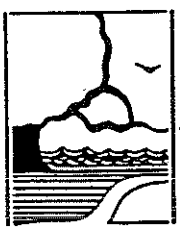
# GUIDELINES AND FORMS FOR INSPECTION OF ILLINOIS DAMS

November, 1999



Illinois Department of Natural Resources
Office of Water Resources

ONE NATURAL RESOURCES WAY
SPRINGFIELD, ILLINOIS 62702-1272

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## I. INTRODUCTION

The water stored behind a dam represents potential energy which can create a hazard to lives and property located downstream of it. To minimize the risk associated with the storage of water a dam must be properly designed, constructed, operated, and maintained. These guidelines and forms were developed to assist dam owners in meeting the requirements for the operation, maintenance and inspection of dams.

In this document, a dam is defined as all obstructions, walls, embankments, or barriers together with their abutments and appurtenant works, if any, constructed for the purpose of storing or diverting water or creating a pool. A person proposing to construct a new dam in Illinois or who proposes to make major modifications to an existing dam is required to secure a permit from the Department of Natural Resources, Office of Water Resources. The requirements which must be met in order to secure such a permit are outlined in the "Rules for Construction and Maintenance of Dams." A copy of the rules may be obtained from the Office of Water Resources (OWR), One Natural Resources Way, Springfield, Illinois 62702-1271 or 2050 Weat Stearns Road, Bartlett, Illinois 60103.

## II. MAIN ELEMENTS OF AN EARTH FILL DAM

The majority of dams in Illinois are of the earth fill type. The main elements of earth fill dams are the (A) Foundation, (B) Embankment, (C) Principal Spillway, (D) Emergency Spillway and (E) Drawdown Facility. Exhibit I is a sketch showing the typical components of an earth fill dam.

### (A) Foundation

The foundation is the soil or rock upon which the dam is constructed. The foundation must have the strength needed to safely support the embankment and reservoir.

To control the seepage through the foundation that typically occurs when the reservoir is filled, drainage blankets, toe drains, rock toes, or relief wells are sometimes included in the design. A cutoff core trench is used in many dams to reduce seepage through the foundation material. All of the seepage control systems provide for discharging or controlling the seepage water in a safe manner while preventing the loss of foundation material.

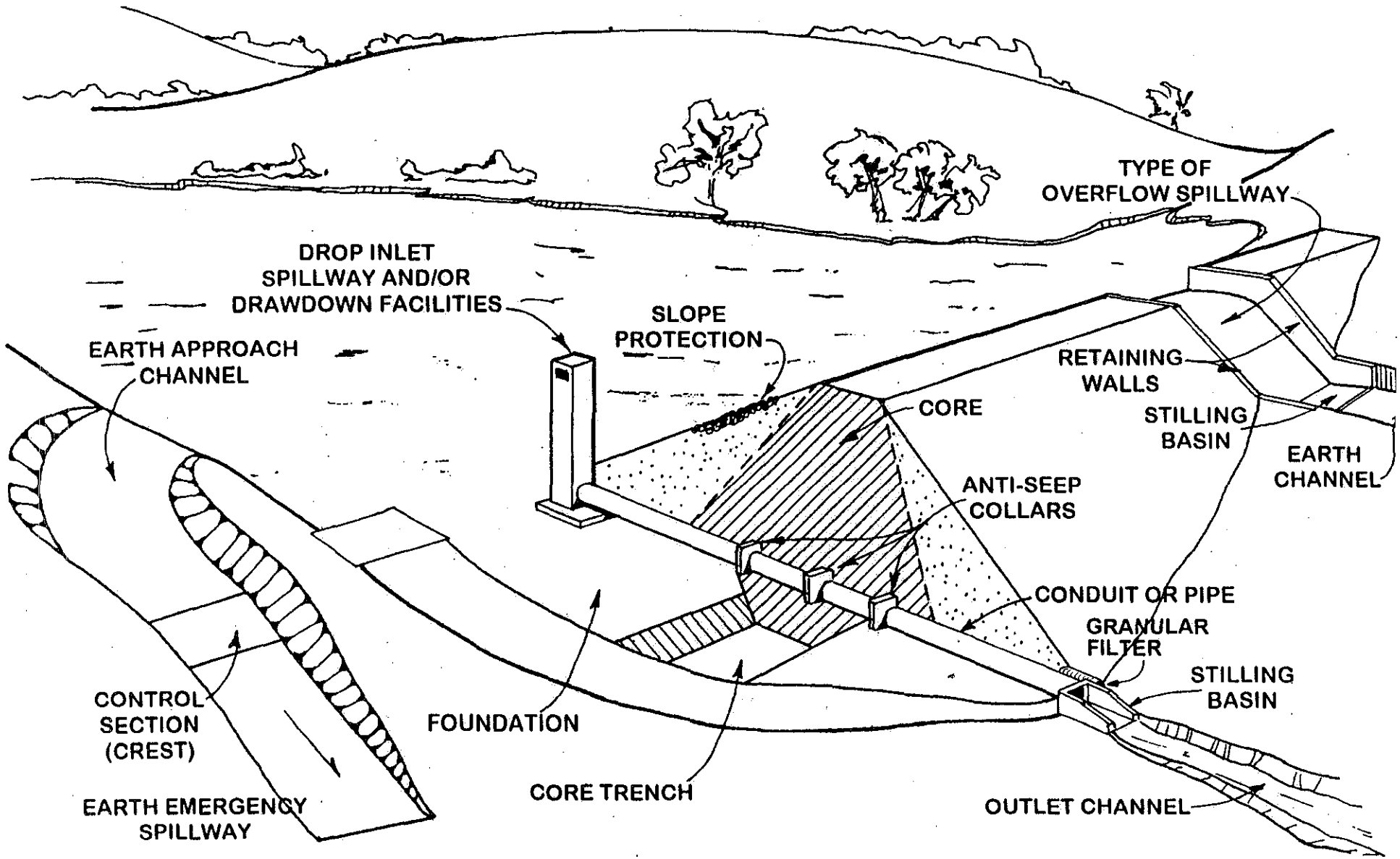
### (B) Embankment

The embankment is the primary part of the dam. It is the section which impounds the lake and holds the water for its intended purpose.

Earthfill embankments fall into two main classifications: homogeneous and zoned. A homogeneous embankment is composed essentially of the same material throughout while a zoned embankment is divided into zones of materials having different strength-deformation and hydraulic characteristics.

Most embankment dams exhibit zoning to some degree with a compacted clayey material forming a relatively impermeable zone for minimizing seepage through the embankment. To control the seepage through the embankment, chimney drains, drainage blankets, toe drains, rock toes, or relief wells are included in the design. All of the seepage control systems provide for discharging or controlling the seepage water in a safe manner while preventing the loss of embankment material.

The dimensions of the dam depend on the purpose and the hazard potential classification of the structure. The steepness of the slopes is a function of the material used in construction but is also affected by foundation conditions, type of maintenance and access capability. The top of the dam must be at an elevation sufficient to safely pass the design storm with adequate freeboard.




# Typical Dam Components

EXHIBIT I

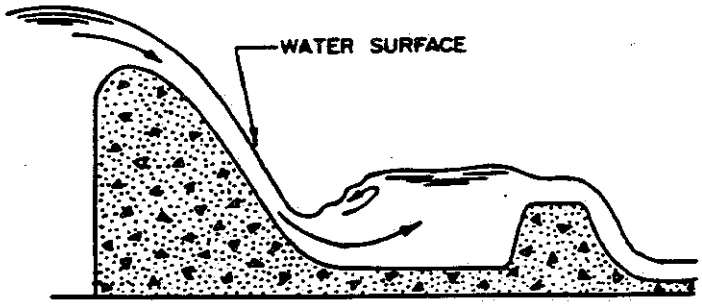
The slopes of the embankment must be vegetated to protect them from the erosive effects of rain. The upstream slope must also have protection against wave action. This protection is usually accomplished by using a rock blanket (riprap), soil stabilization, or by the construction of a vegetated berm (flattened slope at normal pool).

