General Permit

US Army Corps of ENGINEERS
Vicksburg, Memphis and Little Rock Districts

General Permit NO.
ARKANSAS GP-GTR -9089-GC

Permit Issue Date
May 8, 2000

Reference Number
980690530

Permit Expiration Date
May 8, 2005

FOR INFORMATION ONLY. COMMENTS NOT REQUIRED.

ISSUANCE OF A GENERAL PERMIT FOR INSTALLATION OF WATER CONTROL STRUCTURES AND LEVEES ASSOCIATED WITH THE CREATION OF GREENTREE RESERVOIRS IN ARKANSAS

The District Engineers, U.S. Army Corps of Engineers, Vicksburg, Memphis and Little Rock Districts, announce the issuance of general permit ARKANSAS GP-GTR for the purpose of depositing earthen material into waters of the United States associated with the installation of water control structures and levees for the creation of greentree reservoirs (GTR). Man-induced flooding of forested lands during the winter months constitutes a GTR. The purpose of GTR's is to enhance waterfowl habitat by providing foraging opportunities on mast and invertebrates for wintering waterfowl. GTRs provide a more predictable habitat where food resources attract enough waterfowl to produce predictable hunting opportunities. This general permit (GP) is effective within the regulatory jurisdiction of Vicksburg, Memphis and Little Rock Districts in the State of Arkansas.

This GP contains certain limitations and conditions intended to protect the natural and cultural resources. In general, the trees will be flooded only after they enter dormancy and floodwaters will be removed before spring growth is initiated. Conformance with conditions contained in the GP does not necessarily guarantee authorization under this permit. In cases where the respective District Engineer considers it necessary, an individual permit will be required. Levee construction, mechanical clearing, or fill operations not specifically covered by this GP are prohibited unless authorized by a separate permit. The construction of water control structures and levees associated with deep water habitats, such as ponds and lakes, are not authorized by this permit. Listed below are conditions and/or restrictions for installation of water control structures and levees associated with a GTR:

1. The topography of the GTR site is flat or with a slope less than 1% (one foot rise per one hundred feet length). Soils have low permeability to inhibit subsurface drainage and allow for maintenance of proper water levels. The infrastructure and management strategy of the GTR are adequate to assure the required supply and discharge of water. The potential to discharge an adequate amount of water to protect forest resources can occur whenever necessary. Vegetation of the proposed GTR site is suitable to enhance long-term waterfowl habitat by providing foraging opportunities on mast and invertebrates for wintering waterfowl.

2. The proposed site of the GTR is properly positioned in the floodplain, which depends upon the major geomorphic, topographic and other structural and hydrological features of the floodplain. Areas that are flooded during late winter/early spring either naturally (including beaver problems) or because of man-made alterations (e.g. dams, agricultural development, flood control) are not acceptable sites for GTRs because flooding already occurs during the management period and flood water removal at the beginning of the growing season will be prohibited by high water levels outside the GTR. In small floodplains, GTRs should be positioned to minimize the blockage of channel flow by levees and water control structures. An example of this is shown on Enclosure 1. Regardless of the size of the floodplain, GTRs should not be placed immediately next to the river system or to the flood control levees. GTRs should be positioned at slightly higher elevations within the floodplain to ensure that appropriate water discharge is possible during moderately high waters. See Enclosure 1, for examples of poor and preferred site selections.

3. Greentree Reservoirs greater than 100 acres and multiple impoundments shall be reviewed by the Environmental Protection Agency, U.S. Fish and Wildlife Service, Arkansas Game and Fish Commission, Arkansas Soil and Water Commission, Arkansas Natural Heritage Commission, Arkansas Forestry Commission and the Arkansas Department of Environmental Quality.

4. Levees shall be designed to maintain water levels within the GTR between four and ten inches and not exceed 18 inches (excluding channels). Levee height shall not exceed three feet and shall contain emergency spillways as needed to prevent excessive damage. Levee crown shall not exceed ten feet to support mowing equipment and deter burrowing activity of beaver or other animals and shall have side slopes 3:1 or flatter.

5. Dams and/or levees shall not be constructed across primary rivers or perennial streams. The placement of water control structures and levees shall be based on topography and drainage patterns. Each individual GTR of multiple impoundment systems shall be capable of being flooded and drained independently of each other. Levees shall be placed on contours, and when possible, on existing dikes, roadways, pipelines, or other disturbed areas to prevent habitat fragmentation. See Enclosure 2 for examples of water control.

6. Compensatory mitigation shall be required for the loss of wetland functions and values at a ratio to be determined by the Corps on a case by case basis.

7. Stoplog water control structures (Enclosure 3) shall be used to emulate natural hydrological regimes. In areas subject to beaver activity, installation of beaver pond levelers and/or emergency drainage systems are necessary to maintain control of water levels. See Enclosure 4 for an example of a beaver pond leveler.

8. Flood durations shall mimic natural historical patterns and follow an approved water-level management plan. Guidelines within the management plan include beginning and ending managed flood dates. Initial man induced flooding will begin after tree dormancy (after November 15) and occur over a period of seven to ten days to assure oxygenated water where trees and shrubs are less impacted. Final dewatering will begin the day following the last day of duck season or January 15 and be completed by February 15. Slow drawdown will occur to facilitate nutrient cycling processes and prevent losses of valuable nutrients. Dewatering refers to raising gates on pipes, removing flashboards from risers, and possibly pumping water from the GTR to a ditch or river.

9. Greentree reservoirs shall remain dry one out of every three years except during natural flood events (i.e. no man-induced flooding). This shall be accomplished by leaving the gates and droplog structures open one out of every three years. If the GTR was to remain dry and a flood event occurs, it shall remain dry the following year.

10. Any forest harvesting within the impoundment shall be conducted in accordance with a management plan pending agency review and shall be restricted to those activities that promote the growth of a healthy, diverse forest.

11. Boat lanes, food plots and "duck holes" shall be constructed with chainsaws only. No excavation, mechanical clearing, or ditch construction shall be allowed.

12. The GTR shall be monitored on an annual basis by a professional forester or biologist and a report of the results shall be provided to the Corps of Engineers no later than July 15 of each year. The report shall include but not be limited to: an assessment of vegetation changes or stress; a description of water management, including water depth, flooding and dewatering dates and recommendations for operating the GTR the following year. See Enclosure 5 for monitoring information. Special conditions concerning the operation of the GTR may be modified or added as a result of the findings of the annual report. If monitoring reveals significant adverse impacts to the GTR, corrective measures

may be necessary to ensure the integrity of the forested land. The Corps will provide a copy of the annual report to the appropriate resource agencies.

