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Questions and Answers on Rehabilitation of Deep Creek Watershed Dams 19A and 21 Yadkin County, NC

Background: The Deep Creek Watershed Plan was authorized for implementation in January 1958 under the authority of the Watershed Protection and Flood Prevention Act (PL-566) as amended. The original plan called for land treatment in the upstream watershed, 17 flood control dams, and 39.7 miles of stream channel improvements. Supplemental Watershed Plan (#1) was approved in September 1958 to include the Yadkin County Commissioners as a co-sponsor of the project. Supplemental Watershed Plan (#2) was approved in September 1962 to delete the Tri-Creek Soil and Water Conservation District as a Sponsor and to add Yadkin Soil and Water Conservation District as one of the local sponsors. It also relocated flood control dam number 15 to an adjacent watershed. Supplemental Watershed Plan (#3) was approved in August 1966 to extend the installation period to June 1969, add 7,145 feet of stream channel improvement, and relocate and renumber 5 flood control sites.

Both Dam No. 19A and Dam No. 21 were built in 1961. Both dams are regulated by the State of North Carolina, Division of Dam Safety. At the present time, both dams require an upgrade in order to reduce the risk of dam failure and to meet NRCS and North Carolina Dam Safety criteria for a vegetated earthen auxiliary spillway.

Q. How do flood control dams work?

A. In a watershed without a dam, a flood event can be caused any time that precipitation creates more runoff than can be safely carried in the stream network. A flood control dam does two things. The most important one is that it detains water behind the dam so that flood water can be released slowly in amounts that match the capacity of the stream. Secondly, the dam traps sediment that would otherwise be transported downstream.

The main components of a flood control dam are the earthen embankment; the normal or sediment pool; the floodpool; the principal spillway; and the auxiliary spillway. The principal spillway riser and pipe control the day-to-day elevation of the water in the lake and provide for a controlled release of the water in the flood pool. The flood pool, which is the water storage area between the principal spillway crest and the auxiliary spillway crest, is designed to detain the water that would accumulate behind the dam in events equal to or smaller than an event with a 100-year annual recurrence interval. This storm is the event that has a one percent chance of occurring in any given year. In a bigger flood event, the water level will be higher than the crest of the auxiliary spillway and the excess water will pass around the dam embankment through the auxiliary spillway.