(C) Principal Spillway

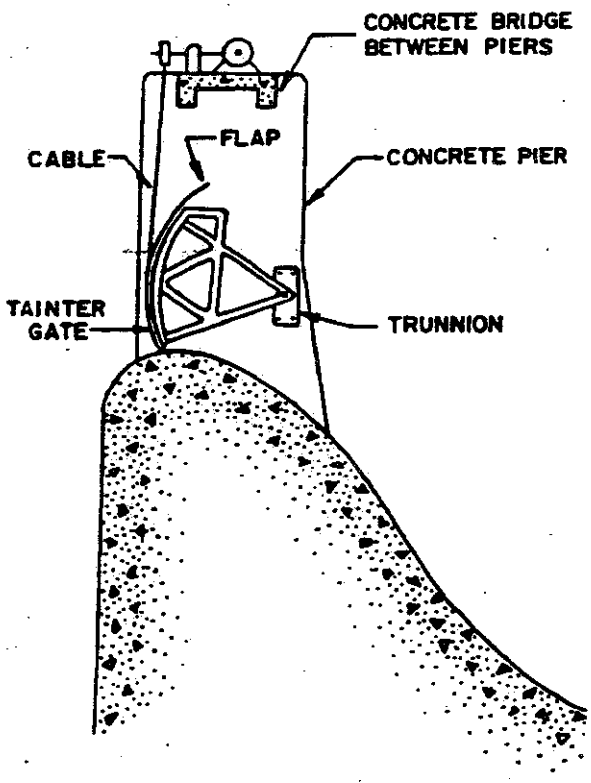
The principal spillway is the one which maintains the normal water level of the lake. This spillway may be either (1) a metal or concrete pipe through the dam incorporating a stand pipe or riser intake structure or (2) a concrete overflow type which may or may not be gated. The principal spillway's function is to pass normal amounts of water past the dam in a safe and non-erosive manner. The intake structure or overflow crest must have provisions to prevent its clogging with trash and debris. Exhibit II contains a sketch of a typical overflow spillway and energy dissipators. Exhibit III shows typical drop inlet spillways and energy dissipators.

A conduit or pipe through the dam is frequently a major source of problems in earth dams. The conduit should always extend to such a point where its discharge will not erode the embankment or foundation materials. Erosion of these materials can cause structural or seepage failures. Provisions must be made to dissipate the energy created by passage of water over the spillway or through to outlet conduit.

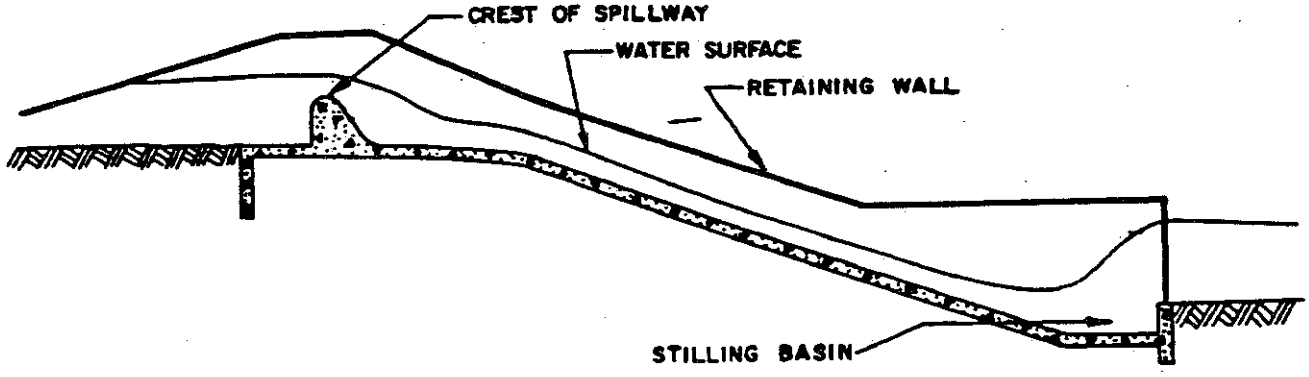
The very nature of the conduit through the embankment produces a potential seepage path along the conduit. The compaction of the material around the conduit is difficult and usually must be accomplished by hand methods. Uniform compaction is difficult to achieve and requires continuous construction control. Previously the problem of seepage along the conduit was thought to best be reduced by anti-seep collars. Anti-seep collars were attached to the pipe concrete conduit in such a manner that the length of the seepage path was increased. Currently, granular filters at the downstream end of the pipe to provide for discharging or controlling the seepage water in a safe manner while preventing the loss of embankment or foundation material are typically used. For either method, careful compaction of the material around the conduit is still necessary.




TYPICAL CONCRETE DAM
AND ENERGY DISSIPATOR




TYPICAL GATED DAM
OR OVERFLOW SPILLWAY




TYPICAL OVERFLOW SPILLWAY AND STILLING BASIN

**EXHIBIT II**

(D) Emergency Spillway

The emergency spillway is the one which functions during extreme floods to prevent overtopping of the dam. A typical emergency spillway is an excavated channel in earth or rock located a safe distance from the dam embankment. The emergency spillway functions with the primary spillway to pass the design storm without overtopping the dam. The emergency spillway should always discharge away from the dam and should be constructed in a manner so that it will not fail due to erosion when it functions. Discharge of the spillway too close to the dam can rapidly erode the embankment and cause failure of the dam.

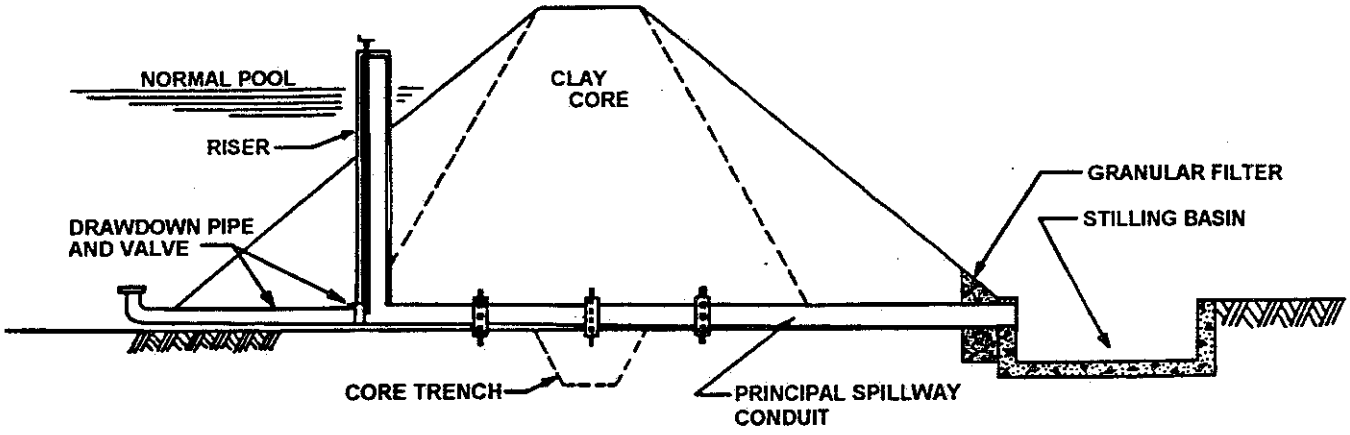
Some Illinois dams incorporate both the principal spillway and emergency spillway into a single structure. These structures are generally in the form of concrete overflow sections or large culverts. Regardless of the form, the spillway system must be able to pass the design storms in a safe manner so that the dam will not be overtopped or otherwise adversely affected.

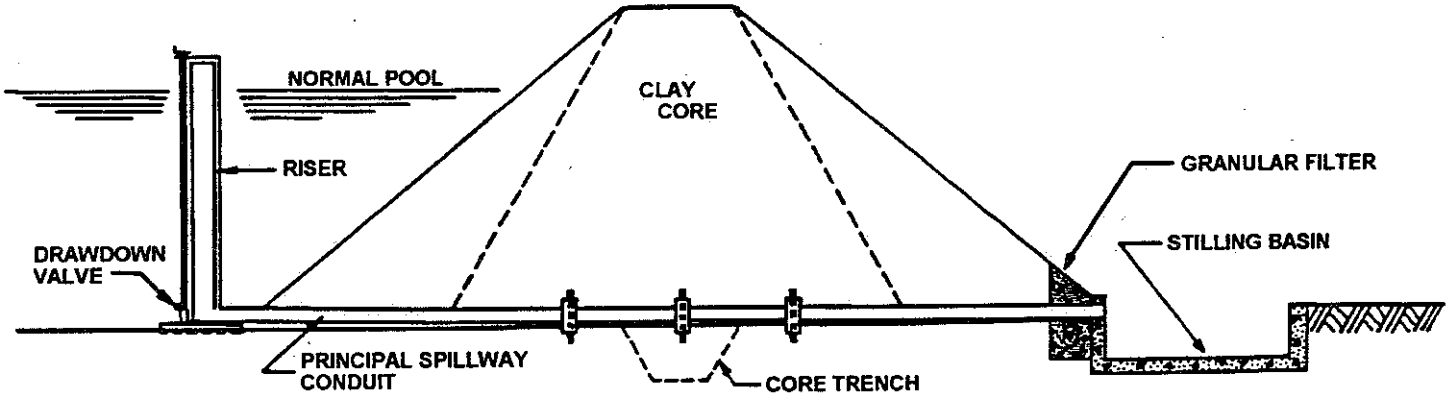
(E) Drawdown Facility

The drawdown facility provides a means for lowering or draining the reservoir. Dams have a drawdown facility to allow a fluctuating pool level, to kill weeds and mosquitoes, to lower the water level for repairs to the dam and to drain the lake when failure of the dam may be imminent. The drawdown facility is generally a pipe with a valve which may be operated when needed. Many times the drawdown facility is incorporated into the principal spillway with a gate valve in the riser. The drawdown valve should be located on the upstream side of the dam when the dewatering pipe passes through the entire embankment. This location keeps the water pressure in the conduit at zero and minimizes the potential for a rupture of the pipe.