13. The authorized structure(s) shall not extend into the channel of a receiving stream to the extent that it shall interfere with navigation (including recreational boating) or adversely affect the flow-carrying capacity of the receiving stream.

14. Excavation and deposition of earthen material during site preparation for a pipe structure and levee placement shall be no more than necessary to place the structure.

15. Any fill material shall be compacted upon completion of construction. Any areas disturbed by construction activities will be seeded, or sodded as necessary to restore cover and prevent erosion. In areas subject to currents, riprap may be required for slope protection.

16. Material used for fill (e.g. levees) shall be nonpolluting. It may be obtained from the project site, or offsite from an upland (non-wetland) area.

17. All excess material not used in construction shall be placed in an upland non-jurisdictional disposal area.

18. The construction activity shall not prolong/increase the inundation, drain, or augment the drainage of surrounding wetlands to the point of adverse impacts, such as timber mortality. Authorized structures shall not increase/decrease frequency, duration, or elevation of floodwater on areas outside the project site. If the topography of the project area suggests to the District Engineer that drainage patterns on adjoining properties may be adversely affected, appropriate survey data depicting the extent of the impact of the structure will be required from the applicant prior to a permit decision.

19. No activity which may adversely impact a site listed in or eligible for listing in the National Register of Historic Places shall be allowed by the General Permit. Additional material shall not be taken from a known historical or archeological site such as an Indian mound. If unknown cultural resources are uncovered during construction, the permittee must notify the District Engineer and stop work immediately.

20. If damage to a revetment occurs as a result of work conducted in accordance with this General Permit, the permittee shall be required to make necessary repairs at his/her own expense. These repairs must meet specifications designated by the District Engineer.

21. The discharge shall not occur in a component or a proposed component of the National Wild and Scenic River System or in a component of a state Scenic River System or Special Category Waters without the appropriate Federal or state authorization.

22. All construction activities shall be performed during dry conditions and in a manner that will minimize adverse effects on water quality and aquatic life. Prior to the beginning of any construction activities, appropriate erosion control measures, such as silt fences, silt barriers or other suitable devices shall be placed between the construction area and affected waterways (wetlands); and maintained in a functioning capacity until the area is permanently stabilized upon project completion.

23. The discharge shall not adversely affect a public water supply intake. Any project, which is deemed by the District Engineers to have the potential to affect water quality at a public water supply intake, must obtain approval from the Department of Health.

24. The discharge shall not contain unacceptable levels of pathogenic organisms in areas used for recreation involving physical contact with the water.

No sewage, oil, refuse, or other pollutants will be discharged into the water course.

25. The discharge shall not destroy or adversely affect threatened or endangered species or their critical habitat as identified under the Endangered Species Act.

26. The local county administration should be contacted to determine the need for construction permits (i.e. FEMA).

27. Water withdrawals shall be registered with Arkansas Soil and Water Commission, 101 East Capitol, Suite 350, Little Rock, AR 72201.

28. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 29 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

29. A copy of the signed permit, if issued, shall be recorded with the deed of the property at the local county seat and a certified copy returned to the Corps of Engineers. If you sell the property associated with the authorization under this General Permit, you must contact the appropriate Corps District so that authorization can be transferred to the new owner.

30. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

31. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit request proves to have been false, incomplete, or inaccurate.

This action is being taken pursuant to Federal regulations printed in the Federal Register on November 13, 1986, concerning permits for activities in waters of the United States. These regulations state the U.S. Army Corps of Engineers' responsibility for regulating structures or work in or affecting waters of the United States under Section 10 of the Rivers and Harbors Act of 1899 (30 Stat. 1151; 33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344).

General Permits may be issued for a category or categories of activities when: (1) those activities are substantially similar in nature and cause only minimal individual and cumulative environmental impacts; or (2) the General Permit will result in avoiding unnecessary duplication of the regulatory control exercised by another Federal, state, or local agency, provided it has been determined that the environmental consequences of the action are individually and cumulatively minimal. The determination that the proposed activities comply with the requirements for issuance of General Permits will be made using information which will be available for inspection at the respective District offices: Vicksburg District's Regulatory Branch, 4155 Clay Street, Vicksburg, MS 39183-3435; Memphis District's Regulatory Branch at 167 North Main, Rm B-202, Memphis, TN 38103-1894; and Little Rock District's Regulatory Branch, 700 W. Capitol Ave., Little Rock, AR 72203.

Authorization to conduct work under this General Permit will not negate the responsibility of the applicant to obtain other state or local authorizations or permits required by law for the proposed activity. Authorization also will not

convey any property rights, whether in real estate or material, or any exclusive privileges. Furthermore, no injury to property or invasion of rights or any infringement of Federal, state, or local laws or regulations is authorized.

REQUEST FOR AUTHORIZATION UNDER THE GENERAL PERMIT: IN ORDER TO BE AUTHORIZED BY THIS GENERAL PERMIT, PERSONS PROPOSING THE WORK ARE REQUIRED TO SUBMIT TO THE APPROPRIATE DISTRICT ENGINEER, IN WRITING, THE FOLLOWING INFORMATION FOR A DEPARTMENT OF THE ARMY PERMIT AT LEAST 30 DAYS PRIOR TO CONDUCTING THE WORK:

The respective District addresses are: Mr. Mike McNair, Vicksburg District Regulatory Branch, 4155 Clay Street, Vicksburg, MS 39183-3435; Mr. Larry Watson, Memphis District Regulatory Branch, 167 North Main, Rm. B-202, Memphis, TN 38103-1894; and Mr. Jerry Harris, Little Rock District Regulatory Branch, PO Box 867, Little Rock, AR 72203-0867.

a. Letter requesting a Department of the Army Permit: Arkansas GP-GTR.

b. Statement that the work will be conducted in compliance with the terms and conditions of the General Permit and will not adversely impact adjoining properties (i.e. increase flood depths and/or durations).

c. Location map (preferably from a USGS quadrangle map) showing the proposed worksite (including section, township, range, and county). The map should also show existing impoundments (GTR's, lakes, irrigation reservoirs, etc.).

d. Plan map or drawing showing the proposed and existing water control structures and levees. The structures and levees will be labelled existing or proposed.

e. Detailed topographic survey of the site.

f. Cross-sectional and linear drawings of any proposed water control structures and levees and associated borrow ditches, including dimensions and amounts of excavated and fill material in cubic yards.

g. A description of the present conditions of the project site and the proposed activity, its purpose, and intended use. The description will contain a written list and plan maps of all dominant plant species, soils, and hydrology parameters.

h. Estimated starting and completion dates of construction.

i. A water-level management plan that will indicate flooding and dewatering tactics, flood dates, flood depths, measures to mimic natural hydrology, etc. Applicants may contact their appropriate Arkansas Game and Fish Commission, U.S. Fish and Wildlife Service, Natural Resources Conservation Service or State Forestry Commission for technical assistance in developing a water-level management plan. The plan will include a time schedule describing the dates of flooding and draw-down, and the duration of time necessary to achieve the intended water-level fluctuation proposed during the period of impoundment.