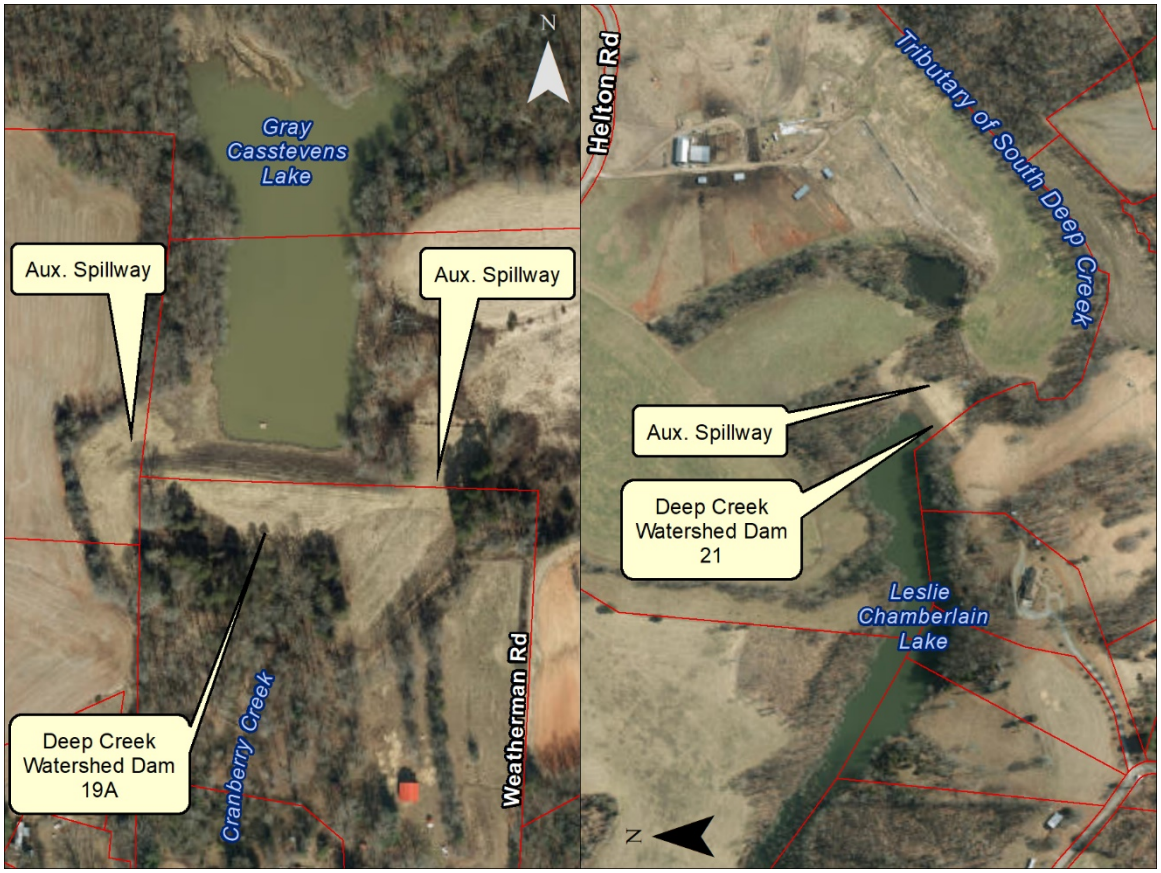
Sediment pool. The reservoir is designed to store sediment in the area below the elevation of the lowest principal spillway inlet and to detain flood water in the area between the lowest principal spillway inlet and the crest of the auxiliary spillway. After the dam is completed, water accumulates below the lowest principal spillway inlet to create a lake. As the lake fills with sediment, the amount of water in the lake decreases. When the sediment pool has filled to the elevation of the lowest principal spillway inlet, the pool no longer has permanent water storage, but the designed flood water detention storage is still intact. If the actual sedimentation rate is greater than the designed sedimentation rate, the sediment storage volume will be filled before the design life of the structure has been reached. The additional sediment would begin to fill the flood water detention volume above the lowest principal spillway inlet and reduce the available flood storage. Initially, sediment delivered to the reservoir would pass directly through the lowest principal spillway inlet. Eventually, this inlet would be blocked by debris and sediment and the level of the water would rise to the crest of the auxiliary spillway. Watershed dams 19A and 21 were planned for a design sediment life of 50 years.

As the flood pool loses storage due to sediment deposition, the auxiliary spillway operates, or has flowage, more often. For a vegetated earthen auxiliary spillway, repeated flows could erode the soil material and eventually cause the spillway to breach. Repeated flows increase the operation and maintenance costs for the Sponsors.

Principal spillway: A principal spillway has three main parts: the riser, the pipe, and the outlet. The riser is typically a concrete tower that controls the level of water in the lake. Most risers have a drain gate at the bottom of the riser that allows the lake to be completely drained. The elevation of the water in the lake is determined by the amount of sediment that has to be stored over the life of the dam. For a two-stage riser, the water flows through the first-stage inlet in the riser until the water rises to the elevation of the second-stage inlet. Then, it flows through both inlets. The water falls to the bottom of the riser before exiting through the principal spillway pipe. The principal spillway pipe conveys water through the dam safely. The water exits into an outlet structure, typically called a stilling basin. Its purpose is to slow the velocity of the water leaving the pipe so it doesn't cause erosion in the stream channel. For dam 19A, the principal spillway is a 18-inch pipe and dam 21 has a 30-inch diameter principal spillway pipe.

Auxiliary spillway: There are four parts of an auxiliary spillway. The inlet section is on the side closest to the lake. It has a gentle upward slope toward the middle of the auxiliary spillway. The water that reaches the inlet section has little or no velocity and, therefore, does not cause erosion to occur. The level center section is called the control section. The control section is usually located where the auxiliary spillway crosses the centerline of the top of the dam. The purpose of the control section is to make the water in the auxiliary spillway spread out evenly rather than concentrate into little channels. The third section is called the constructed outlet. Its purpose is to keep the water flowing out of the auxiliary spillway in a controlled manner until the water gets far enough away that it will not cause erosion on the earthen embankment itself. Once this point is reached, the water is free to go on downstream. The fourth component of an auxiliary spillway is the training dikes. Training dikes are used in conjunction with the outlet section to direct the flow of the water away from the back side of the dam embankment. Training dikes can also be used in the inlet section to direct water into the auxiliary spillway.

The Deep Creek Dams were originally designed to store all the floodwater from the 100-year, 10-day storm. In storm events that are larger than the design storm, water passes through the auxiliary spillway rather than overtopping the dam.