The drawdown facility, when separate from the principal spillway facility, must be carefully placed, may have anti-seep collars or downstream filters, and the material around the conduit must be carefully compacted for the same reasons mentioned for principal spillways. Exhibit III shows typical drawdown facilities. Exhibit IV shows a typical sluice gate which is the most common type of drawdown facility.

# TYPICAL DROP INLET SPILLWAYS
# AND
# DRAWDOWN FACILITIES



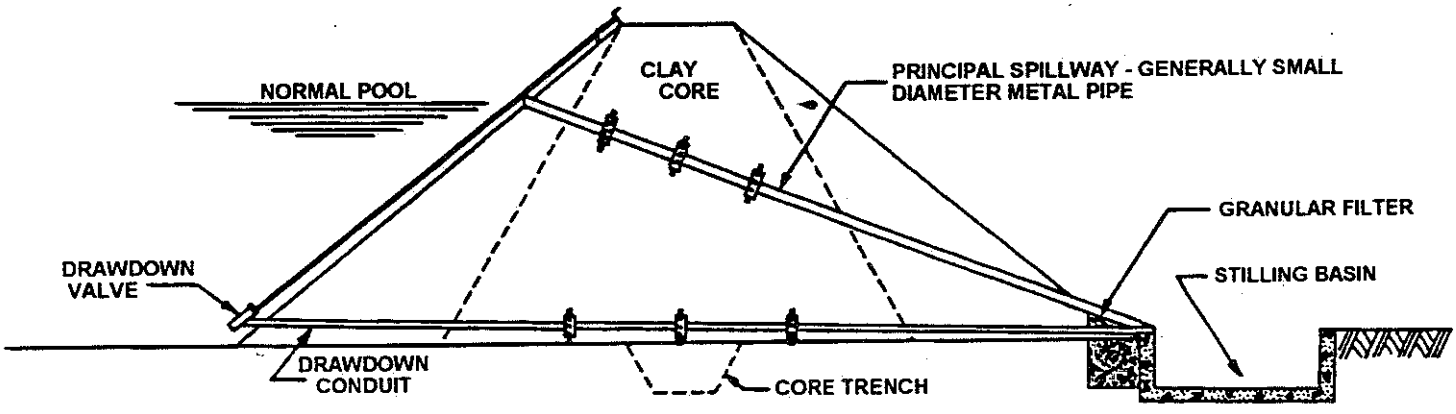




**EXHIBIT III**

# TYPICAL SLUICE GATE

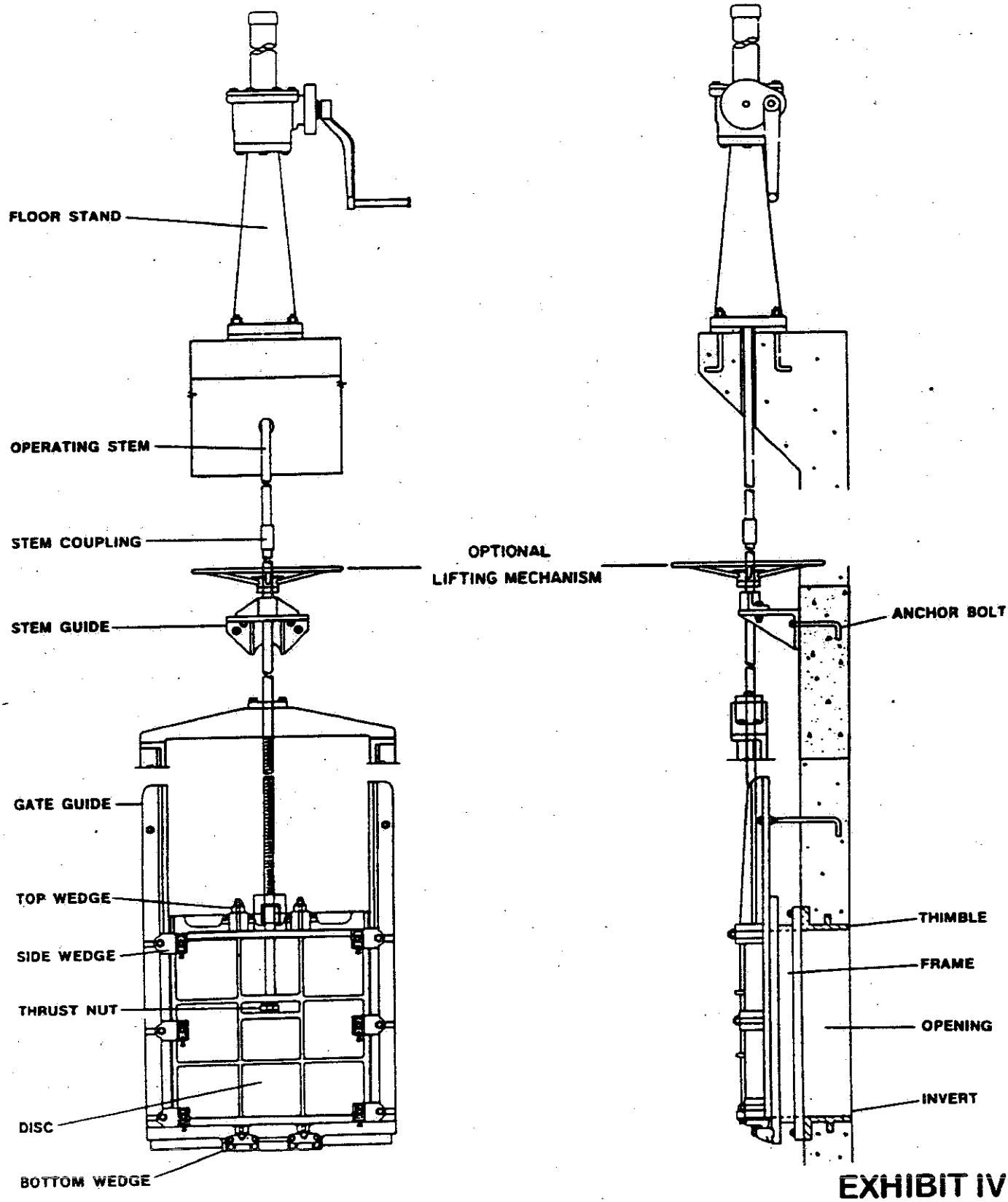



EXHIBIT IV

## III. MAIN ELEMENTS OF A CONCRETE OR MASONRY DAM

The main elements of a concrete or masonry dam are the: (A) Foundation, (B) Concrete or Masonry Dam Structure which may or may not be gated and (C) Drawdown Facility. Exhibit II contains a sketch of a typical concrete dam with and without gates.

### (A) Foundation

The foundation material must have the strength needed to safely support the concrete or masonry dam structure and reservoir. Seepage through the foundation must be controlled so that the concrete or masonry dam will be stable under the design conditions and will retain water for its intended purpose. To control the seepage through the foundation that typically occurs when the reservoir is filled, drainage blankets, toe drains, or relief wells are sometimes included in the design. A grout curtain is used in some dams to reduce seepage through the foundation material. All of the seepage control systems provide for discharging or controlling the seepage water in a safe manner while preventing the loss of foundation material.

### (B) Concrete or Masonry Dam Structure

The concrete or masonry is the primary part of the dam. It is the section which impounds the lake and holds the water for its intended purpose. Concrete or masonry dams must be capable of resisting overturning, sliding and overstressing with adequate factors of safety for normal and maximum loading conditions.

