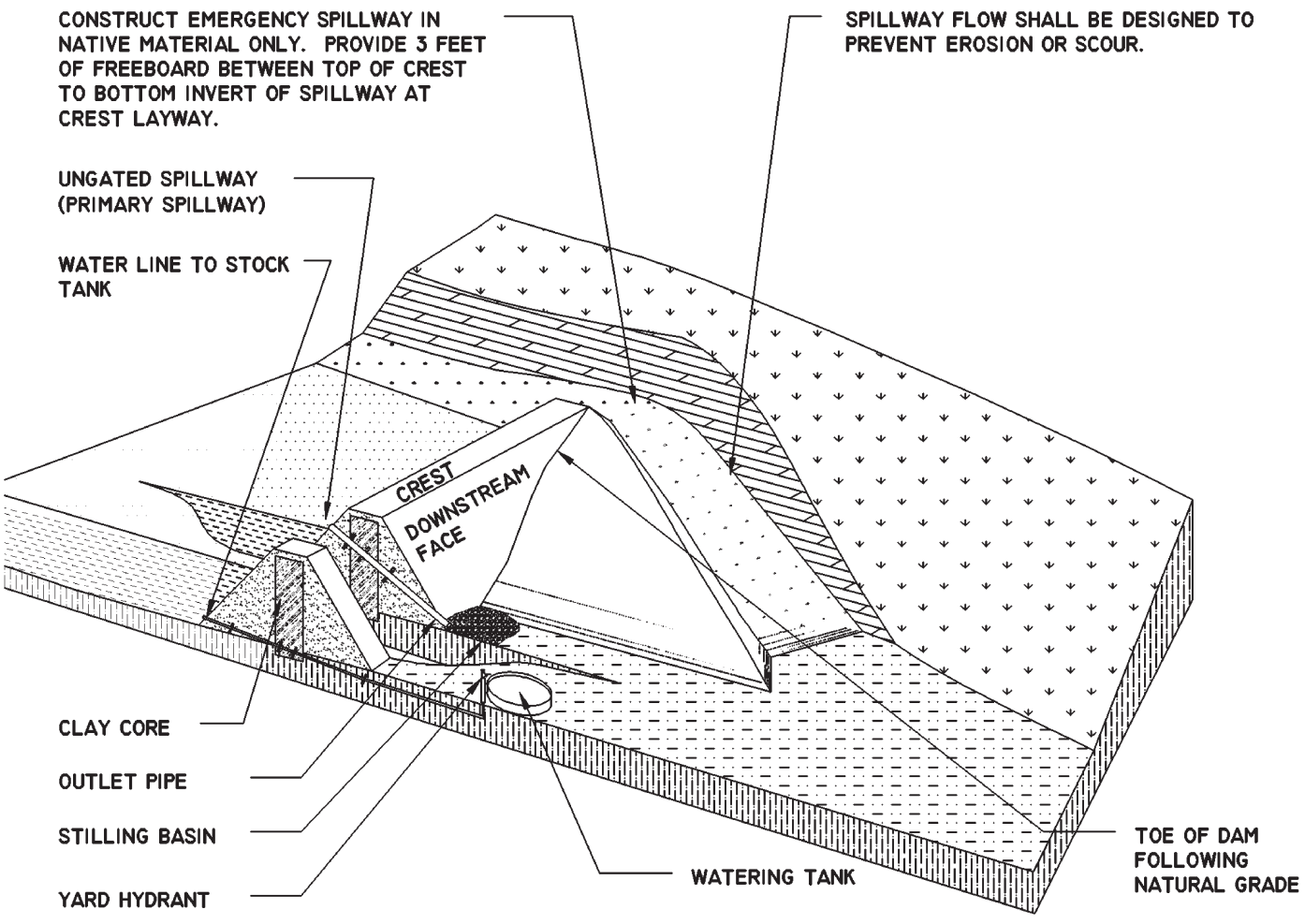
OUTLET DRAIN STRUCTURE MAY NOT BE NEEDED FOR THE FOLLOWING:

- WHEN THE POND IS MAINTAINED AT A CONSTANT WATER LEVEL.
- THE POND IS SHALLOW ENOUGH TO USE A SIPHON OR PUMP TO EMPTY.
- THERE ARE NO DOWNSTREAM HAZARDS THAT COULD REQUIRE EMERGENCY DRAWDOWN OF THE SYSTEM.