Deep Creek Dam No. 19A Deep Creek Dam No. 21

Q. What is wrong with the dams?

A. The hazard classification of both dams has been changed by the North Carolina Division of Dam Safety from low hazard to high hazard. This change in hazard classification means that the auxiliary spillways of the dams must be upgraded to meet more stringent performance criteria than those required when the dams were built. The capacity must be sufficient to pass the volume of water associated with the Probable Maximum Precipitation (PMP) without overtopping the dams.

A breach would cause a very quick release of all of the water impounded behind the dam. Little or no warning would be available to people downstream.

Q. What does "hazard class" mean?

A. All impounding structures are grouped into one of three hazard classifications. For the purposes of this classification, hazards pertain to potential loss of human life or damage to the property of others downstream from the impounding structure in the event of failure or faulty operation of the impounding structure or appurtenant facilities.

Hazard potential classifications are:

1. High Hazard Potential: an impounding structure failure will cause probable loss of human life or serious economic damage.

2. Significant Hazard Potential: an impounding structure failure may cause the loss of human life or appreciable economic damage.

3. Low Hazard Potential: an impounding structure failure would result in no expected loss of human life and would cause no more than minimal economic damage.

The performance criteria for a dam is based upon the hazard class. An auxiliary spillway of a high hazard dam must be able to safely pass the volume of water associated with an event that hydrologists call the "Probable Maximum Precipitation" or "PMP".

Q. Who is responsible for the upkeep of these dams?

A. The dams are owned, operated, and maintained by the Yadkin Soil and Water Conservation District.

Q. Are the dams structurally safe?

A. The evaluated life of the originally constructed dams was 50 years. By all visual appearances, they are both in good physical condition. The earth embankments are stable and the principal spillways are functioning appropriately. The auxiliary spillways are well vegetated and stable. The internal integrity of the principal spillways and the gates that control the water level of the lakes and allow the lakes to be drained for repairs, if needed, appears to be good. An assessment of the overall integrity of the structural components will be needed as we move forward with rehabilitation to assure that the dams continue to provide flood control for at least the next 50 years.

Q. If water has never flowed through the auxiliary spillway at either dam, why are we concerned?

A. The easy answer is "because it is the law." However, there is a more complex answer. As with many engineering practices, as the risk increases, the necessary factor of safety increases. Both dams were built as a "Low" hazard dam because there was no potential for threat to loss of life in the event of a dam failure at the time of construction. Today there is more development and infrastructure in the downstream floodplain. Both of the dams are now classified as a "High" hazard dam because a breach of the dam would cause probable loss of life or serious economic damage. By rehabilitating these dams to meet the necessary dam safety standards, we are reducing the risks associated with these dams to an acceptable level.

Q. What is the role of the federal government?

A. The role of the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) in rehabilitation of our nation's aging watershed dam infrastructure is spelled out by Public Law (PL) 83-566, as supplemented by PL 106-472, otherwise known as

"The Small Watershed Rehabilitation Amendments of 2000". Congress recognized that the nation has a large number of small watershed dams, such as Deep Creek Dams 19A and 21. Since 1948, federal assistance through NRCS has been used to install more than 11,000 small dams across the country to provide public benefits such as flood protection, recreation, municipal and industrial water supplies, etc. These dams are part of our nation's public infrastructure just as roads and bridges are, and like roads and bridges, they require annual maintenance and eventual replacement as they reach the end of their designed useful life.

Q. What actually does the federal dam rehabilitation legislation require for dams to be rehabilitated?

A. Anticipating a growing need to rehabilitate these dams, Congress passed legislation in November of 2000 to allow the NRCS to work with local dam owners to determine the technical needs and feasibility of rehabilitating our aging dams. Scientific understanding of the functions and values of dams, and the associated environmental issues and concerns have increased substantially since the 1950's, 60's and 70's when most of the nation's small dams were constructed. These laws are designed to: 1) better protect public safety and the environment; 2) assure sound technology is used; 3) assure economic justification and 4) make sure that federal projects have public support. Specifically, Congress mandated that federal technical and financial assistance be provided only:

- Where there is local leadership and decision making, typically led by a local watershed steering committee with full public participation by all affected individuals and parties; and
- Within the context of the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), Section 7 of the Endangered Species Act, and the Principles, Requirements, and Guidelines (PR&G) for Implementing Water and Land Related Resources Implementation Studies and Federal Water Resource Investments.