The spillway systems for concrete and masonry dams usually provide for some portion of the dam to serve as the principal spillway and energy dissipator. Gates may be used to control the reservoir level and to provide increased discharge capability during flood events. The gates are a structural component of the dam and must be designed, maintained, and operated correctly to assure that the necessary spillway capacity is available. The concrete or masonry structure must also be designed such that the energy created by the falling water over the dam is safely passed and dissipated in order to prevent erosion of the dam itself or at the downstream base of the dam. In some locations the dam provides for the entire spillway capacity. At other locations an earth cut emergency spillway in one of the dam abutments may be used. The requirements for the earth emergency spillway are the same as those for an earth embankment dam.

Seepage through a concrete or masonry structure must also be controlled to minimize damage to the structure. Drainage galleries within the dam are sometimes used to collect, monitor and safely discharge the seepage that does occur.

(C) Drawdown Facility

The drawdown facility for this type of dam may be the gated spillway system, i.e. the gates serve both to allow passage of flood events and to reduce the reservoir level to an acceptable elevation when necessary. At some dams the drawdown facility is a separate structure and must function in a manner similar to the drawdown facilities for an earth embankment dam.

## IV. MAINTENANCE OF DAMS

Maintenance is discussed in relation to the main elements of the dam. Several items apply to different elements. The maintenance of all elements must be viewed as an entity rather than maintaining each element separately.

### (A) Foundation

Maintenance of the foundation is not a typical problem if sufficient subsurface investigation was done in the design of the dam. However, the monitoring of relief wells, piezometers, the ground surface downstream of the dam, or similar items may indicate that seepage through the foundation is increasing. In some instances the loss or weakening of foundation material may require measures such as grout curtains, slurry walls, or downstream berms to be constructed to assure the continued integrity of the dam.

### (B) Embankment

Maintenance of the of the slopes and crest of the embankment should be provided on a routine basis.

(1) Vegetation: A good vegetative cover should be established and maintained. Properly maintained vegetation can help prevent erosion of embankment and earth channel surfaces. Grass is the most common type of vegetation found on an embankment. Grass is an effective and inexpensive way to prevent erosion on embankment surfaces. Crown vetch or similar vegetative covers are not recommended since they prohibit an effective inspection of the dam and can grow over eroded areas without indicating their existence. The maintenance of the vegetation is accomplished by:

a. Seeding, fertilizing and mulching areas which are refilled, barren, or thinly vegetated. Periodic fertilization is necessary to maintain vigorous vegetation. Watering may be necessary in dry seasons.

b. Mowing the vegetation. Mowing should occur as needed, usually at least twice annually or at any time the grass is taller than 1 foot. The mowing allows the grasses to establish thick erosion resistant sod and also makes it much easier to detect any potentially dangerous conditions such as seepage, erosion channels, cracks, and burrowing animals. It is important to remember to use the proper equipment for the slope and type of vegetation to be cut, and to always follow the manufacturer's recommended safe operation procedures.

c. Removing and preventing the growth of trees and brush. The presence of trees and brush is the most common form of neglect in the area of embankment maintenance. Uninformed owners will often allow trees and brush on their dams. Woody vegetation is, however, one of the dam's worst enemies, and will lead to more serious maintenance problems if not controlled. Trees and brush should not be permitted on embankment surfaces or in vegetated earth spillways. Trees and brush develop large root systems which can provide seepage paths. Their toppling, particularly during storm events, may leave large holes which can weaken the embankment for the approaching flood.

(2) Erosion: Erosion channels may occur on all areas of the dam but are frequently most severe along the line of contact at the abutments or groin. Whether on a slope or at a spillway outlet, erosion is a common maintenance problem on embankments. Erosion is a natural process and its continuous forces will eventually wear down almost any surface. Erosion control and repair is essential to prevent more serious damage to the embankment. Rills and gullies should be refilled, compacted, and then seeded. Erosion in large gullies can be slowed by stacking bales of hay or straw across the gully until permanent repairs can be made. Erosion may be aggravated by improper drainage, settlement, pedestrian traffic, animal burrows, or other factors. Repairs of all erosion channels on the dam should also address the cause of the erosion in order to prevent a continuing maintenance problem.

(3) Slumps: A slump or slide is a portion of an earth embankment which moves downslope, sometimes suddenly, often with cracks developing. The repair of slumps and slides on the dam is important and other than the movement of topsoil on the embankment shortly after construction should not be undertaken without an investigation by an engineer. A slump may occur for many reasons such as improper compaction, side slopes being too steep, and/or as a result of seepage. The cause of the slump should be determined before repair efforts begin. Correction of the underlying causes will most likely result in savings of time, labor, and expenses over the life of the structure.

(4) Cracks: The entire embankment must be closely inspected for cracks. Short, isolated cracks are not usually significant, but larger well defined cracks indicate a serious problem. Cracks can occur in either the transverse (perpendicular to the dam axis) or longitudinal (parallel to the dam axis) direction or be randomly patterned on the embankment. Transverse cracks indicate differential settlement within the embankment. Longitudinal cracks may signal the early stages of a slump. Random patterned cracking, desiccation cracks, are usually due to the drying of the embankment surface during the summer. Cracks should be documented as they appear. Transverse and longitudinal cracks should be investigated by an engineer before repairs are initiated.

(5) Wave Protection Devices: Slope protection is particularly susceptible to weathering. The action of waves, rain, freezing, and mechanical impacts can cause the movement, settlement, and/or destruction of the slope protection. All settlement, movement, or destruction should be repaired or replaced to conform to the original section of the embankment.

(6) Animals: The dam and surrounding area should be free of animal traffic and habitation. Domesticated animals such as cows, sheep, or horses should not be allowed on the embankment. Their hooves can damage the sod covering, especially if the cover is thin or the dam is wet from rainfall. Their grazing on the embankment vegetation can reduce its erosion resistance for the embankment.

Burrowing animals such as groundhogs, ground squirrels, muskrats, and crawdads should be kept off the dam by whatever means necessary. Some of the holes of the ground squirrels and crawdads may only be from 1" to 2" in diameter, however, their proliferation across the embankment face can weaken the outer portion of the embankment making it susceptible to sliding..

a. Groundhogs: A groundhog borrow is usually forked, with more than one entrance and with several side passages or rooms from 1 to 12 feet long. The groundhogs usually stay above the phreatic surface (upper surface of seepage or saturation) to stay dry. Groundhogs will be discouraged from inhabiting the embankment if the vegetation cover is kept mowed. Control methods should be implemented during early spring when active burrows are easy to find, young groundhogs have not scattered and there is less likelihood to damage to other wildlife.

b. Muskrats: Muskrats make their homes by burrowing into the banks of lakes and streams or by building their "houses" of bushes and other plants. Their burrows begin from 6 to 18 inches below the water surface and penetrate the embankment on an upward slant. At distances up to 15 feet from the entrance, a dry chamber is hollowed out above the water level. Once a muskrat den is occupied, a rise in the water level will cause the muskrat to dig farther and higher to excavate a new dry chamber.

Barriers to prevent burrowing offer the most practical protection to earthen structures. A properly constructed riprap and filter layer will discourage burrowing. As the muskrat attempts to construct a burrow, the sand and gravel of the filter layer caves in and thus discourages den building. The filter and riprap should extend at least 3 feet below the water line to offer a better deterrent to the animals.

c. Repair: Damage (and the potential for problems) is compounded where groundhogs or other burrowing animals construct their dens in the embankment opposite muskrat dens. If dens are found they should be promptly repaired. The recommended method of backfilling a burrow in an embankment is mud-packing. This simple, inexpensive method can be accomplished by placing one or two lengths of metal stove or vent pipe in a vertical position over the entrance of the den. Making sure that the pipe connection to the den does not leak, the mud-pack mixture is then poured in to the pipe until the burrow and pipe are filled with the earth-water mixture. The pipe is removed and dry earth is tamped into the entrance. The mud-pack is made by adding water to a 90 percent earth and 10 percent cement mixture until a slurry or thin cement consistency is attained. All entrances should be plugged with well compacted earth and the vegetation re-established.

(C) Principal Spillway or Concrete or Masonry Dam Structures:

The primary purpose is to pass normal flows of water in a safe manner. If this is not being accomplished, remedial measures must be undertaken. Items of maintenance concerning the principal spillway or concrete or masonry dams include:

(1) Trash Racks: Trash racks are used for many types of spillways to provide for the accumulation of debris in at controlled manner which does not restrict the capacity of the spillway to pass flood flows. A well designed trash rack will stop large debris that could plug the spillway but allow unrestricted passage of water and smaller debris. The trash rack should be properly attached to the spillway and strong enough to withstand the hammering forces of debris being carried by high velocity flow, a heavy load of debris, and ice forces.