COMPONENTS OF A SMALL DAM

NOT TO SCALE



COMPONENTS OF A SMALL DAM W/ WATER TANK

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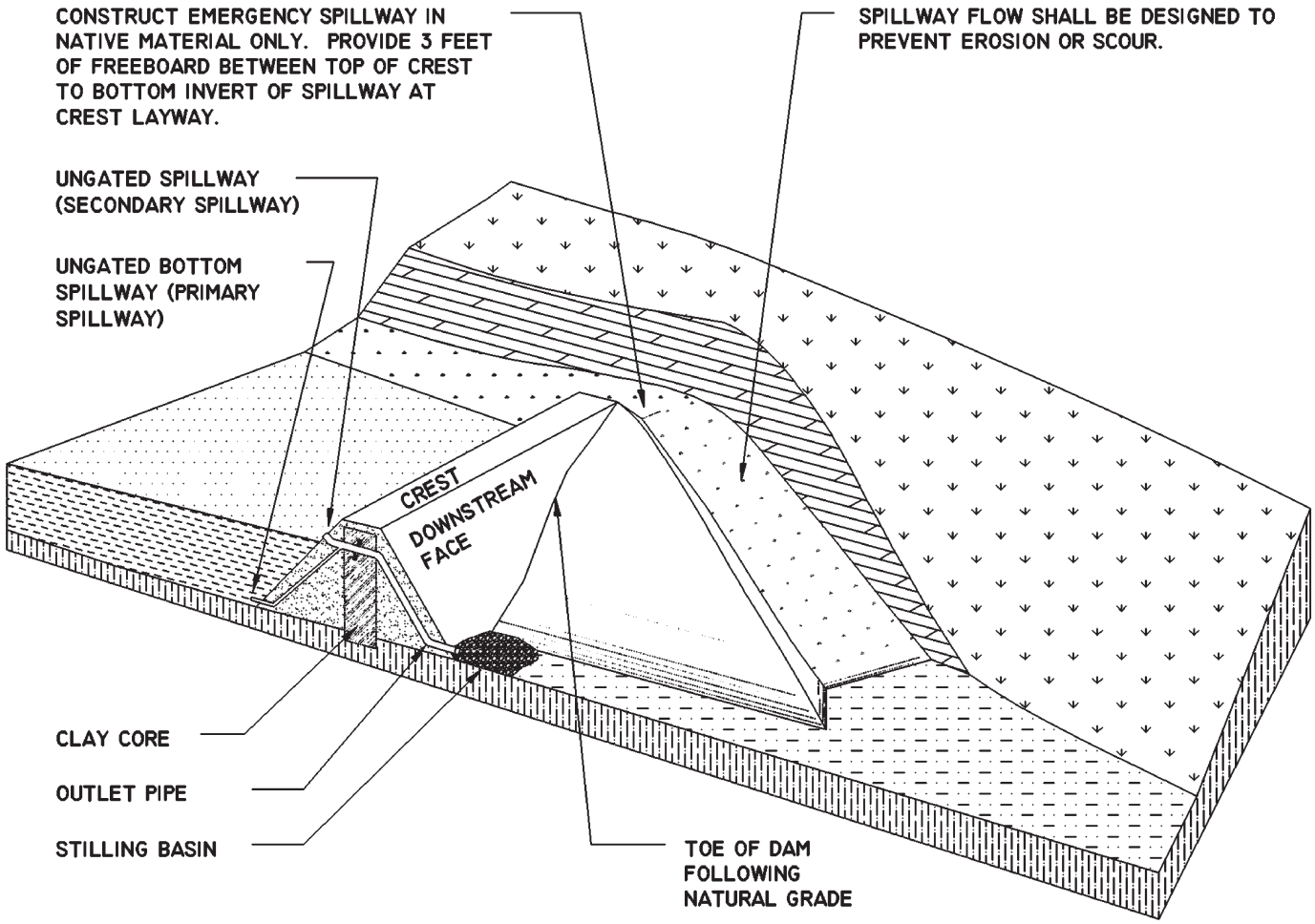