After reviewing the information submitted, the District Engineer will advise the inquiring party in writing whether the work is authorized under the General Permit; will request additional information, if needed; or will advise that the proposed activity will require an individual permit.

The decision whether or not to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the activity on the public

interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits which reasonably may be expected to accrue from the project must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the project will be considered, including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people.

If you wish to obtain additional information on the General Permit, Arkansas GP-GTR, please contact Judy O. DeLoach at the U. S. Army Corps of Engineers, 167 North Main, Room B-202, Memphis, Tennessee 38103-1894, telephone 901/544-0737, E-mail judy.o.deloach@mvm02.usace.army.mil

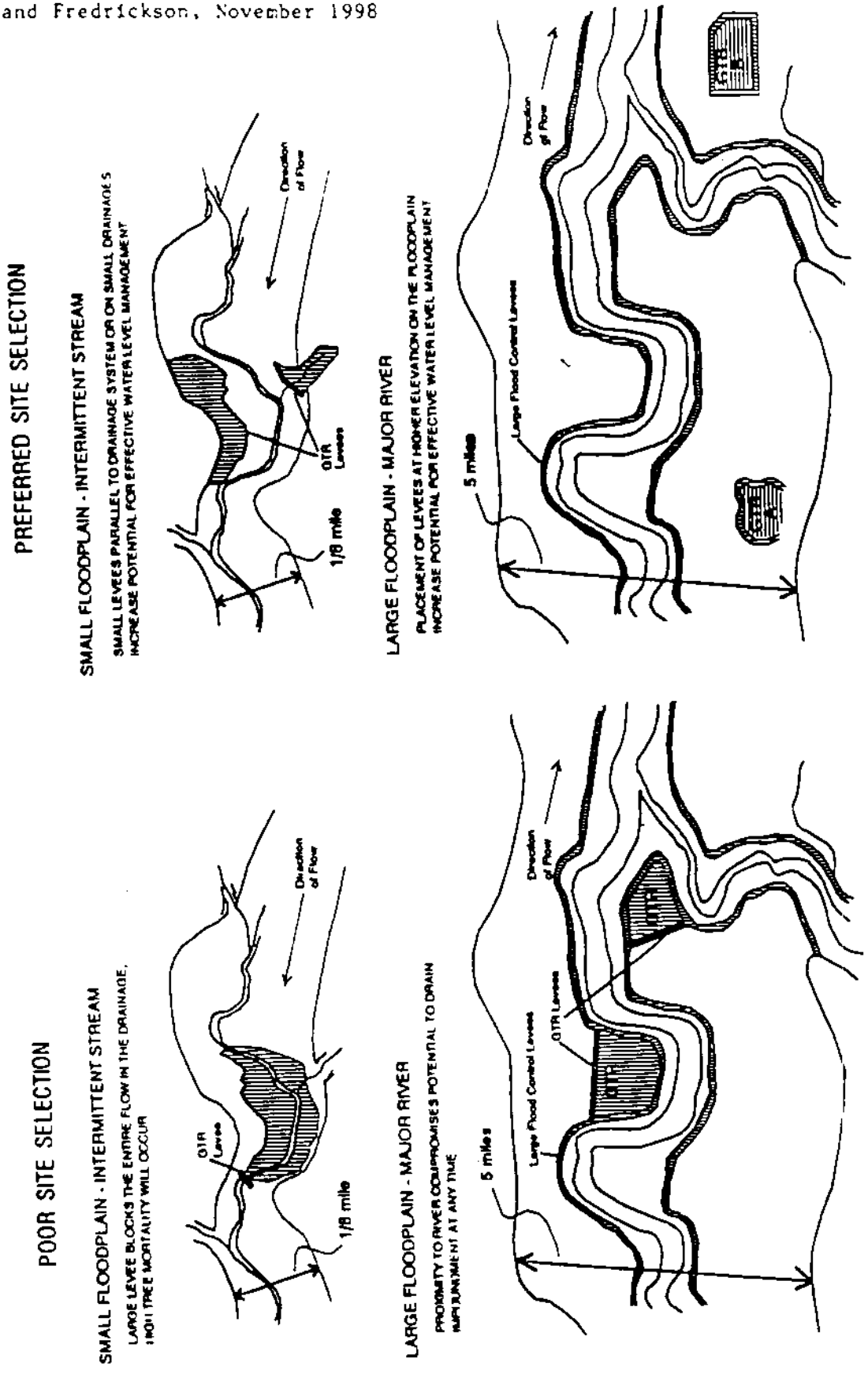
SIGNATORIES

Daniel W. Krueger
Colonel, U.S. Army
District Engineer
Memphis District

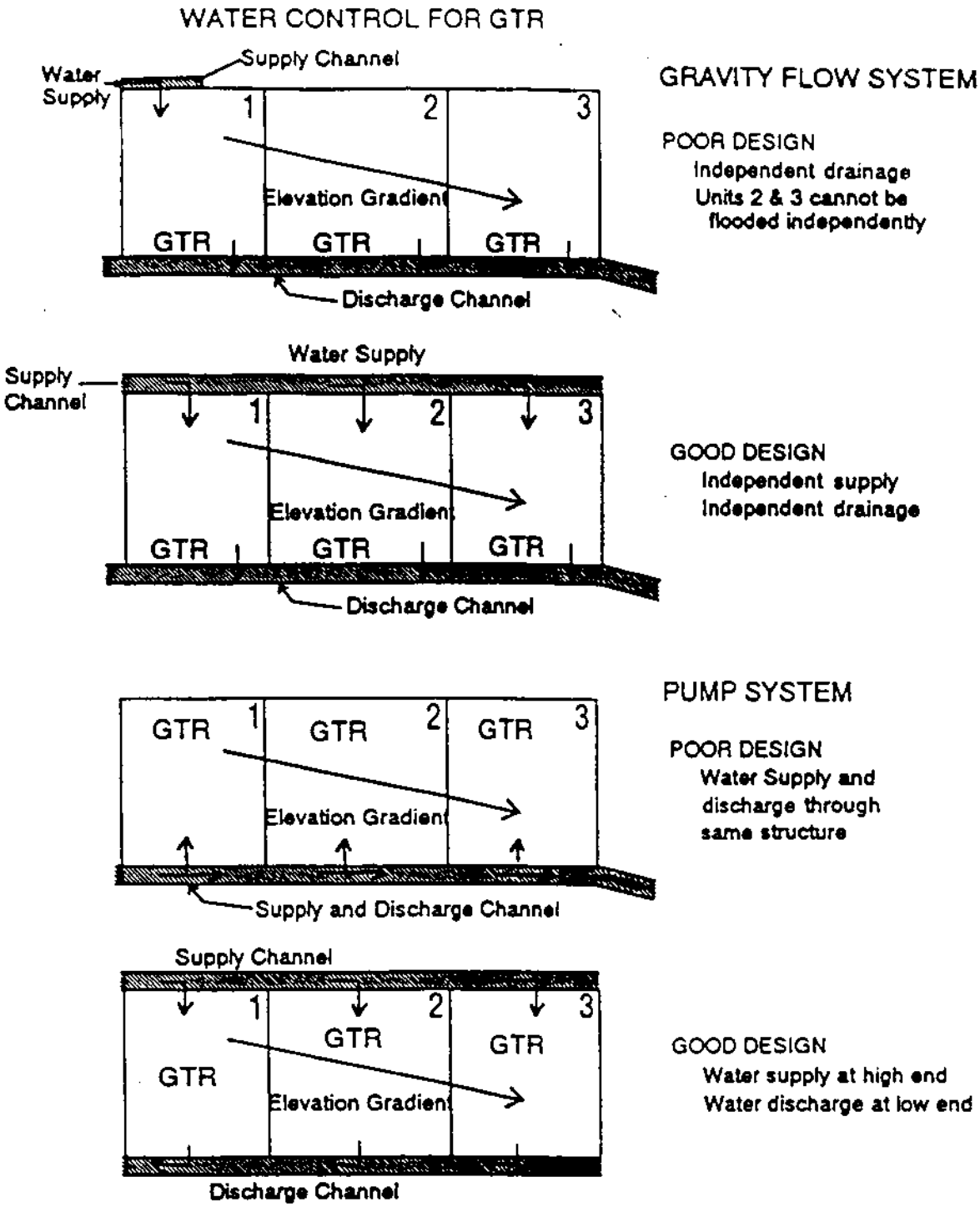
Thomas A. Holden, Jr.
Colonel, U.S. Army
District Engineer
Little Rock District

Robert Crear
Colonel, U.S. Army
District Engineer
Vicksburg District

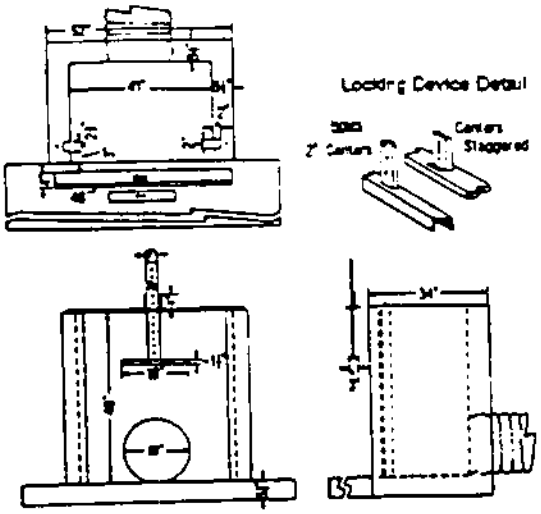
Enclosures



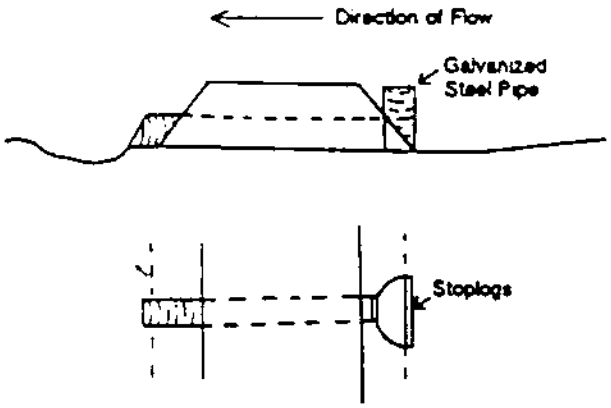
ENC 1. . Site selection for greentree reservoirs in large and small floodplains.



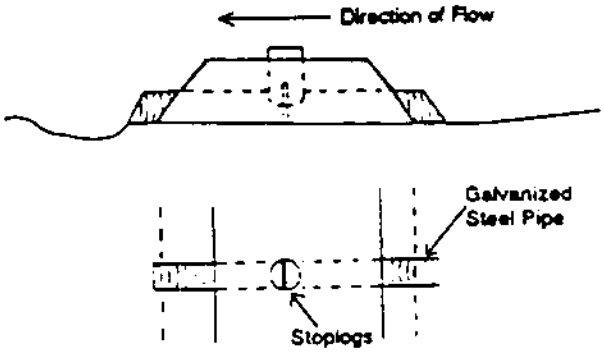
ENC 2. Common designs for water supply and discharge in GTR's Poor designs lack the potential for independent control of water within an impoundment.



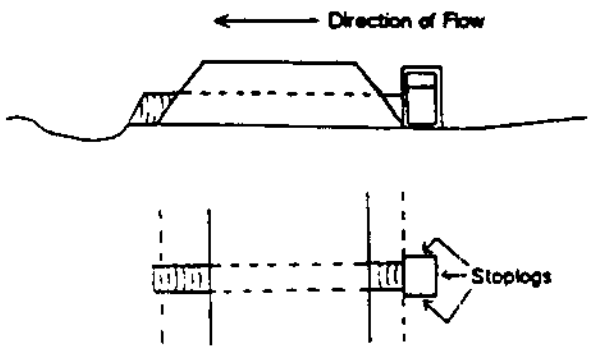
A. STANDARD STOPLOG STRUCTURE



B. HALF-ROUND GALVANIZED STEEL RISER

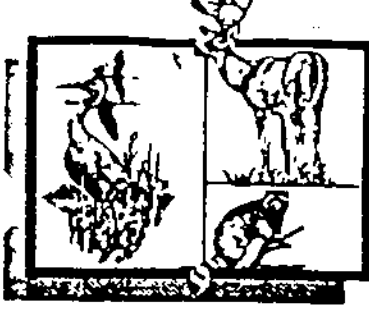


C. INLINE GALVANIZED STEEL RISER



D. STEEL BOX RISER WITH THREE SETS OF STOPLOGS

ENC 3. Examples of cost effective stoplog water-control structures. Size of structure is dependent on area to be drained.



THE CLEMSON BEAVER POND LEVELER

DEPARTMENT OF AQUACULTURE, FISHERIES AND WILDLIFE

The Clemson Beaver Pond Leveler (Figure 1) was developed to meet two goals. The need to suppress the problem of flooding agricultural and timber lands was paramount. The second goal was to maintain or improve some of the benefits derived from beaver ponds and associated plant communities while preventing extensive flood damage. The leveler does not negate the need for direct control of beaver populations where problems are both extensive and severe; however, it may reduce this need. The leveler offers the opportunity to get along with, and in some cases, derive benefits from the existence of a few beavers.

How the Leveler Functions

The pond leveler intake device is designed to minimize the probability that current flow can be detected by beavers, therefore minimizing dam construction. Device testing at about 30 sites in South Carolina during the past three years has shown that beavers were unable to detect a submerged intake device as the source for pond water loss. The intake device should be installed so that it is always below the water surface even when the pond level is at a minimum.

A second stimulus that causes beavers to build dams and fill culverts and standpipes is the sound of falling or trickling water. When the outlet end of the leveler assemblage can be below water on the downstream side of a dam, problems should not develop. At test sites where standpipes have been used and water flows out in a fountain-like fashion, beavers have made no attempt to stop water flow. Stand-pipes regulate the water levels in the ponds and are essential where periodic drawdown and reflooding is desirable.

Special Considerations

The Clemson Beaver Pond Leveler device should help reduce flooding, manipulate pond levels, solve road culvert plugging problems, and prevent filling of standpipes and culverts used as water control structures in fish ponds. However, the leveler is not a panacea for eliminating all beaver problems. This particular design will be limited to situations where the water input to a pond is from a small stream or spring. During periods of unusually high rainfall, problems may develop. In fish ponds, where the leveler is used in combination with a standpipe and culvert water control structure (Figure 2), prolonged flow of water over the standpipe riser boards may cause beavers to fill the standpipe. To reduce this possibility, riser boards should extend about one foot above the normal water level so that storm water can be stored and drained slowly through the leveler.

Some indications suggest that where a pond was drained and the intake device was above water and near the dam, the beaver may be stimulated to construct the new dam on the upstream side of the device. It's important that the intake device be installed so that it is totally or mostly submerged at all times.

Leveler Installation at Active Beaver Sites

In the South, beaver activity levels are highly correlated with seasonal temperatures. Most dam-building, expansion, and repair occur during the cool months. If the leveler is installed at an active dam site, installation during this cool period is best. The dam can be dug out and the device laid in place. Beavers will rebuild over the outflow pipe, which will not deter water flow through the pipe.

Beaver dams can be dug out by hand more easily than most people imagine using a fire-fighting tool called a pulaski. A pulaski has an ax bit on one side and a mattock on the other. Dams should be broken first on the downstream side so that water pressure can be used to push out dam materials.

When parts of a leveler assemblage have to be transported across a stretch of water, they can easily be floated. Ends of outflow pipes are taped over with water-resistant tape. The pipes are then tied together to form a raft. The intake device and other assemblage parts are set on the raft and floated to the site.

For further information on the Clemson Beaver Pond Leveler contact Dr. Gene W. Wood, Mr. Larry A. Woodward, or Dr. Greg Yarrow • Department of Aquaculture, Fisheries and Wildlife • G08 Lehotsky Hall, Clemson University, Clemson, South Carolina 29634, (803) 656-3117.

ENC 4.

A list of materials is provided in Table 1. The leveler design is shown in Figures 3 and 4.

Table 1. List of Materials

Quantity	Item
1	10' section, 10" dia. PVC pipe (Schedule 40)
1	PVC cap for 10" dia. PVC pipe (Schedule 40)
1	10" x 8" PVC pipe reducer coupling (Schedule 40)
4	86" sections, 3/4" dia. plastic roll pipe (water pipe), 160 psi grade
4	¾" metal couplings for roll pipe
16	¼" x 2" galvanized eyebolts
16	¼" galvanized nuts
16	¼" galvanized washers
16	16" sections, 8 ga. galvanized wire (medium hardness)
2	96" sections, 2" x 4" 12 ½ ga. galvanized welded wire
2 lbs	Crab trap clamps (fasteners)

The above materials are required to assemble the intake device for the Clemson Beaver Pond Leveler. The carrying pipe (flow pipe) may consist of 20 to 40 feet of 8" diameter PVC, Schedule 40 with coupling sleeves and elbows appropriate to the desired configuration.

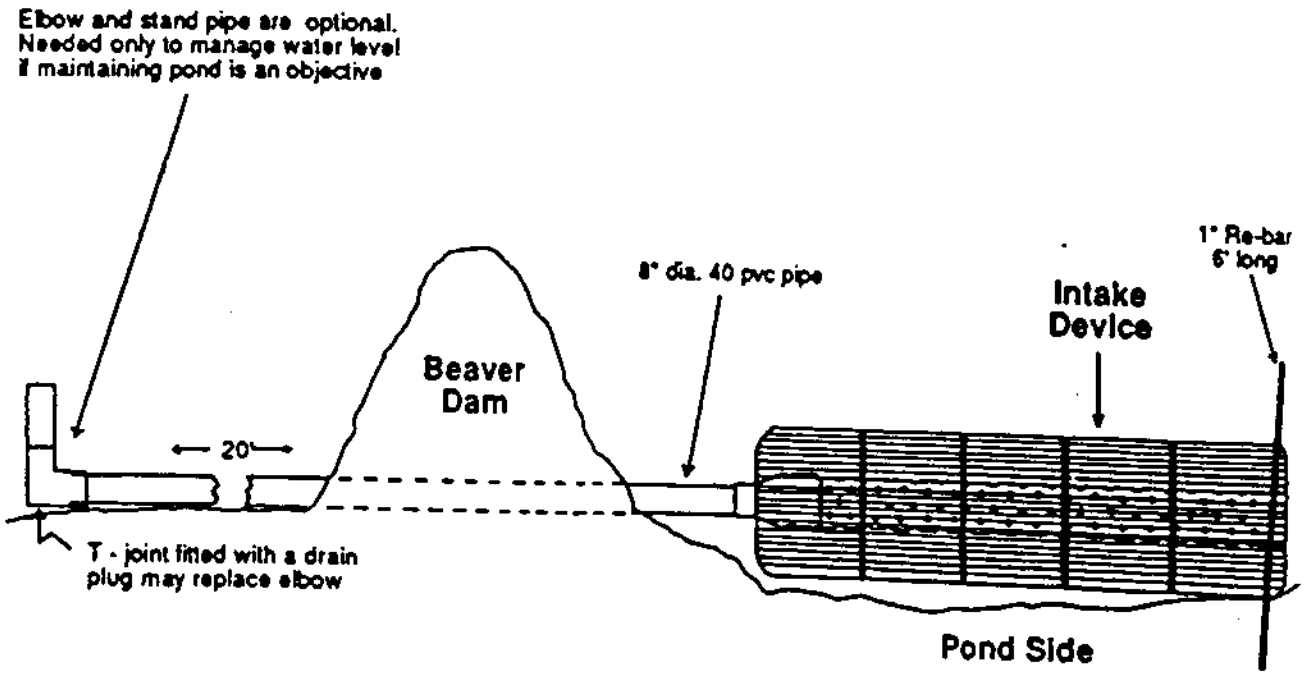


Figure 1. Clemson Beaver Pond Leveler

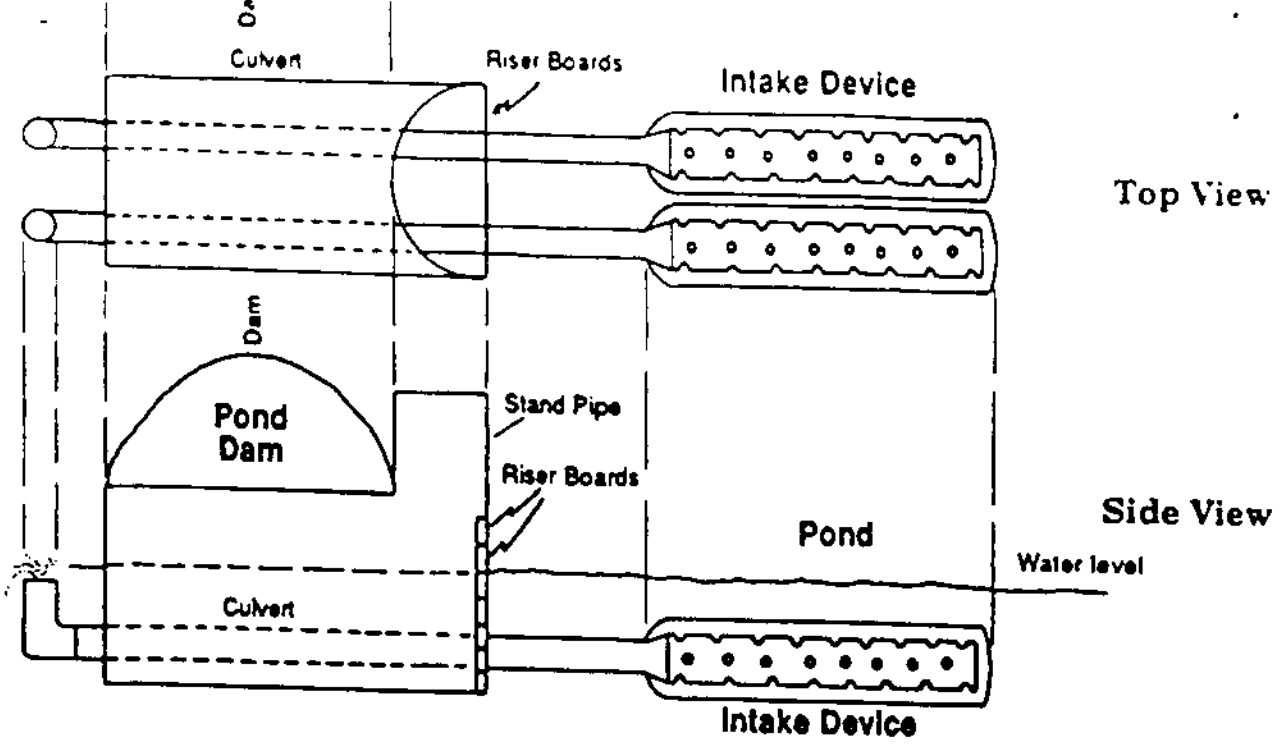


Figure 2. Beaver Pond Leveler in Combination with Fish Pond Standpipe-Culvert Water Control Structure

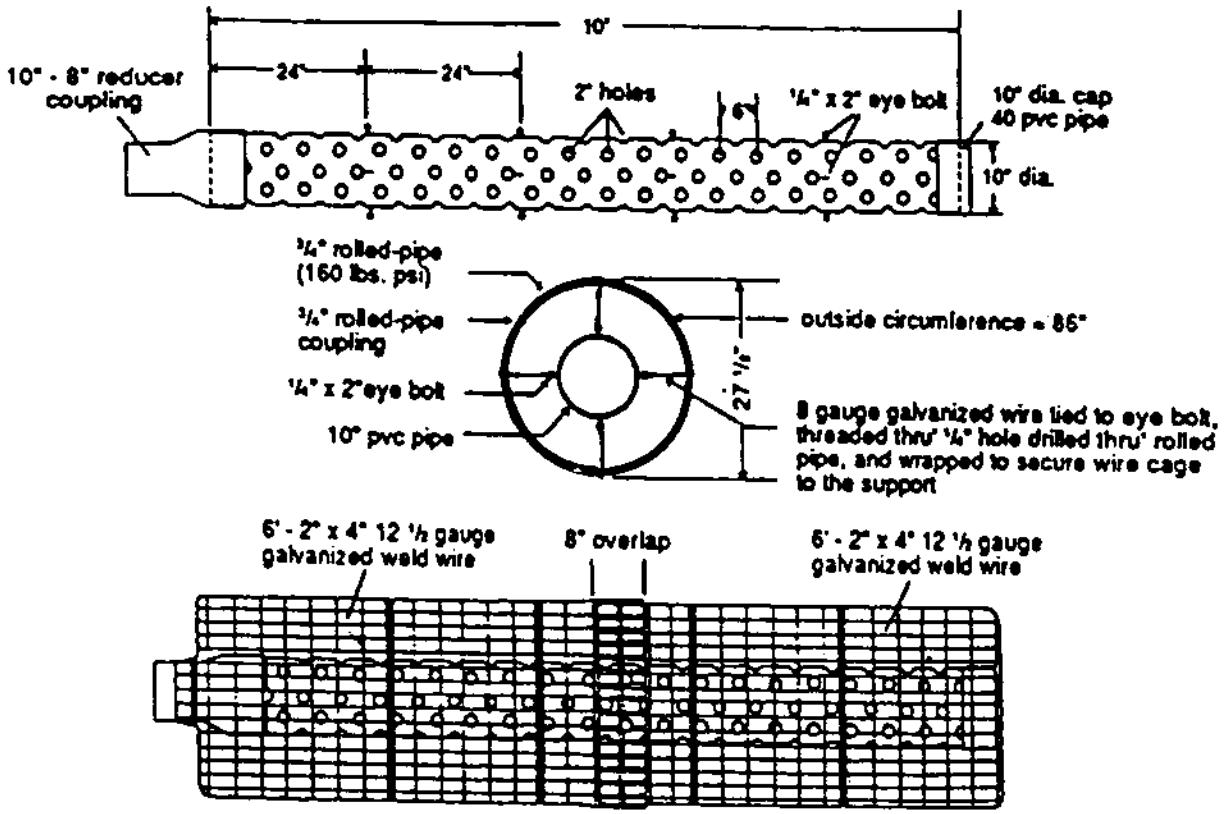


Figure 3. Design of Intake Device

Clemson Beaver Pond Leveler

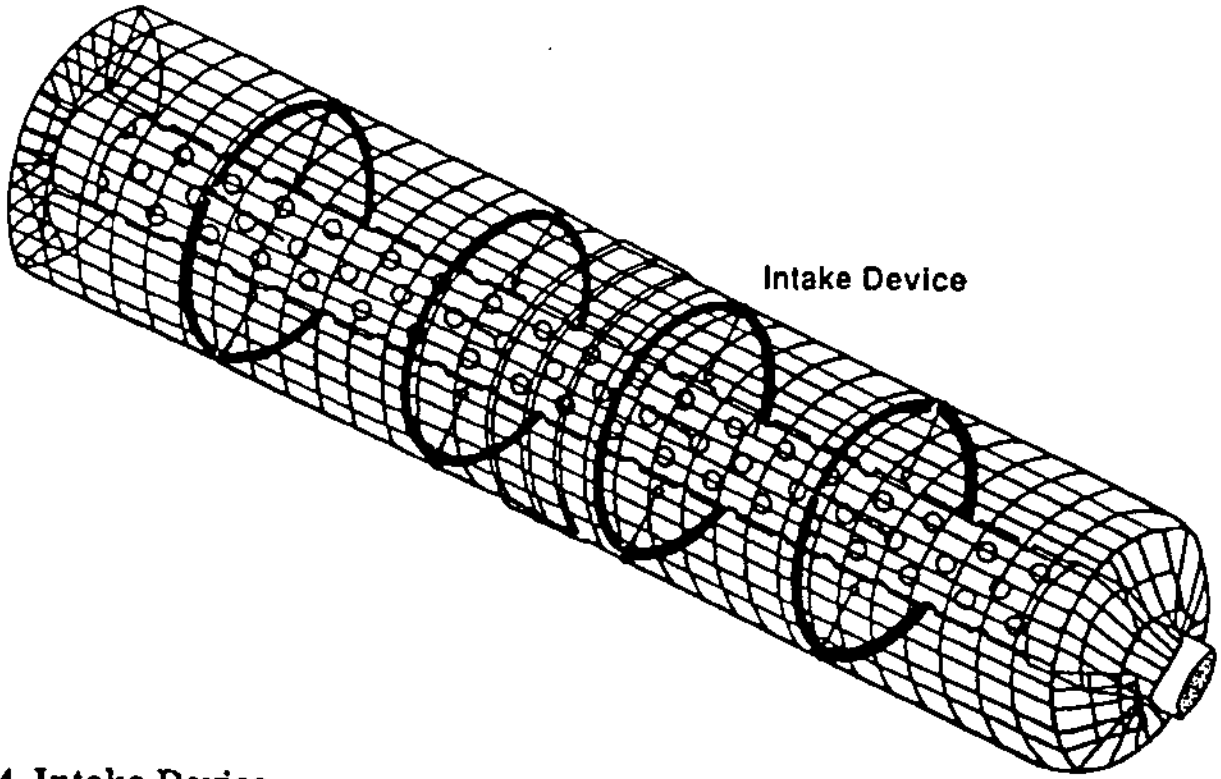


Figure 4. Intake Device

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—MONITORING

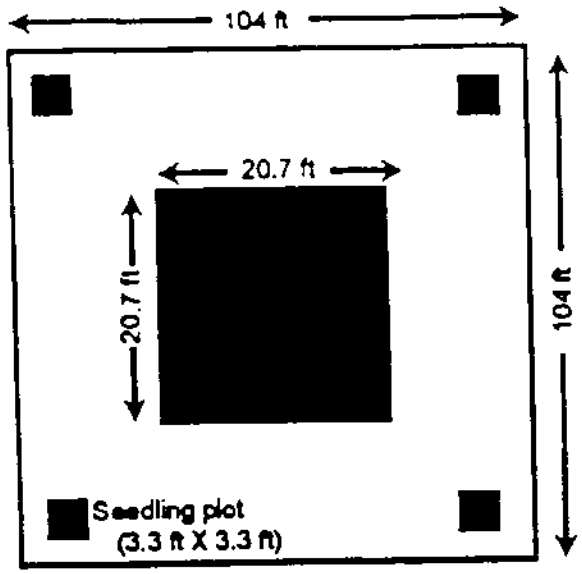
The monitoring phase is essential to evaluate the success of management activities, to make necessary adjustments to improve habitat management strategies, and to prevent damage to the integrity of the BLH forest. In essence, monitoring of GTRs can be conducted at 2 levels: (1) an evaluation of impoundment conditions to prevent ecological damage; and (2) an assessment of habitat quality through more intensive assessments of plant and animal communities. For purposes of this document, we will only address the former monitoring scheme.

Monitoring in GTRs is particularly critical because of the amount of damage that can occur in a short period if flooding extends into the growing season. An effective monitoring plan should assess water conditions, tree stress, regeneration conditions, and species composition changes. Monitoring is not meant to be research, therefore, some of the limitations associated with research such as random samples do not necessarily apply. Systematic sampling is advantageous because there is the potential to assess general conditions throughout an impoundment. Plots should be established within representative plant communities, elevations, timber-management tracts, or other areas that may provide unique information about the impoundment or management activities. Plots should be replicated and if conditions warrant, other plots should be added to monitor problem areas. Several hydrologic and vegetation variables should be measured at varying time intervals (Table 3).

The overall plot should be at least 0.25 acres in size (Fig. 12).

Table 3. Overview of minimum and intensive sampling strategies for GTRs. GTR managers can use these methodologies to help prevent ecological damage to the GTR area. An assessment of habitat quality through more extensive and intensive sampling of plant and animal communities is not covered in this handbook but is recommended for land managers.

Strategy	Variable	Sampling scheme	Information	Frequency of sampling
Minimum	Overstory	Plots	DBH Species Composition Buttressing P/A Crown Class	Pre-impoundment; every 7–10 yrs
			Stress Class	Pre-impoundment; annually
	Regeneration	Transects	Presence/Abundance and Composition	Pre-impoundment; annually in fall prior to flooding
	Water	Plots	Depth	Pre-impoundment; every 2 weeks in growing season first 2–3 yrs; minimum of monthly thereafter
Intensive				
	Overstory	Plots	DBH Species Buttressing P/A Crown Class	Pre-impoundment; every 5 yrs
			Stress Class	Pre-impoundment; annually
	Shrubs/Saplings	Plots	DBH Species	Pre-impoundment; every 5 yrs
	Regeneration	Plots	Species Height (subsample)	Pre-impoundment; every 5 yrs
	Water	Plots	Depth	Pre-impoundment; every 2 weeks



Plot Design

Figure. 12. Layout of an intensive monitoring plot. Minimum monitoring procedures should include the 104 ft. x 104 ft. overstory sampling plot.

As an absolute minimum, water depth, and the diameter, species, presence/absence of butressing, and crown class of all trees (> 6.0 inches diameter-at-breast height (dbh)) should be measured and recorded. Water depths should be measured at the center of each whole plot every 2 weeks during the growing season for the first 2–3 years of management. Intensive sampling during the first few years is necessary to evaluate flooding patterns on the site and to identify potential drainage problems resulting from topography or beavers. If beavers are not a problem and topography is not limiting drainage, then water-level sampling can be moved to once per month.

The placement of numbered tags on all trees are helpful (Note: Aluminum nails should be used and 0.5" or more of the nails should be left on the outside of the tree to allow for tree growth. In subsequent samples the nails should be readjusted to allow for additional growth). Canopy condition must also be assessed based upon the coloration of leaves and mortality of branches within the crown. Some suggested crown stress classes are as follows: 1) none to 5% of crown dead; 2) 6 to 25% of crown dead; 3) 26 to 50% of crown dead; 4) 51 to 75% of crown dead; 5) 76 to 95% of crown dead; 6) 96 to 100% crown dead; and 7) tree is dead and most or all branches have deteriorated and fallen. The presence, composition and abundance of regeneration should be determined and incorporated into the annual water-management plan as described above. The minimum assessment of seed production and the abundance and composition of regeneration can be accomplished by establishing transects in the impoundment and traversing these in the fall (September). It is particularly important that the transects provide an overview of all communities, thus selection of transect location is a critical component of monitoring.

Additional vegetation data could be collected to provide a more thorough assessment of water-management activities on vegetation. This can be accomplished by establishing a 0.01 acre subplot centered within the whole plot. Five seedling plots (3.28 ft X 3.28 ft) should be placed in each corner and at the center of the whole plot. In each of the 0.01 acre subplots, the diameter and species of all saplings and shrubs (> 4.5 ft tall but < 6.0 in dbh) should be recorded. The species of all seedlings should be recorded in each of the seedling plots. This information will enhance the ability of managers to detect gradual, long-term shifts in vegetative communities at an early stage and allow for corrective actions in a timely manner. Early detection of problems with seedling and sapling abundance and composition can provide valuable insights into compositional changes and can prevent a degradation of habitat quality. For example, a total lack of seedlings or seedlings of only the most water-tolerant species suggests that either mast failure, germination, or establishment of the less water-tolerant species are occurring and water-management activities should be carefully scrutinized. Appropriate corrections should be made to prevent compositional shifts and/or mortality of less water-tolerant tree species.

Regardless of whether the minimum or intensive approach is used, all vegetation should be measured prior to construction of the GTR. Tree stress and a visual estimate of the abundance and composition of regeneration should be measured on an annual basis (Table 4). Annual water-management plans should carefully consider tree stress values. Impoundments should not be flooded if trees are stressed regardless of what the long-term water-management plan dictates.

Indicators of flooding stress on bottomland trees and potential for recovery

Condition	Probable cause	Potential for recovery
Yellowing of leaves (Chlorosis)	Saturated soils and/or shallow flooding during the growing season	Good if flooding frequency and duration reduced. Do not flood for at least 2-3 years or longer if trees do not recover
Loss of flowering	Saturated soils and/or shallow flooding for extended period during dormant and growing season	Good if flooding frequency and duration reduced
Canopy thinning (fewer leaves produced)	Saturated soils and/or shallow flooding for part of the growing season for 2 or more years	Fair if flooding frequency and duration reduced. Do not flood for at least 2-3 years or longer if trees do not recover
Butt swelling on red oaks	Dormant season flooding at same depth, duration and timing for 10 or more years	Fair if flooding frequency, duration, and depth is changed to be dynamic within and among years
Tip die-back	Long-deep flooding in dormant season and extended flooding in 2 or more growing seasons	Fair when first noticed, but trees most likely have reduced vigor and will have increased mortality in next 5 to 7 years. Do not flood for at least 2-3 years or longer if trees do not recover
Large dead branches (2" or more in diameter)	Long-deep flooding in dormant season and well into and during the growing season	No reversal possible