The accumulation of the debris must be removed on a frequent basis, during and after storm events, to assure that the designed spillway capacity will be available. The material which is removed should be taken away from the spillway area, even if the debris is to be burned after drying, to prevent high reservoir stages from moving the debris back to the trash rack.

During the removal of debris the rack should be checked for rusted and broken sections. Damaged portions of the rack should be repaired as needed.

(2) Conduits: The conduit must be sound and water tight and have the strength to support the loads applied to it. When the conduit is inspected improper alignment (sagging), elongation and displacement at joints, cracks, leaks, surface wear, loss of protective coating, corrosion, and blockage should be noted. Some items may be repaired quite easily, however, the effective repair of the internal surface or joint of a conduit is difficult and should not be attempted without careful planning and proper professional supervision. Collapse or separation of the pipe requires immediate repair which may involve the drawdown of the lake and reconstruction of part of the earth embankment. Repairs of this type should not be undertaken without an investigation by an engineer. Other repairs might include:

a. The replacement of asphalt mastic which is used as a joint filler for non-pressure conduits. The mastic will generally provide a satisfactory seal for only about five years and is not recommended for other than temporary repairs.

b. Depending upon their cause and size, cracks can sometimes be repaired with either an epoxy, oakum or gasket type material. The repairs should provide for the internal surface of the conduit to be as smooth as possible so that high velocity flow will not damage the repair material. The manufacturers recommendations regarding the appropriate product to use for the specific repair and the installation should be followed. Hairline cracks in concrete are not generally considered a dangerous problem and repair is not needed unless the cracks open up.

c. Corrosion is a common problem of conduits and primarily of those made of metal. Coatings to resist accelerated corrosion, when applied to pipes which are in service, are generally not very effective because of the difficulty in establishing a bond. Bituminous coatings cannot be expected to last more than one or two years. Sometimes corrosion can be controlled or arrested by installing cathodic protection. A metallic anode such as magnesium is buried in the soil and is connected to the metal pipe by a wire. Natural voltage current flows from the magnesium (anode) to the pipe (cathode) and will cause the magnesium to corrode and not the pipe.

(3) Concrete: Concrete is a widely used material in dam construction which is durable and strong. However, maintenance problems eventually develop in nearly all concrete structures. Minor repairs, as outlined below, can be performed during routine maintenance. Although these repairs are seldom a permanent solution to concrete problems, minor repairs may help to prolong the useful life of the structure. Extensive cracking, slab or wall movement, large areas of exposed reinforcing steel, and severe undermining are examples of structural problems which require professional advice and may require a permit from the Office of Water Resources before repairs can be made.

a. Spalled concrete. Spalling is the loss of surface concrete and can expose the reinforcing steel. Patching is the process of replacing this material. All loose and unsound concrete should be removed from the spalled area and beneath the reinforcing bars if they are exposed. The edges of the area to be repaired should be saw cut to about $^{3}/_{4}$" deep. An appropriate bonding agent may be applied prior to patching with new concrete. If the spalled area is large enough, anchors must be installed to hold the replacement concrete in position. This work should be done by an experienced contractor.

b. Cracks. Small cracks may be repaired by surface sealing with an appropriate adhesive. Epoxy injection and sawcut and seal techniques are used for larger cracks. Surface sealing is used to stop water flows or as a temporary measure until more permanent crack repairs can be made.

c. Surface Deterioration. Concrete deterioration on dams is accelerated by the presence of chemicals in the water as well as the freeze-thaw process. Many types of commercial coatings are available to make the concrete resistant to this deterioration. The selection of an appropriate sealer is difficult and must be carefully matched to the specific problem. A specialty contractor should perform the repairs and apply the coating.

(D) Emergency Spillway:

It is extremely important that the dam owner understand the purpose and function of the emergency spillway. This area of the dam is often neglected because the owner rarely sees flow in it. The emergency spillway is designed to pass flood flows around the dam on an infrequent basis. This type of spillway usually consists of a vegetated earthen channel that is precisely dimensioned to convey water without overtopping the dam. A certain amount of erosion and damage to the emergency spillway is anticipated in the overall design.

Since the emergency spillway is used on an infrequent basis, maintenance of the channel should not be a burdensome task. As is the case of the embankment maintenance, there are certain items that need to be addressed that include:

(1) Maintenance of Vegetation: Periodic mowing to prevent trees, brush and weeds from creating a flow obstruction, particularly at the control section. A poor vegetative cover will usually result in extensive, rapid erosion when the spillway functions, and require more costly repairs. The vegetative cover should be given the same care and maintenance as the embankment of the dam. Reseeding and fertilization are necessary to maintain a vigorous growth of vegetation.

(2) Prompt Repair of Damage: Erosion can be expected in the spillway channel during high flows, and can also occur as a result of rainfall and local runoff. The latter is a more common problem in large spillways, and may require special treatment, such as terraces or drainage channels. Erosion of the side slopes will deposit material in the spillway channel, especially where the side slopes meet the channel bottom. In small spillways, this deposition can significantly reduce the spillway capacity. This condition often occurs immediately after construction, before vegetation becomes established. In these cases, it may be necessary to reshape the channel to provide the flow capacity.

(3) Removal of Flow Obstructions: Emergency spillways are often used for purposes other than the passage of flood flows. Among these uses are reservoir access, parking lots, boat ramps, boat storage, pasture, and cropland. Permanent structures (buildings, fences, fish screens, guardrails, etc.) should not be constructed in these spillways. If fences are absolutely necessary, they should cross the spillway far enough away from its control section (at the highest point in the channel) so they do not interfere with flow. Any change to the dimensions of the spillway channel will alter its capacity to carry flood flows and could cause failure of the dam.

(E) Drawdown Facility:

The reservoir drawdown facility should always be operable in order for the pool level to be reduced in case of an emergency or for necessary repairs. The drawdown facility must be tested periodically to assure its operational readiness. Before operating a valve or gate, it should be carefully inspected and all appropriate parts lubricated and repaired. Valves and gates that have not been operated for a long time present a special problem for dam owners. A professional engineer should be contacted for advice and assistance in properly exercising a questionable gate or valve. A contractor's assistance may be needed if the gate and operating components do not move smoothly, without binding.

The valve or gate should be operated from the fully closed to the fully opened position as recommended by the manufacturer or at least four times each year. Sediment and debris can build up and block the drain inlet. This problem can be minimized if the valve or gate is operated and maintained periodically. Also, early detection of equipment problems or breakdowns, and confidence in equipment operability, are benefits of periodic operation.

An uncontrolled and rapid drawdown of the lake level could induce more serious problems such as slides in the saturated upstream slope of the embankment or reservoir area. Drawdown rates should not exceed 1 foot per week for slopes of clay or silt material except for emergency situations. Very flat slopes or slopes with free-draining upstream zones can withstand more rapid drawdown rates. It is prudent to advise downstream residents of large or prolonged discharges because of the possibility of downstream flooding.

Some older dams have drains with valves at the downstream toe. If the valve is located at the downstream end of a conduit extending through the embankment, the conduit is under the constant pressure of the reservoir. If a leak in the conduit develops within the embankment, saturation, erosion, and possibly failure of the embankment could occur. These drains should be monitored closely and owners should plan to relocate the valve upstream or install a siphon drain system.

## V. PRINCIPAL TYPES OF DAM FAILURES

Dam failures are usually produced by either inadequate design, improper construction, or inadequate maintenance. All new dams must follow the guidelines set forth in the Rules. Problems in the design, construction and maintenance of new dams will hopefully be minimized. On many older dams very little is known about their design and construction. Therefore, most conclusions are based on knowledge gained from visual inspections. It is most important, with respect to these structures, to be aware of the principal types of failure and the tell-tale signs that may foretell failure. Earth dam failures can generally be grouped into three classifications. They are Hydraulic, Seepage, and Stability; however, failures are often caused by a combination of these reasons.

### (A) Hydraulic Failures

Hydraulic failures are those resulting from the uncontrolled flow of water over or adjacent to the dam, plus the erosive action of water on the dam and its foundation. Earth dams are particularly susceptible to hydraulic failure since earth erodes at relatively small flow velocities.

### (B) Seepage Failures

All dams have some seepage. Seepage must be controlled in velocity and amount. Seepage occurs both through the dam and under and around the dam in the foundation and abutment materials. Seepage, if uncontrolled, can erode material starting at the downstream slope or foundation back toward the upstream slope to form a "pipe" which often leads to a complete failure of the structure. This phenomenon is known as "piping". Another type of seepage problem is sloughing (miniature slide on upstream or downstream slope of the embankment).