COMPONENTS OF A SMALL BOTTOM DRAW DAM

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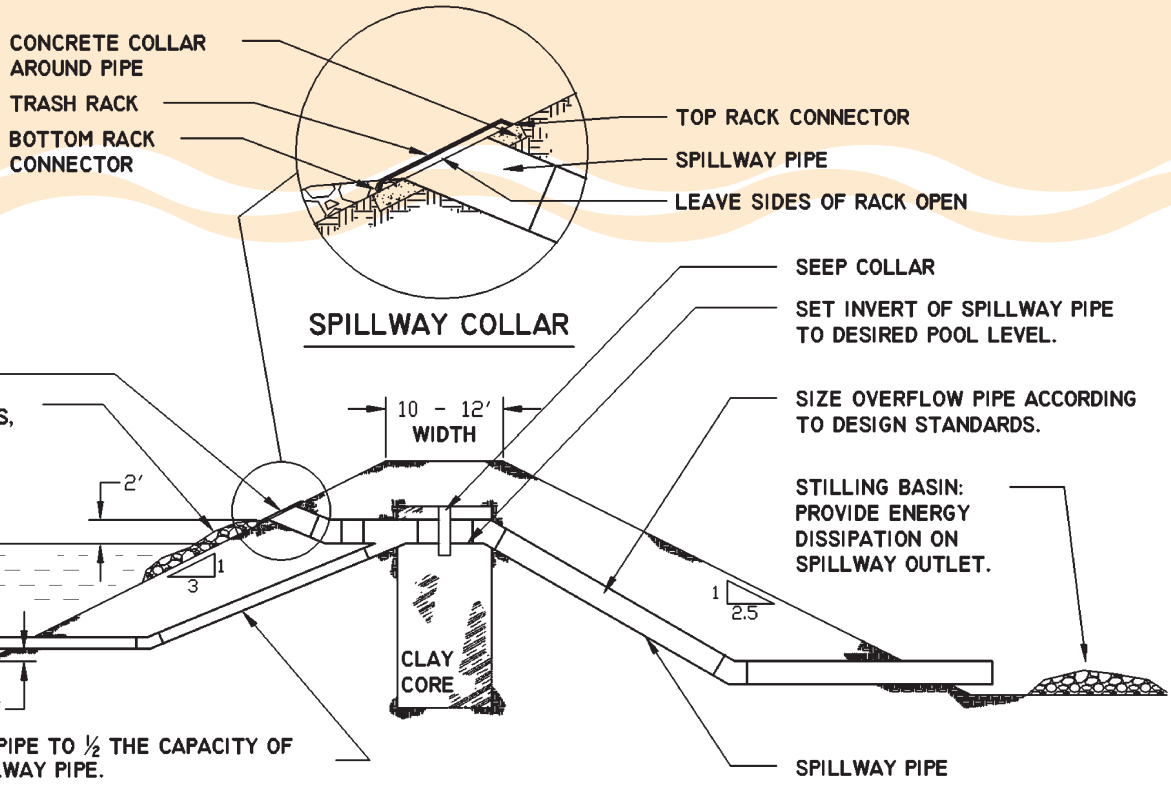

BOTTOM DRAW SPILLWAY STRUCTURE SECTION

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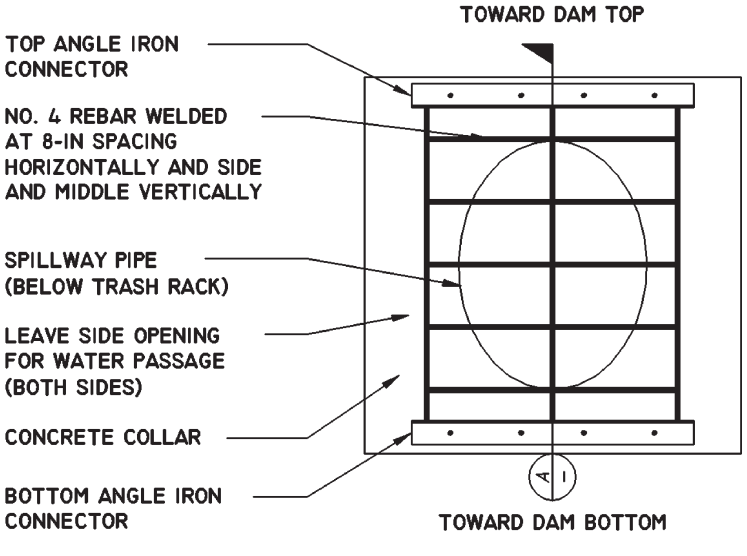
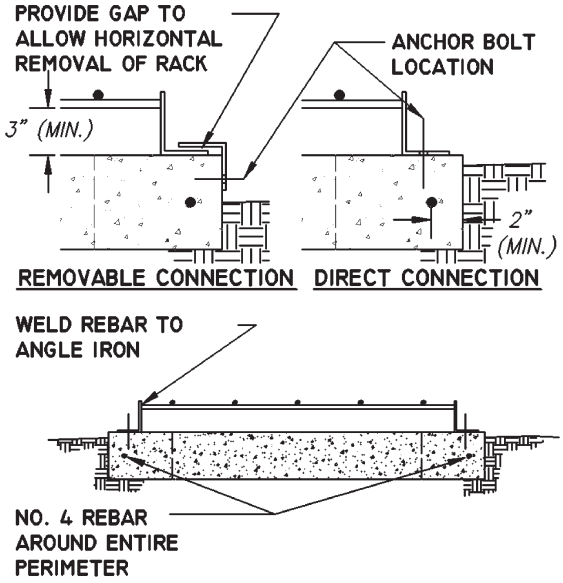


RACK PLAN VIEW



RACK SECTION A

SPILLWAY COLLAR & TRASH RACK DETAIL

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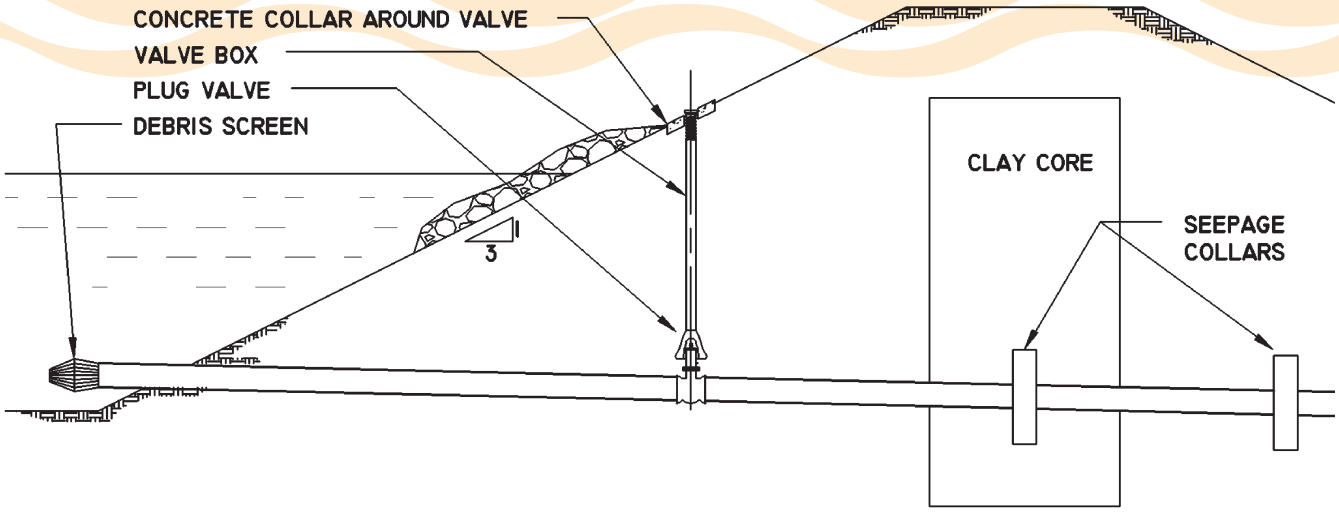
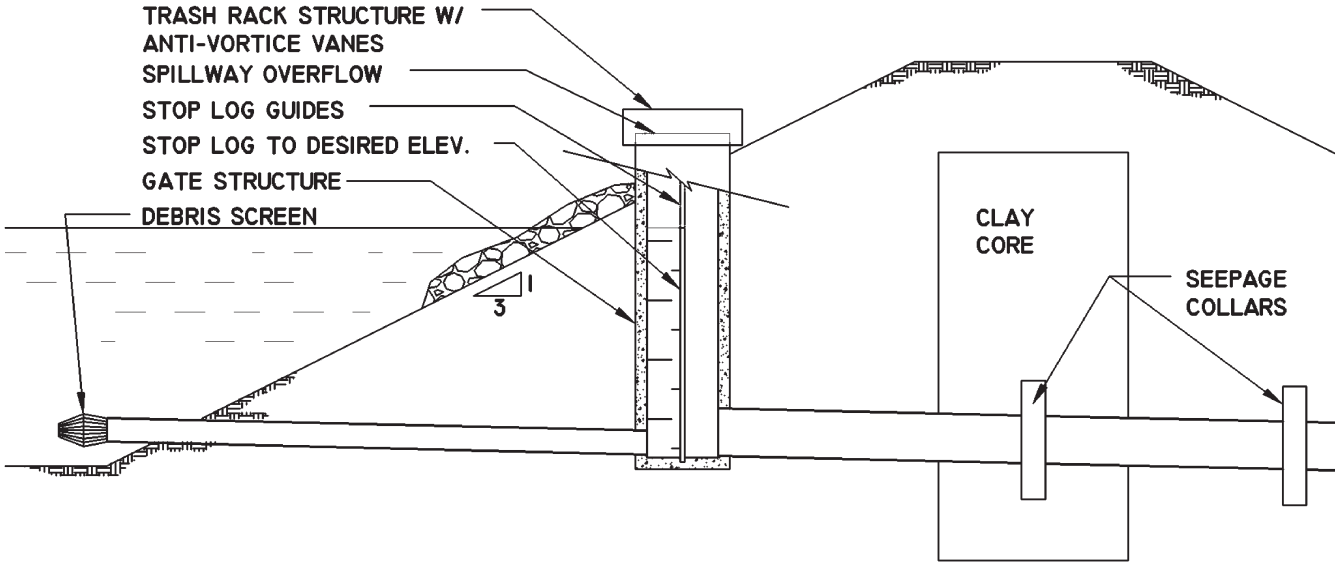


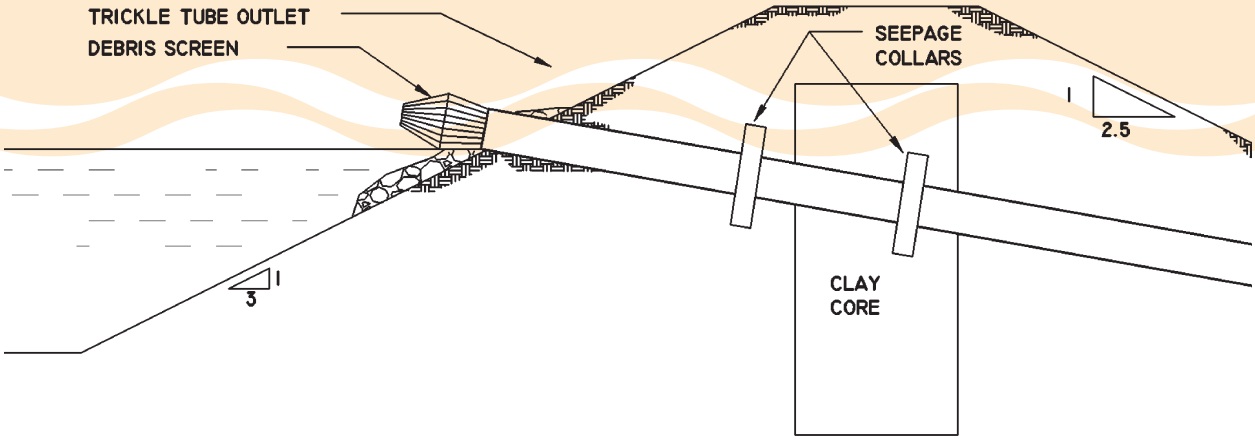
OUTLET VALVE DRAIN STRUCTURE

NOT TO SCALE



OUTLET GATE DRAIN STRUCTURE

NOT TO SCALE



TRICKLE TUBE OVERFLOW STRUCTURE

NOT TO SCALE

Another option for ponds with a large watershed is a drop outlet structure which allows water to drain quickly. It allows water to trickle over the rim of an open, vertical pipe with the rim set at the desired water level. Water is then drained from the drop structure through a horizontal pipe through the dam.

Ponds with these two types of outlet structures can be drained, either partially or completely, by either installing a gated valve or stop logs inside the drop outlet structure, or by installing a drain tube near the bottom of the dam. An accessible valve can then be installed on the drain tube, below the frost line in the earthen toe at the back of the dam. Water levels also can be manipulated by pumping or siphoning, but this can be time consuming and expensive. An optional watering line can be installed with the drain tube to provide water for livestock below the dam.

Another type of outlet structure is the bottom withdrawal spillway, which discharges water from the bottom of the pond. This device is designed to carry much of the incoming muddy water through the pond, dam, and then downstream, resulting in a minimal rise in the pond water level. It also maintains good water quality by removing stagnant water, sediment and organic materials from the pond bottom. This will improve the productivity of the pond and extend the life of the pond by 50%. An optional watering line can be installed through the dam to facilitate livestock watering below the dam.

Outlet structures, particularly drop structures, can prevent unwanted fish from entering the pond from downstream. Regardless of the type of outlet used, anti-seep collars should be installed around the pipe that passes through the dam to prevent the pipe from washing out. Trash guards or hooded inlets should also be installed on drain pipes, both for safety and to prevent them from becoming clogged with debris.

Another necessary feature for water overflow, especially for ponds having outlet structures, is an emergency spillway. While the drainpipe carries water during normal runoff, an emergency spillway carries flood runoff away from the

pond so the dam is not damaged or breached. The upper tube opening for outlet structures is generally set 12 inches below the earthen spillway level. This keeps water from flowing across the earthen spillway for an extended period of time, which would otherwise leave it moist and vulnerable to severe erosion during heavy rains. The width of the spillway is determined by a complex set of calculations that takes into consideration local rainfall duration and intensity, the slope of the watershed, and the type of ground cover anticipated in the spillway.

NRCS and NRD personnel need to be contacted regarding dam construction, water control structures, and appropriate emergency spillways for various pond sizes and levels of dam hazard.

Vegetation Establishment

Permanent native vegetation should be planted on the dam, spillway, terraces, waterways, and other disturbed areas as soon as possible after construction is completed. Utilize higher seeding rates in areas prone to erosion during the filling process and on steep slopes, particularly the front and back sides of the dam. Use a seed mixture of native grass, with emphasis on rhizomatous, sod-forming species. Native grasses produce a rigid, above-ground growth that provides excellent cover for wildlife, as well as an extensive, deep-reaching, fibrous root system that helps prevent soil erosion. Plants which are adapted to the on-site conditions and have proven wildlife values should be used whenever possible. NRCS and Commission Wildlife Division personnel can provide recommendations on what and when to plant.

The pond banks should be planted with permanent vegetation to prevent erosion and provide an aesthetic setting for fishing and other activities. Emergent vegetation, such as cattails, bulrushes, and arrowhead, can be dug up in other ponds in early spring, when new shoots begin to show, and transplanted into shallow-water areas of your pond. Keep in mind the aggressive nature of these plants, particularly cattails, when considering transplanting them into your pond. They may spread more than you want and eventually require control methods.

See page 40 for additional information on aquatic vegetation establishment.

Establishing a cover crop of wheat, rye, oats, or sorghum, or allowing weeds to grow in the pond basin, is recommended before new ponds fill. This helps to stabilize the soil and keeps the water clear. When the cover crop and weeds

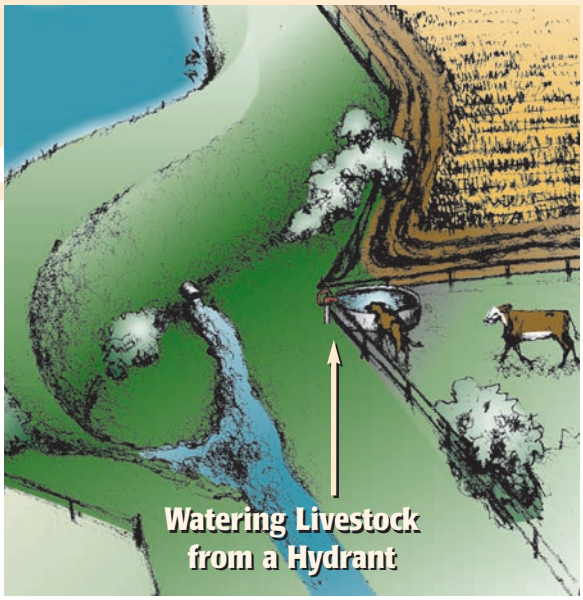
are flooded, they provide a substrate on which aquatic organisms can grow. Subsequent decomposition adds nutrients to the pond and improves water clarity by facilitating settling of suspended soil particles. The ensuing nutrient boost also facilitates initial establishment and expansion of fish food items (such as zooplankton, phytoplankton, and aquatic insects). New ponds generally have an abundance of nutrients so it is quite common for algae to become established in the first 2 or 3 years. Eventually, most algae is replaced naturally by more desirable emergent and submerged vegetation.

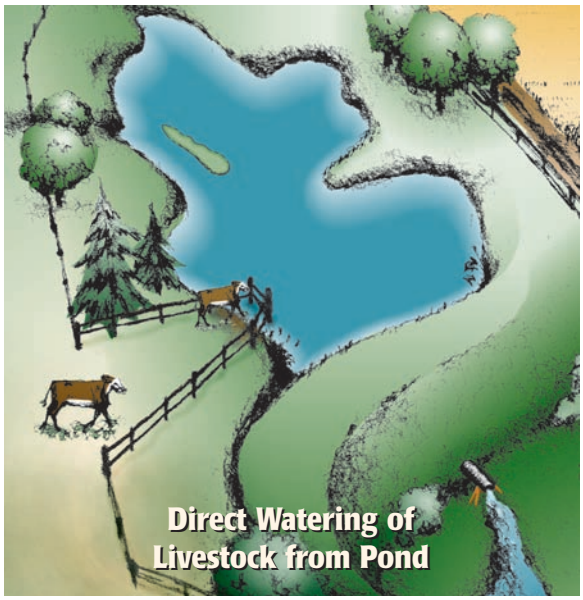
The dam should be protected from erosion due to waves with rock rip-rap or dense grass, such as prairie cordgrass. Trees should not be planted or allowed to grow on the dam as their roots can cause water leakage problems, nor should they be planted along the northwest corner of ponds. Prevailing northwest winter winds are needed to prevent excessive accumulation of snow on the ice, which can cause winter fish kills.

Other Pond Uses

The intended uses of the pond should be carefully considered before a pond is designed or the site selected. If you want a fishing pond, and the pond is designed specifically for fishing, it will be easier to manage and maintain and have greater recreational potential than if it were designed for an alternate use. Some uses will not be compatible with fish production, while some can be, with proper pond design.

Livestock watering will interfere with fish production if no precautions are taken to restrict their access. When livestock are allowed unlimited access to the pond shoreline and/or feeder stream, they trample the banks, resulting in shoreline erosion and the destruction of fish spawning and nursery areas. This can also weaken the dam and spillway, and shorten the life of the pond. Most importantly, livestock will muddy the water and increase nutrient inputs, which will prevent the establishment of desirable fish populations.


Watering Livestock from a Hydrant


Direct Watering of Livestock from Pond

Ponds less than 5 acres should be fenced with a 100-foot minimum buffer, including the dam, emergency spillway, entire pond perimeter, and feeder stream, to exclude livestock. Auxiliary watering techniques can then be used. A pipe installed through the dam to a stock tank located outside the fenced area below the dam will provide cattle with clean, quality water, which can increase their weight gains. The 2-inch diameter pipe should extend into the pond and connect with a standpipe that has a top 4 feet lower than the water surface when full. Coarse gravel can be placed in the standpipe to

filter the water and prevent fish from entering. A float valve can be installed in the stock tank to maintain a consistent water level.

If a pond or feeder stream has to be used for direct watering, both should be fenced to limit cattle access to small areas. Contact NRCS personnel about available buffer and cost-share programs regarding buffer establishment, fencing, and auxiliary watering. Keep in mind that prescribed grazing can be used to manage upland and wetland vegetation. Contact Commission wildlife staff for prescribed grazing information.

Livestock access to the pond and/or feeder stream has to be restricted to prevent environmental damages.

Fishing and **irrigation** are usually not compatible uses, especially if the pond is used as a return catch basin for irrigation runoff water. Using a pond as a source of irrigation water normally results in widely fluctuating water levels that will hinder fish reproduction and growth, and can cause fish kills. A pond can be used as a water source for small irrigation projects, such as gardens or lawns, provided inflows are sufficient to replace the water used and lost to leakage and evaporation. A permit is needed from the DNR before any water can be withdrawn from a pond. Ponds can provide water for **fire fighting**, provided precautions are taken to prevent fish and vegetation from plugging up the water intake system.

Flood control ponds designed to retain sediment and high volumes of runoff water generally do not make good fishing ponds. The water normally remains turbid for extended periods of time after runoff events and deposited sediment gradually fills in the pond. Although sight-feeding fish like bass and bluegill will do poorly under turbid conditions, channel catfish can produce a viable fishery. Catfish success will depend upon food availability, pond depth, and population density if natural recruitment (spawned fish survive to adult size) occurs.

Ponds less than 5 acres can provide many hours of fishing, swimming, boating, and **other recreational activities.** Power boating and skiing are not recommended due to the small size of these ponds. Wave action will cause shoreline erosion and resuspension of sediment, resulting in turbid water and reduced productivity. If the pond will be used for a variety of recreational activities, some safety precautions should be taken. Swimming areas should be marked and all obstacles removed. Have life saving devices, such as ring buoys, rope, and long poles, nearby to facilitate rescue operations during winter and summer activities. Pond owners should contact their attorneys and insurance agents about protection against a lawsuit if an accident should occur at their pond.

Permit Requirements and Environmentally Sensitive Areas

Whether you are building a new pond or restoring an old one, no permits are required if the finished structure has a low hazard dam less than 25 feet high, a storage capacity of less than 15-acre feet of water at the spillway crest or overflow, less than 50 acre-feet of total flood storage capacity at the top of the dam, and no diversion or withdrawal of water. It is always best to ask if you are unsure about whether or not you need a permit. Any questions on permitting should be directed to the DNR office in Lincoln. NRCS personnel can also answer questions about permit requirements. If a permit is required, it must be obtained before construction can begin; otherwise, the pond is subject to removal, or impounded water may have to be released for downstream water-right holders.

There are places where ponds should not be built and some places may require special permits.

Regardless of whether a DNR permit is required, there are places where ponds should not be built. Construction should be avoided in areas where existing wildlife or habitats are unique or pristine, or where construction would negatively affect watershed functions below the pond. Threatened and endangered (T&E) species must be considered before construction begins. Usually, there are no concerns for ponds constructed on upland sites. Inquiries about known locations of T&E species should be directed to the Commission's Natural Heritage Program. If construction will affect a wetland or waters of the state, a U.S. Army Corps of Engineers (ACOE) Section 404 Permit will likely be required. The NRCS must also be contacted if a wet area is being considered for a site. They may require a permit, along with special construction considerations. Here again, ask if you are unsure. A Section 404 Permit is also required if habitat materials are added to any waters in the state. Questions can be directed to the ACOE regional offices in Omaha or Kearney. See Appendix A for the list of contacts.

While planning your pond, be sure to check your property deed for recorded easements for buried pipelines or power cables, and overhead lines. The restrictions in these easements and their locations may affect what you can do and where, and possibly change your site choice. Pond construction must not affect a public road or a neighbor's property.

Technical Assistance (Construction and Cost-Share)

An important first step in building a pond is obtaining technical advice on construction that will maximize the pond's fishery potential and longevity. The primary sources for technical assistance are the Commission, NRCS, NRD, and UNL Cooperative Extension.

If you need additional information or would like to discuss any topics in greater detail, contact the Commission's district fisheries management staff in your area or the Private Waters Specialist at the Lincoln headquarters. The Commission's Wildlife Habitat Partners Section staff can provide information about establishment and management of wildlife habitat on property surrounding your pond. They can discuss their WILD Nebraska Program and various NRCS buffer programs that provide cost share funding for developing or enhancing wildlife habitat.

The local county NRCS office should be contacted regarding site selection, pond design and construction considerations, including what permits are required. They have programs that may provide cost-share funding for construction, particularly in high priority areas. They also have programs that provide cost-share or even payments for establishing buffers and set-aside (CRP) acres. They have a publication, "Ponds - Planning, Design, Construction," that is very informative.

The NRD's have cost-share funding for construction, with requests prioritized. See Appendix A for a complete list of technical assistance contacts. There also are private contractors and consultants who can be hired for various construction and management services. See Appendix B for a list of those services. Consult the yellow pages in your phone book or contact a local Commission fisheries biologist or the Private Waters Specialist to obtain a list of names and contact information for contractors and consultants.