NEPA requires that environmental considerations be central to any federal investment that alters the landscape and our natural resources. NHPA requires that historic preservation (cultural and historic resources) be considered, and appropriately dealt with, whenever federal funds result in physical changes on the landscape. Section 7 of the Endangered Species Act, directs all Federal agencies to ensure that any action they authorize, fund, or carry-out does not jeopardize the continued existence of an endangered or threatened species or designated or proposed critical habitat. PR&G state that Federal investments in water resources as a whole should strive to maximize public benefits, with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures.

Therefore, dam rehabilitation supported by the NRCS requires planning and evaluation in view of identified social, economic, historic and environmental considerations. The end objective of this process is to only provide federal funds to projects that are technically and environmentally sound, socially acceptable, economically justified, and supported by grass-roots democratic processes.

Q. What does the NRCS planning process require?

A. The federal statute stipulates:

- that there must be local sponsors who support and lead the planning process;
- that NRCS technical expertise serve the locally-led planning process to arrive at any recommended works of improvement; and
- that the evaluation of alternatives includes:
    1) No action (termed the "future without federal investment", i.e., what happens if the federal government doesn't do anything);
    2) Decommissioning (removal of the dam through a controlled breach followed by stabilization of the site);
    3) Rehabilitation of the existing dam to establish a minimum projected useful life of 50 years (this usually involves consideration of several technically feasible solutions); and
    4) Identification of an alternative that meets National Economic Efficiency criteria (this may be one of the other alternatives or a combination of several).

When applicable, non-structural alternatives will be evaluated. These include relocation and/or flood-proofing of "at-risk" inhabited dwellings and other properties in the downstream floodplain to prevent possible loss of life and property should the dam breach. ("Non-structural" is a term that refers to not repairing the dam, but instead taking actions, such as elevating buildings, homes, roads, etc., and building small floodwalls around buildings to reduce future damages

Q. What does the planning process mean to the local people?

A. The planning process allows for public participation and input into the planning of the dam rehabilitation project. Local sponsors must initiate the process by applying for federal assistance. The sponsors (Yadkin County Commissioners and the Yadkin Soil and Water Conservation District) have made an application. The sponsors must also commit to supporting, leading and guiding the planning process. The sponsors must then support the process in practical terms by facilitating communication with the local residents, including hosting public information, education and participation meetings; by hosting environmental scoping meetings[1]; by providing guidance on what the local community desires to have happen; and by obtaining landowner permissions to allow access to private property for data gathering.

Q. What activities will need to be conducted in the watershed to complete the plan?

A. Planning for dam rehabilitation will involve a number of different actions. The local sponsors and general public should be willing to facilitate all needed investigations and analyses. The following investigations and analyses will be needed:

[1] Scoping is a federal planning term used to describe identification of relevant issues and concerns.

- Sediment surveys;
- Analysis of the rainfall and runoff characteristics and the stream hydraulics;
- Investigations and analysis of the dam's existing components, layout, and size for conformance to NRCS and State design criteria.
- Surveys of the downstream floodplain and the assets (homes, businesses, roads and bridges, and utilities that are in harm's way);
- Survey of upstream properties that may be in harm's way;
- Analysis of the expected flooding damages that would likely occur in the future;
- An assessment of the in-stream and in-lake plants and animals, and water quality, as well as the associated wetlands and upland areas immediately adjacent to the lake and stream and below the dam;
- An assessment of ecosystem services potentially impacted by the project; and
- Analysis of all required alternatives as well as any other alternatives identified in the planning process.

Q. What is the planning and implementation process?

A. For a typical dam rehabilitation project, the process should generally proceed as follows:

The Water Resource Planning Process

1) An application for federal assistance is made (already completed for these dams).
2) Upon authorization to act on the request, the NRCS initiates discussions on how to proceed (already underway).
3) Public meetings are held.
4) Contacts are made with local landowners to get their permission to conduct the needed surveys and investigations.
5) A scoping meeting is held to solicit the knowledge and ideas of other interested federal, state and local agencies, university scientists, etc.
6) The needed inventories, investigations, and analyses are initiated and completed.
7) Additional public meetings are held to inform the public of what has been learned and again solicit the ideas of the local leaders and members of the public.
8) A draft of a watershed supplement to the original Deep Creek Watershed Work Plan is prepared that contains the technical alternatives along with their associated economic, social, and environmental implications. One watershed supplement will be prepared for each dam.
9) An interagency and public review of the watershed supplement is carried-out. Comments are accepted and incorporated, as deemed appropriate.

10) The final watershed supplement is prepared and signed by the local Sponsors and NRCS State Conservationist.

11) The supplement is submitted to NRCS headquarters for authorization to implement the selected plan as soon as funds are available.

12) A design for the rehabilitation project is prepared.

13) When Congress and the local sponsors provide the needed construction funds, a detailed project agreement is developed between the NRCS and the sponsors. Preparation of a new Operation and Maintenance (O&M) Agreement and an Emergency Action Plan are also required prior to construction.

14) All necessary State and/or Federal environmental and related permits are obtained by the local sponsors.

15) The local sponsors will obtain any required easements prior to construction.

16) The competitive bidding process is used to select a construction firm.

17) The contractor performs the work under either a local contract administered by the Yadkin Soil and Water Conservation District or Yadkin County, or a federal contract administered by NRCS.

18) After completion of the rehabilitation, annual O&M is carried out, and annual safety inspections are made, by the local sponsors.

Q. How long does the planning process usually take?

A. Typically about 2 years.

Q. How long does the design phase usually take?

A. Typically 1-2 years are required from preparing a request for proposals to completion of the design.

Q. How long does the permitting phase take usually?

A. Getting the needed permits usually takes 2-4 months.

Q. How long does it take to actually implement a recommended solution?

A. The length of time it actually takes to perform the work depends upon the amount and complexity of the work undertaken. For example, relocation of properties out of the floodplain is a vastly different process than repair of an existing dam. Each alternative can also have unforeseen obstacles pop up that must be resolved. Assuming construction is the selected alternative, the entire implementation process from start to finish shouldn't take more than one year. This also assumes good weather conditions for construction and no mechanical issues.

Q. How does the federal cost/sharing work?

A. Federal funds for dam rehabilitation are authorized for 100% of the planning costs for developing the dam rehabilitation plan. If approved by NRCS, federal funds can also pay up to 100% of the design costs for the project. Federal funds can also cover up to 65% of the total costs of a project but will not exceed 100% of the actual construction costs incurred for rehabilitation. The local sponsors are responsible for the remaining 35%. Any nonfederal funds can be used as part of the local cost-share. Credits towards the sponsor's 35% share of the total cost include acquisition of land rights and valuation of in-kind contributions such as services provided by local staff. The cost of environmental permits will solely be the responsibility of the local sponsors. NRCS pays 100% of the technical assistance costs for planning and design and for all assistance provided by the agency.

Q. If we draw down the lakes before a storm, will that eliminate the need to rehabilitate the dams?

A. No. Drawing down the lakes by opening the gate at the bottom of the riser is a tricky proposition. It is very difficult to get the correct timing. A rapid drawdown of the lake water could cause mudslides across the face of the dam. A correctly done drawdown of the lake is unlikely to occur quickly enough to provide more flood water storage. In addition, if a piece of debris gets caught in the gate, it may not be possible to close the gate and all of the water will drain out.

Q. Will you have to dredge the lakes?

A. We are not sure yet. For the purpose of the rehabilitation program, NRCS must ensure that there is a minimum future life of 50 years. Both lakes will be surveyed to ascertain the amount of sediment currently in the lakes. Based on these surveys and estimates of future erosion and sedimentation, there will be a determination made regarding the future sediment storage in the lakes. As stated in the question about the purpose of a flood control dam, sediment accumulation is a normal and expected function of a dam.

Q. Will you have to drain the lake?

A. We don't know yet. During the planning process, NRCS has to evaluate all of the components of the dam to be sure that they will last for the life of the rehabilitated dam. Most of the parts of the dam are in good shape. However, the final decision cannot be made until the evaluation is complete.

Q. Rehabilitation seems to be a foregone conclusion. Are there any other choices?

A. If the dam is not rehabilitated to meet the current safety standards, the only other choice would be to remove it in its entirety. This would reduce the threat to loss of life from a dam

breach but could increase the flooding caused by fairly common rainfall events. Downstream flooding would occur more frequently.

Final Comments: At the end of the dam rehabilitation planning and implementation process:

1) The environmental, social and economic benefits of the end result should serve the public interests for at least the next 50 years.
2) The local sponsors, and public in general, should feel that the process worked effectively and responsibly to meet their needs; and
3) The entire process should have been conducted in a professional and open manner, supportive of our mutual values for fair and democratic public procedures.