### (C) Stability Failures

Stability failures involve the rupture of the dam and/or its foundation. This is a particularly important hazard on large dams and on dams built of low strength clays and silts and other materials such as slag, fly ash, etc. Generally speaking, these types of failures are interrelated and complex. For example, uncontrolled seepage may weaken the soil and lead to a stability failure. A stability failure may also shorten the seepage path and lead to a "piping" failure. Surface erosion may lead to stability or piping failures.

(The accompanying Tables 1, 2 and 3 give a summary of failures and possible remedies. The preventive or corrective measures listed in the tables are not all-inclusive.)

TABLE 1

TYPES OF HYDRAULIC FAILURES (30% of all failures - more in dams under 50 ft.)

| FORM | CHARACTERISTICS | CAUSES | PREVENTIVE OR CORRECTIVE MEASURES |
|---|---|---|---|
| Overtopping | Flow over embankment washing out dam | Inadequate spillway capacity | Spillway designed for a greater flood |
| | | Clogging of spillway with debris | Maintenance, trash booms, clean or redesign |
| | | Insufficient freeboard due to settlement, skimpy design | Allowance for freeboard and settlement in design; increase crest height or add flood parapet |
| Wave Erosion | Undercutting of upstream face by waves, currents | Lack of riprap, riprap too small | Properly designed riprap or other slope protection |
| Toe Erosion | Erosion of toe by outlet discharge | Spillway or outlet too close to dam | Training walls and/or energy dissipators |
| Gullying | Rainfall erosion of dam face | Lack of sod or poor surface drainage | Sod, fine riprap; surface drains |

TABLE 2

TYPES OF SEEPAGE FAILURES (40% of all failures)

| FORM | CHARACTERISTICS | CAUSES | PREVENTIVE OR CORRECTIVE MEASURES |
|---|---|---|---|
| Loss of Water | Excessive loss of water from reservoir and/or occasionally increased ground water levels near reservoir | Pervious reservoir rim or bottom | Blanket reservoir with compacted clay or chemical admix; grout seams and cavities |
| | | Pervious dam foundation | Use foundation cutoff; grout; upstream blanket |
| | | Pervious dam | Impervious core |
| | | Leaking conduits | Watertight joints; waterstops; grouting |
| | | Settlement cracks in dam | Remove compressible foundation; use stage construction; avoid sharp changes in abutment slope; compact soils at moisture contents above optimum |
| | | Shrinkage cracks in dam | Use lower plasticity material on core; adequate compaction and appropriate moisture contents |
| Seepage erosion or piping | Progressive internal erosion of soil from downstream side of dam or foundation backward toward the upstream side to form an open conduit or "Pipe" often leads to a washout of a section of the dam | Settlement cracks in dam | Remove compressible foundation; use stage construction; avoid sharp changes; internal drainage with protective filters |
| | | Shrinkage cracks in dam | Lower plasticity solid; adequate compaction at appropriate moisture content; internal drainage with protective filters |

TABLE 2 (Continued)

| FORM | CHARACTERISTICS | CAUSES | PREVENTIVE OR CORRECTIVE MEASURES |
|---|---|---|---|
| Seepage erosion or piping (Continued) | Progressive internal erosion of soil from downstream side of dam or foundation backward toward the upstream side to form an open conduit or "Pipe" often leads to a washout of a section of the dam (Continued) | Pervious seams in foundation | Foundation relief drain with filter; cutoff |
| | | Pervious seams, roots etc. In dam | Construction control; core; internal drainage with protective filter |
| | | Concentration of seepage at face | Internal drainage with filter; toe drain |
| | | Boundary seepage along conduits, walls | Stub cutoff walls; internal drainage with a filter; good soil compaction |
| | | Leaking conduits | Watertight joints; waterstops; durable materials |
| | | Animal burrows | Riprap; plug holes; wire mesh |
| | | Seepage through abutment | Grout curtain; upstream blanket |

TABLE 3

TYPES OF STABILITY FAILURES (30% of all failures - less in dams under 50 ft.)

| FORM | CHARACTERISTICS | CAUSES | PREVENTIVE OR CORRECTIVE MEASURES |
|---|---|---|---|
| Foundation | Sliding of entire dam, one face, or both faces in opposite directions, with bulging of foundation in the direction of movement | Soft or weak foundation | Flatten slope; employ broad berms; remove weak material; stabilize soil; stage construction |
| Upstream slope | Sliding in upstream face with little or no bulging in foundation below toe | Steep slope | Flatten slope or employ berm at toe |
| | | Weak embankment soil | Improve moisture content and/or compaction; better soil |
| | | Sudden drawdown of reservoir | Flatten slope; rock berms; operating rules |
| Downstream slope | Slide in downstream face | Steep slope | Flatten slope or employ berm at toe |
| | | Weak embankment soil | Improve moisture content and/or compaction; better soil |
| | | Loss of solid strength by seepage pressure or rainfall | Core, internal drainage with protective filters; surface drainage |
| Spillway or Stilling Basin | Displacement of concrete slabs, walls or crest accompanied by erosion of underlying soil | Joints and cracks not kept sealed. Poor design causing uplift forces on spillway. Inadequate or blocked filter drains under concrete. | Regular maintenance of cracks and joints; redesign of shape of spillway; repair or redesign filters |

## VI DOWNSTREAM HAZARDS FROM DAM FAILURES

The owner of a dam is responsible for the operation, maintenance, and inspection of his structure. Negligence by the owner in fulfilling his responsibilities can lead to the creation of extremely hazardous conditions to downstream properties and residents. In the event of failure the owner can be subjected to a barrage of liability claims. Criminal charges have been filed on occasion as the result of catastrophic dam failures.

Failure of the dam can cause considerable loss of capital investment and income, possible property damage, and loss of life. Loss of the reservoir can cause severe hardship for those dependent on it for their livelihood and can also upset the ecological balance of the area. A dam and appurtenant works must be properly maintained after they are constructed.

## VII. INSPECTION ITEMS

Understanding and recognizing potentially dangerous conditions may prevent a catastrophic dam failure. From our program, and the information learned from the programs of other states, it appears that the majority of deficiencies in the proper maintenance of dams occur because the owners do not have an understanding of the techniques necessary for a proper program of inspection and maintenance. The items listed below should be used as a guideline to the inspection of a dam but are not intended to be all-inclusive.

1. Water Level: Note depth of water upstream and downstream of the spillway.

2. Earth Embankment: Walk the top, side slopes, downstream toes, and upstream waterline of the dam looking for cracks, erosion, seepage, slumps, slides, condition of slope protection, animal damage, and that seepage control structures are operational and not clogged.

3. Vegetation:

   a. Grass: should be thick, vigorous growth and short enough to prevent clumping and laying-over which may kill growth.

   b. Trees: there should be no trees on the earth embankment or earth emergency spillway or within 20′ ± of the earth embankment or concrete structures.

   c. Herbicides: any herbicide used must be non-toxic to fish.

4. Channels: Note debris, erosion, obstruction, vegetation, and sediment which may block or restrict flow to or from spillways and outlet works.

5. Concrete Structures: Note any changes which have appeared since the last inspection (signs of seepage, cracks, breaks, spalling, erosion, or movement in the concrete or at construction and expansion joints).

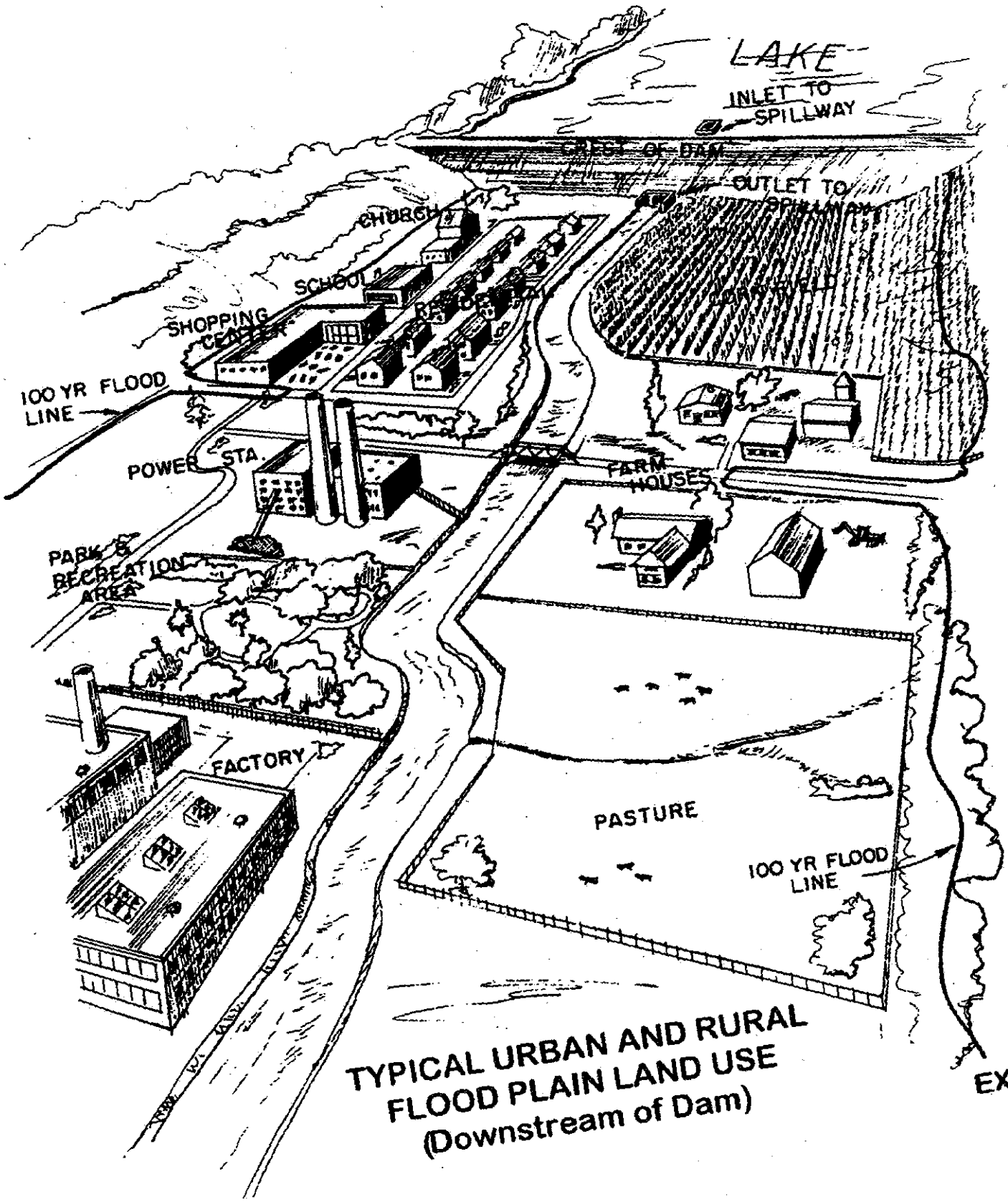
6. Riprap: Should be graded layers of rock over gravel bedding or a geosynthetic filter fabric. Grass growth within riprap is acceptable but No trees. Check to determine whether stone is deteriorating due to freezing and thawing action.

7. Fences: Check for damage, accumulated debris, operation of gates and locks, adequacy of locations (to prevent public hazard and to not obstruct spillway water flow).

8. Mechanical Equipment: Note physical and operating condition. Know where keys are located to open padlocks or fence locks to gain access to operating equipment. Know location of operating wheels or cranks. All equipment should be operated on a regular basis and generally not less than four times annually.

9. Monitoring Devices: weirs, piezometers, settlement platforms, etc. current reading and condition.

10. Downstream Land Use: Make visual inspection of flood plain downstream of dam and determine existing land uses occupying the 100-year flood plain. Exhibit V contains a sketch of typical floodplain uses downstream of a dam.




**TYPICAL URBAN AND RURAL FLOOD PLAIN LAND USE (Downstream of Dam)**

**EXHIBIT V**

## VIII. RECORDS

A log-book of the dam should be kept by the owner noting dates of periodic inspections, personnel present, weather, observations made, unusual events and to record maintenance activities.

## IX. EMERGENCY PROCEDURES

All Class I and II dams should have an Emergency Action Plan consistent with the Interagency Committee on Dam Safety format.

If an Emergency Action Plan has been prepared for the dam, use the plan to determine appropriate actions during an emergency.

If an Emergency Action Plan has **not** been prepared for the dam, then during and immediately following unusual storm and flood events the owner or his designated representative should make visual inspections of the dam and its appurtenances at intervals of not less than 2 per day. In the event that a breach or overtopping of the dam appears imminent, the owner should notify the local Emergency Services and Disaster Agency or Police Department in an effort to provide as much warning time as possible for the evacuation of persons downstream of the dam. The Office of Water Resources should be contacted after the immediate notification responsibilities have been met. Items to watch for during the inspections include:

1. Unaccounted-for seepage.
2. Muddy water discharge from any portion of the earth embankment.
3. "Boils" forming in the embankment or downstream areas of the dam.
4. Soil discharges through concrete joints, cracks, or openings.
5. Blockage of primary or emergency spillway by floating debris or ice.
6. Failure of any portion of primary spillway, which results in the removal or threatened removal of the earthen embankment.
7. Water discharging from the emergency spillway.
8. Sudden slumping, cracking, or settling of earth embankment.

It is recommended that dam owners with dams in seismic zone 2 or 3 (roughly the southern 1/3 of Illinois) obtain the publication entitled "Guidelines for Inspection of Dams Following Earthquakes" from the United States Committee on Large Dams. The inspection format included in that publication should be used in the event of an earthquake.

## X. DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream. (Illustration 1 depicts the principal parts of a "typical" earthen dam and its appurtenant works.)

Appurtenant Works - The structures or machinery auxiliary to dams which are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil which is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam which releases impoundment water.

Concrete Block - An erosion protection method using interlocking concrete blocks, usually with openings that are filled with soil and grass.

Core - A zone of material of low permeability in an earthen dam.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment or structure built alongside a river to prevent high water from flooding bordering land.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment including such items as a toe drain, a weephole, and a chimney drain.

Drawdown - The resultant lowering of water surface level due to the controlled release of water from the impoundment.

Embankment - Fill material, usually earth or rock, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Emergency Action Plan - A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives.

Failure - An incident resulting in the uncontrolled release of water from a dam.

Freeboard - The vertical distance between a stated water level and the top of a dam. (See Illustration 1.)

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the dam operator. These inspections are frequent visual "walk-around" inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against current, wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment which moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway which controls both normal and flood flows and is constructed of non-erodible materials.

Auxiliary Spillway - A spillway which works in conjunction with the principal spillway to control flood flows and is constructed of non-erodible materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the stream bed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

Trash Rack - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

# XI. DAM INSPECTION FORMS

# Dam Inspection Report

Name of Dam _____ Dam ID No. _____

Permit Number _____ Class of Dam _____

Location _____ Section _____ Township _____ Range _____

Owner _____ _____
Name Telephone Number (Day)

_____ _____
Street Telephone Number (Night)

_____ County _____
City Zip Code

Type of Dam _____

Type of Spillway _____

Date(s) Inspected _____

Weather When Inspected _____

Temperature When Inspected _____

Pool Elevation When Inspected _____

Tailwater Elevation When Inspected _____

Inspection Personnel:

_____
Name Title

_____
Name Title

_____
Name Title

_____
Name Title

Professional Engineer's Seal

The Department of Nautural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams".

## CONDITION CODES

NE - No evidence of a problem

GC - Good condition

MM - Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled

IM - Item needing immediate maintenance to restore or ensure its safety or integrity

EC - Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam

OB - Condition requires regular observation to ensure that the condition does not become worse

NA - Not applicable to this dam

NI - Not inspected - list the reason for non-inspection under deficiencies

## EARTH EMBANKMENT

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Surface Cracks | | | |
| Vertical and Horizontal Alignment of Crest | | | |
| Unusual Movement or Cracking At or Beyond Toe | | | |
| Sloughing or Erosion of Embankment and Abutment Slopes | | | |
| Upstream Face Slope Protection | | | |
| Seepage | | | |
| Filter and Filter Drains | | | |

## EARTH EMBANKMENT
(Continued)

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Animal Damage | | | |
| Embankment Drainage Ditches | | | |
| Vegetative Cover | | | |
| Other (Name) | | | |
| Other | | | |
| Other | | | |
| Other | | | |

## CONCRETE OR MASONRY DAMS

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Seepage | | | |
| Structure to Abutment/ Embankment Junctions | | | |
| Water Passages | | | |
| Foundation | | | |
| Surface Cracks in Concrete Surfaces | | | |
| Structural Cracking | | | |
| Vertical and Horizontal Alignment | | | |

## CONCRETE OR MASONRY DAMS
(CONTINUED)

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Monolith Joints | | | |
| Contruction Joints | | | |
| Spalling of Concrete | | | |
| Filters, Drains, etc. | | | |
| Riprap | | | |
| Other (Name) | | | |

IF THE DAM IS GATED - Fill out the portion of the Principal Spillway Form related to Gated Spillways

## PRINCIPAL SPILLWAY
## APPROACH CHANNEL

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Debris | | | |
| Side Slope Stability | | | |
| Slope Protection | | | |
| Other (Name) | | | |
| Other | | | |
| Other | | | |
| Other | | | |

## PRINCIPAL SPILLWAY

☐ Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion, Spalling, Cavitation | | | |
| Structure to Embankment Junction | | | |
| Drains | | | |
| Seepage Around or Into Structure | | | |
| Surface Cracks | | | |
| Structural Cracks | | | |

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

## PRINCIPAL SPILLWAY
(Continued)

☐ Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Alignment of Abutment Walls | | | |
| Construction Joints | | | |
| Filter and Filter Drains | | | |
| Trash Racks | | | |
| Bridge and Piers | | | |
| Differential Settlement | | | |
| Other (Name) | | | |

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

## PRINCIPAL SPILLWAY
(Continued)

☐ Conduit ☐ Gated

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion, Spalling, Cavitation | | | |
| Joint Separation | | | |
| Seepage Around of Into Conduit | | | |
| Surface Cracks | | | |
| Structural Cracks | | | |
| Trash Racks | | | |
| Differential Settlement | | | |
| Alignment | | | |
| Other (Name) | | | |

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

## PRINCIPAL SPILLWAY
(Continued)

☐ Chute

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion, Spalling, Cavitation | | | |
| Structure to Embankment Junction | | | |
| Construction Joints | | | |
| Expansion and Contraction Joints | | | |
| Differential Settlement | | | |
| Surface Cracks | | | |
| Structural Cracks | | | |
| Wall Alignment | | | |
| Other (Name) | | | |

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

## PRINCIPAL SPILLWAY

☐ Principal Spillway ☐ Dewatering ☐ Other:

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Gate Sill | | | |
| Gate Seals | | | |
| Gate and Frame | | | |
| Operating Machinery | | | |
| Emergency Operating Machinery | | | |
| Other (Name) | | | |
| Other | | | |

## OUTLET WORKS
## IF SEPARATE FROM PRINCIPAL SPILLWAY STRUCTURE

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion, Spalling, Cavitation | | | |
| Joint Separation | | | |
| Seepage Around or Into Conduit | | | |
| Intake Structure | | | |
| Outlet Structure | | | |
| Outlet Channel | | | |
| Riprap | | | |
| Other (Name) | | | |
| Other | | | |

## ENERGY DISSIPATOR

☐ Principal Spillway Type:

☐ Outlet Works

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion, Spalling, Cavitation | | | |
| Structure to Embankment Junction | | | |
| Construction Joints | | | |
| Surface Cracks | | | |
| Structural Cracks | | | |
| Differential Alignment | | | |
| Expansion and Contraction Joints | | | |

## ENERGY DISSIPATOR
(Continued)

☐ Principal Spillway ☐ Outlet Works

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Riprap | | | |
| Outlet Channel | | | |
| Debris | | | |
| Other (Name) | | | |
| Other | | | |
| Other | | | |
| Other | | | |

## EMERGENCY SPILLWAY

☐ Earth  Other:Name _____

| ITEM | CONDITION CODE | DEFICIENCIES | RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE |
|---|---|---|---|
| Erosion | | | |
| Weeds, Logs, Other Obstructions | | | |
| Side Slope Sloughing | | | |
| Vegetation | | | |
| Sedimentation | | | |
| Riprap | | | |
| Settlement of Crest | | | |
| Downstream Channel | | | |
| Other (Name) | | | |

SUMMARY OF MAINTENANCE DONE AND/OR

REPAIRS MADE SINCE THE LAST INSPECTION

DATE OF PRESENT INSPECTION _____

DATE OF LAST INSPECTION _____

1. EARTH EMBANKMENT DAMS

2. CONCRETE MASONRY DAMS

3. PRINCIPAL SPILLWAY

4. OUTLET WORKS

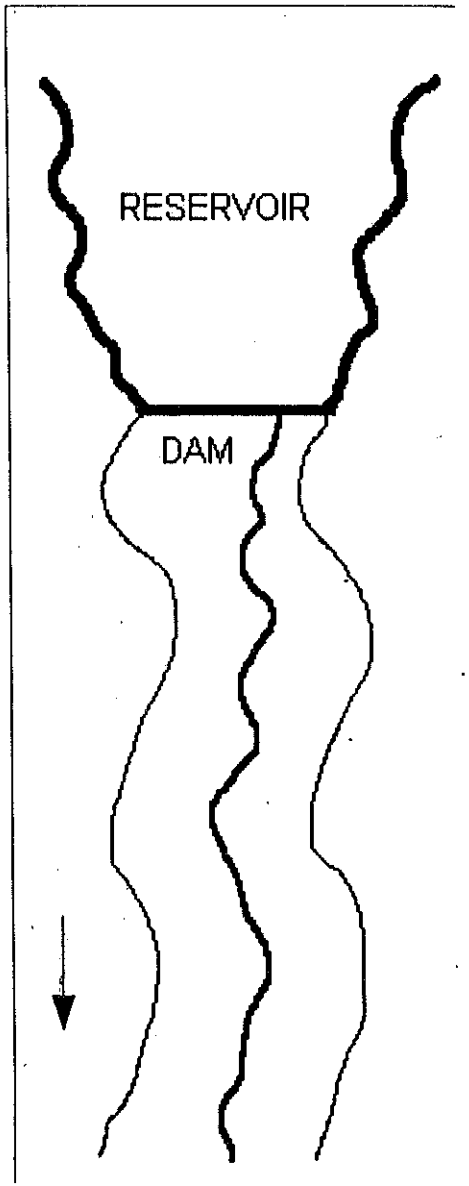
5. EMERGENCY SPILLWAY

DOWNSTREAM DEVELOPMENT
APPROXIMATE WIDTH OF AFFECTED FLOODPLAIN _____ MILES

| MILES DOWNSTREAM FROM DAM | DOWNSTREAM DEVELOPMENT | | | | | | | | | | | | Loss of Life Potential | | | Economic Loss Potential | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OCCUPIED HOMES | UNOCCUPIED HOMES | AGRICULTURAL BUILDINGS | INDUSTRIAL BUILDINGS | COMMERCIAL BUILDINGS | SCHOOLS | HOSPITALS | ROADS & BRIDGES | DAMS | OVERHEAD UTILITIES | OTHER DEVELOPMENT (Name) | OTHER DEVELOPMENT (Name) | NONE | 1 TO 10 | OVER 10 | MINIMAL EXPECTED | APPRECIABLE EXPECTED | EXCESSIVE EXPECTED |
| 0 to 1/4 | | | | | | | | | | | | | | | | | | |
| 1/4 to 1/2 | | | | | | | | | | | | | | | | | | |
| 1/2 to 3/4 | | | | | | | | | | | | | | | | | | |
| 3/4 to 1 | | | | | | | | | | | | | | | | | | |
| 1 to 1-1/4 | | | | | | | | | | | | | | | | | | |
| 1-1/4 to 1-1/2 | | | | | | | | | | | | | | | | | | |
| 1-1/2 to 1-3/4 | | | | | | | | | | | | | | | | | | |
| 1-3/4 to 2 | | | | | | | | | | | | | | | | | | |
| OVER 2 | | | | | | | | | | | | | | | | | | |

The number of homes, buildings, or other items in the floodplain downstream of the dam should be placed in the appropriate row and column to designate their location.

SKETCH IN DEVELOPMENTS DOWNSTREAM OF THE DAM



## Owner's Maintenance Statement

I, _____ , owner of _____ dam,

Dam Identification Number _____ , in _____ County,

am maintaining the dam in accordance with the accepted maintenance plan which is part of

Permit Number _____ .

_____
Signature

_____
Date

## Owner's Operation and Maintenance Plan Statement

I, _____ , owner of _____ dam,

Dam Identification Number _____ , in _____ County,

have reviewed the operation and maintenance plan including the Emergency Action Plan (EAP),

which is part of, Permit Number _____.

I ( ) have enclosed the appropriate revisions or

( ) have determined that no revisions to the plan are necessary.

_____
Signature

_____
Date

The Department of Nautural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams".