

STATE OF WEST VIRGINIA

FULL PERFORMANCE EVALUATION OF THE

DIVISION OF ENVIRONMENTAL PROTECTION

Dam Safety Program

**DEP Should Consider More
Forceful Measures to Bring
Unresponsive Owners into
Compliance with the
Dam Safety Control Act**

OFFICE OF LEGISLATIVE AUDITOR
Performance Evaluation and Research Division
Building 1, Room W-314
State Capitol Complex

CHARLESTON, WEST VIRGINIA 25305
(304) 347-4890

June 2000

PE 00-12-170

JOINT COMMITTEE ON GOVERNMENT OPERATIONS

House of Delegates

Vicki V. Douglas, Chair
Earnest (Earnie) H. Kuhn, Vice Chair
Scott G. Varner
Douglas Stalnaker
James E. Willison

Senate

Edwin J. Bowman, Chair
Billy Wayne Bailey Jr., Vice Chair
Oshel B. Craigo
Martha Y. Walker
Sarah M. Minear

Citizen Members

Dwight Calhoun
John A. Canfield
Mayor Jean Dean
W. Joseph McCoy
Willard (Bill) Phillips, Jr.

Aaron Allred, Legislative Auditor
Office of the Legislative Auditor

Antonio E. Jones, Ph.D., Director
Performance Evaluation and Research Division

John Sylvia, Research Manager
Paul Barnette, Research Analyst

June 2000

TABLE OF CONTENTS

Executive Summary	3
Review Objective, Scope and Methodology	5
Issue Area 1: DEP Should Consider More Forceful Measures to Bring Unresponsive Owners into Compliance with the Dam Safety Control Act	7
FIGURE 1: Dams Under Dam Control Act	7
FIGURE 2: Deficient Dams by Ownership	9
FIGURE 3: DEP Inspections in FY 1999	13
FIGURE 4: Deficient Dams by Age	20
Image 1: Overtopping at Wetzel County Dam	10
Image 2: Erosion from Seepage at Lake Washington	11
Image 3: Before and After Spillway Erosion at Fisher's Creek	14

LIST OF TABLES

Table 1: Inspection Frequency After Construction by Hazard Classification	12
Table 2: Number of Non-Coal Dams by Time Since Last Inspection by Owners Engineer	12
Table 3: Dams <u>without</u> Certificate of Approval	14
Table 4: Number of Dams With Paid Annual Registration Fee by Year Paid	16
Appendix A: Transmittal Letter to Agency	23
Appendix B: List of Deficient Dams	27

Executive Summary

The Dam Control and Safety Act was adopted in 1972 and is designed to protect the lives and property of West Virginia citizens from dam failure. Responsibility for the Dam Control Act is vested in two different offices within the Division of Environmental Protection (DEP). The Office of Mining and Reclamation (OMR) is responsible for the oversight of 134 coal related dams, while the Office of Water Resources (OWR) is responsible for the oversight of 360 non-coal related dams.

Issue Area 1: DEP Should Consider More Forceful Measures to Bring Unresponsive Owners into Compliance with the Dam Safety Control Act.

Of the 360 non-coal dams, 42 have been identified as having major deficiencies. Thirty-nine of these dams are high-hazard, which means that there is the potential for loss of life if the dam should fail. No deficiencies have been identified for the 134 coal-related dams or for the 165 dams built by the United States Soil Conservation Service.

One of three major problems are prevalent in deficient dams: *inadequate spillways*, *seepage*, and *instability*. Inadequate spillway problems are predominantly the result of a change in design standard. In the late 1950's, the U. S. Army Corps of Engineers changed the design standard for spillways to be able to pass through water from a rainfall of 6.5 inches in 6 hours to 27.5 inches in 6 hours. Many dams were built prior to the design change, and therefore they are not in compliance. Seepage and instability are the result of poor construction and the age of the dam. Seepage and instability become a problem when they are allowed to continue unmonitored. Seepage can lead to dam failure in a matter of hours. Instability can also lead to dam failure. These problems are significant since many owners are past due in conducting required inspections and DEP spends a large portion of its time conducting construction inspections and less time conducting inspections on existing dams.

Many dam owners cannot make the necessary repairs to eliminate the deficiencies because of the relatively high costs. With respect to expanding spillways to comply with the new standard, the cost is not the only factor. There is also reluctance because the new standard is significantly higher than the previous standard. Comments made by some owners suggest the attitude that owners consider their dams to be structurally sound under the old standard, and that the new standard is unrealistically high.

Furthermore, many owner's of non-coal dams have been unresponsive to other requirements imposed upon them by the Dam Control and Safety Act. Many dam owners have not paid the annual registration fee and many have not submitted the required reports. Accordingly, there are only a few dams who hold a valid *Certificate of Approval*. DEP does have more forceful actions it can take under the law to bring dam owners into compliance, such as ordering dam reservoirs to be drained, or make necessary repairs to deficient dams and seek reimbursement from the owners. The DEP has ordered one dam reservoir drained recently (Lake Chaweve), and it indicated that it does not have

funding to repair deficient dams. However, given the serious nature of this issue, and the relatively poor conditions of some of the State's dams, DEP should consider using more forceful measures to ensure compliance with the Dam Safety Control Act.

Review Objective, Scope and Methodology

This review of the Dam Safety Program, is part of the Full Performance Evaluation of the Division of Environmental Protection (DEP), as required and authorized by the West Virginia Sunset Law, Chapter 4, Article 10, Section 11 of the West Virginia *Code*, as amended. The Dam Control and Safety Act was passed in 1972, shortly after the disaster at Buffalo Creek. The purpose of the Dam Control and Safety Act was to properly regulate dams to protect the health, safety, and welfare of people and property in this state.

The **objective** of this review is to determine the effectiveness of the Dam Safety Program, and what percentage of dams are in compliance with the Dam Safety Act. The **scope** of this report focused on regulatory activities performed by the Office of Water Resources (OWR), and the Office of Mining and Reclamation (OMR). The audit focused on the time period from the introduction of the deficient list (1995) to the 1999.

The **methodology** included a review of dam files, interviews with staff of OWR and OMR, interviews with West Virginia Soil Conservation Agency, as well as an on-sight inspection of several dams. Information was also utilized from OWR databases to determine inspection frequencies. This performance evaluation complied with **Generally Accepted Government Auditing Standards**.

Issue Area 1: DEP Should Consider More Forceful Measures to Bring Unresponsive Owners into Compliance with the Dam Safety Control Act.

On February 26, 1972 Pittson Coal Company's dam system at Buffalo Creek failed. The resulting disaster killed 125 people, injured 1,000, and left 4,000 people homeless. In the 1973 Legislative session, the Legislature proposed H.B. 501 which created the Dam Control Act. According to the *WV Code*, the purpose of the Dam Control Act is to:

Properly regulate and control (dams) to protect the health, safety and welfare of people and property of this state...The Legislature has ordained this article to fulfill its responsibilities to the people of this state and to protect their lives and private and public property from the danger of a potential or actual dam failure.

Responsibility for the Dam Control Act is vested in two different offices within the Division of Environmental Protection (DEP). The Office of Mining and Reclamation (OMR) is responsible for the oversight of 134 coal related dams, while the Office of Water Resources (OWR) is responsible for the oversight of 360 non-coal related dams. Of the 360 non-coal dams, 165 were built by United States Soil Conservation Service which is now known as the United States Natural Resources Conservation Service (NRCS) within the Department of Agriculture. According to *WV Code §22-14-2*, dams that are designed and built by the NRCS (165 dams) would not require review of plans prior to construction, nor would they require oversight during construction because of the high standards adhered to by the NRCS. However, after the dams are completed and turned over to private sponsors (primarily the West Virginia Soil Conservation Agency and municipalities), the dams are subject to the same oversight by OWR as all other non-coal dams. Figure 1 shows the breakdown of dams under the Dam Control Act.

Figure 1
Dams Under Dam Control Act



Coal Dams & NRCS Dams are in Good Condition, but Many Non-Coal Dams Have Serious Problems

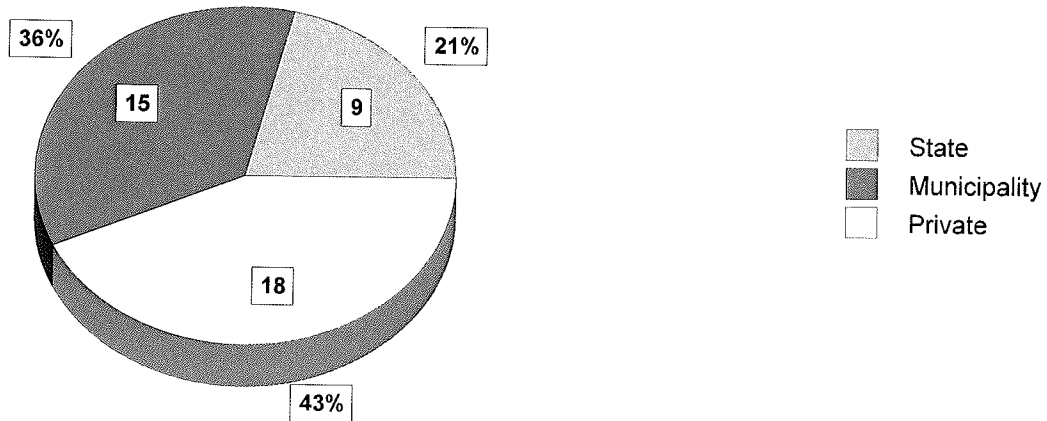
Major deficiencies have not been identified for coal-related dams or NRCS dams. This is due primarily because of adequate oversight during the planning and construction phase of these dams, and because of adequate maintenance after construction. NRCS dams are built to high standards and are adequately maintained by the West Virginia Soil Conservation Agency to prevent deficiencies. Coal-related dams are provided adequate oversight during the planning and construction phase and are maintained through frequent inspection by the OMR. Furthermore, with coal dams being part of the coal production permit, violations have been corrected in a relatively short period of time, since coal production could be interrupted by OMR if corrections are not made timely enough.

However, major deficiencies have been identified for many non-coal dams. The OWR maintains a list of deficient non-coal dams. Currently the list includes 42 dams across the state. Thirty-nine of these dams are high-hazard, which means that there is the potential for loss of life if the dam should fail. The majority of these dams were identified as deficient by the U.S. Army Corp of Engineers during a nationwide inventory of dams between 1978 and 1982. The list of deficient dams is contained in Appendix A.

The ownership of the deficient dams is illustrated in Figure 2. Twenty-four of the dams are owned by either the State (the Division of Natural Resources) or by municipalities. The remaining 19 deficient dams are privately owned, either by individuals, associations or clubs. DEP's effort to improve deficient dams has included notifying dam owners of the deficiencies and has ordered corrections to be made. However, **dam owners have been slow to respond to DEP orders** for a variety of reasons which are discussed further in this report. DEP could take more extreme measures to address deficient dams, such as ordering the dam reservoir to be drained, however, the agency has been reluctant to exercise this authority.

Figure 2

Deficient Dams by Ownership



Major Deficiencies are Inadequate Spillways & Seepage

As was previously mentioned, many dams were identified as being deficient during the National Inventory of Dams in the late 70's and early 80's. Prior to the national inventory, many of these dams were not regulated by the state, and were not being inspected by the owners (or their engineers) on a regular basis, nor were they subject to inspection during the construction process. Although the reasons vary why dams are deficient, three main problems seem prevalent. First, many dams have an inadequate spillway or emergency spillway. At least 26 of the 42 deficient dams have inadequate spillways. Second, many dams display signs of seepage. At least 20 deficient dams display signs of uncontrolled seepage. Third, many dams display signs of instability. At least 17 dams show signs of instability.

Inadequate Spillways

Prior to 1950, the generally accepted design standard for spillways was the 100 year storm. This meant that the dam had to pass enough water through the spillway so that the dam could withstand 4.5 inches of rain in a six hour period without overtopping. If water were to overtop the dam, it could erode the earth that helps keep the dam stable. In the 1950's, the U.S. Army Corps of Engineers decided that they wanted a new standard and requested that the National Weather Service (NWS) calculate the worst probable storm for a design standard. This led to the development of the Probable Maximum Precipitation (PMP) standard. The PMP standard is 27.5 inches of rain in a 6 hour period. However, this standard was not adopted in West Virginia as a design standard until after the Buffalo Creek disaster in 1972. Accordingly, when the Corps conducted the inventory, any dam (especially those built prior to 1972) that was built to the 100 year storm standard and not the new PMP standard was deemed to have an inadequate spillway. According to the OWR, the change

in the spillway standard lead to many dams being placed on the list of deficient dams. Furthermore, at least four dams are on the deficient list based solely on spillway inadequacy. Image 1 below shows a dam in Wetzel County that experienced overtopping which lead to the erosion of earthen material on the dam embankment.¹ The overtopping occurred during a storm in February 2000.

Image 1
Overtopping at Wetzel County Dam



Seepage and Instability

Seepage and instability are the other two problems frequent with dams on the deficient list. These two problems both stem from the same source. Prior to dams being regulated by the OWR, most dam owners wanted to minimize their construction costs. One way of doing this was to make the embankment of the dam as thin as possible. This was also combined with sub-standard core material in the embankment. Over time, water begins to seep through the embankment of the dam to the other side. According to the American Rivers Organization,

Water is an erosive and corrosive agent, which means that over time dams incur structural wear and tear that make them susceptible to failure. Structural integrity may be threatened on a regional basis by factors such as freeze/ thaw conditions, vegetation growth, and seismic disturbances.

When you consider that the life expectancy of a dam is 50 years and the average age of dams on the deficient list is 49 years, seepage and instability can be expected. Seepage will occur in most dams over time and it is not always a problem. Seepage becomes a problem when the water seeping through the embankment begins to carry away its core and face material. This condition is known as piping. Piping can lead to a dam failure in a matter of **hours** depending on the degree of piping

¹The Wetzel County Dam is not under the jurisdiction of the Dam Safety Program. The image serves to illustrate the problem of overtopping.

that is occurring and the thickness of the embankment.

Instability becomes a problem when the force of water pressure against the embankment of a dam exceeds the force that the dam exerts against the water. One way that this occurs is when debris blocks the spillway and emergency spillway and the natural watertable eventually rises. As the water table rises, the force of the water becomes greater than the dam was originally designed to handle. As the force of the water overcomes the force of the material which composes the dam, the dam can collapse and lead to failure. Image 2 shows the effects of water seepage at the Lake Washington Dam in Hurricane.

Image 2
Erosion from Seepage at Lake Washington



Inspection Frequency is Deficient

Piping and instability are two reasons why dams (especially deficient dams) need routine inspections. DEP is required by law (WV Code §22-14-9) to inspect dams during their construction. After construction is completed, owners are required to have periodic inspections conducted by an engineer. DEP may conduct inspections at any time after construction is completed. However, DEP is required to conduct an initial inspection of dams built prior to 1972 to determine what deficiencies, if any, would need to be corrected to bring the dam into compliance with the Dam Control Act.

The frequency of post-construction inspections is stated by Legislative Rule (CSR §47-34-15), which states that owners are to have dams inspected by a professional registered engineer annually for the first three years after a dam is completed. After the first three years, dams are inspected by varying frequencies depending on the hazard classification. Table 1 shows the

frequency of inspections by hazard classification².

Table 1
Inspection Frequency After Construction by Hazard Classification

Class 1 (high hazard)	At least once every two (2) years
Class 2 (significant hazard)	At least once every three (3) years
Class 3 (low hazard)	At least once every five (5) years

Table 2 illustrates the most recent inspection dates by an owner's engineer. Of the total number of dams, 67 dams have no record of an owner inspection ever being conducted. For the remaining 293 dams, many inspections are past due. Class 1 dams have 51% of the required owners inspections past due, 47% of class 2 dams have past due inspections, and 18% of class 3 dams have past due inspections. Of the 42 deficient dams, OWR records indicate that 15 have never been inspected by the owner's engineer, and 12 inspections are past due (see Appendix A).

Table 2
Number of Non-Coal Dams by Time Since Last Inspection by Owners Engineer

Hazard Class	Inspected w/in Last 24 months	Inspection w/in 25 to 36 months	Inspection w/in 37 to 60 months	Inspection over 60 months	No Record of Inspection ever conducted
Class 1	120	27*	52*	9*	37*
Class 2	26	9	18*	4*	9*
Class 3	2	2	5	2*	0*
Class Unknown	9	3	3	4	21
Totals	157	41	78	19	67

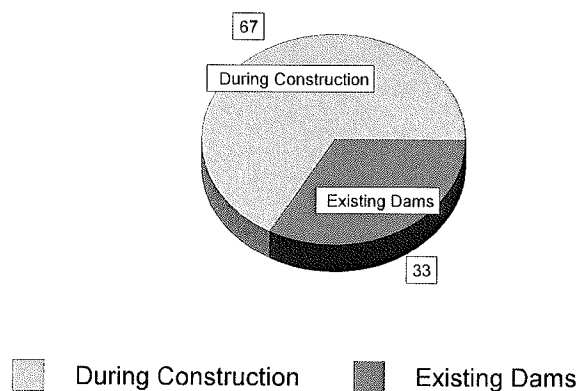
* - indicates those dams that are over due for inspection (51% of Class 1 dams, 47% of Class 2 dams, 18% of Class 3 dams).

2

Hazard classification means "a rating assigned to a structure based upon evaluations and judgments for predicting the danger to human life, property, and environment should failure occur." Class 1- This classification must be used if failure may result in the loss of human life. Class 2 -The potential for loss of human life resulting from failure of a Class 2 dam must be unlikely. Class 3 -The potential for loss of human life resulting from failure of a Class 3 dam must be highly unlikely.

Figure 3 shows that most of DEP's inspections are during dam construction, since this is required by law and it is intended to prevent more deficient dams from being built. More often than not, if poor design and construction standards are identified during the construction phase of a dam, they are less expensive to fix than after the dam is completed. In FY 1999, the OWR conducted 33 inspections on existing dams. This means that OWR inspected less than 10 percent of existing dams. Although OWR maintains a database of all inspections done by an owner's engineers, **OWR only tracks its most recent post-construction inspection performed by its own inspectors.** Therefore, unless an exhaustive search through case files is conducted, OWR does not know the frequency that post-construction inspections were conducted and on which dams. Although inspecting dams under construction is important, existing dams (particularly deficient dams) need to be monitored more often than DEP currently inspects. Without adequate management information, OWR cannot determine the frequency in which it has inspected deficient dams.

Figure 3
DEP Inspections in FY 1999



In addition, according to the OWR, there are 39 dams for which the hazard classification has not been computed. The classification has not been computed because the dam owners have not performed the necessary tests to determine hazard classification. Because hazard has not been determined, then it is not possible to determine the inspection frequency and therefore, the time by which the inspection is overdue.

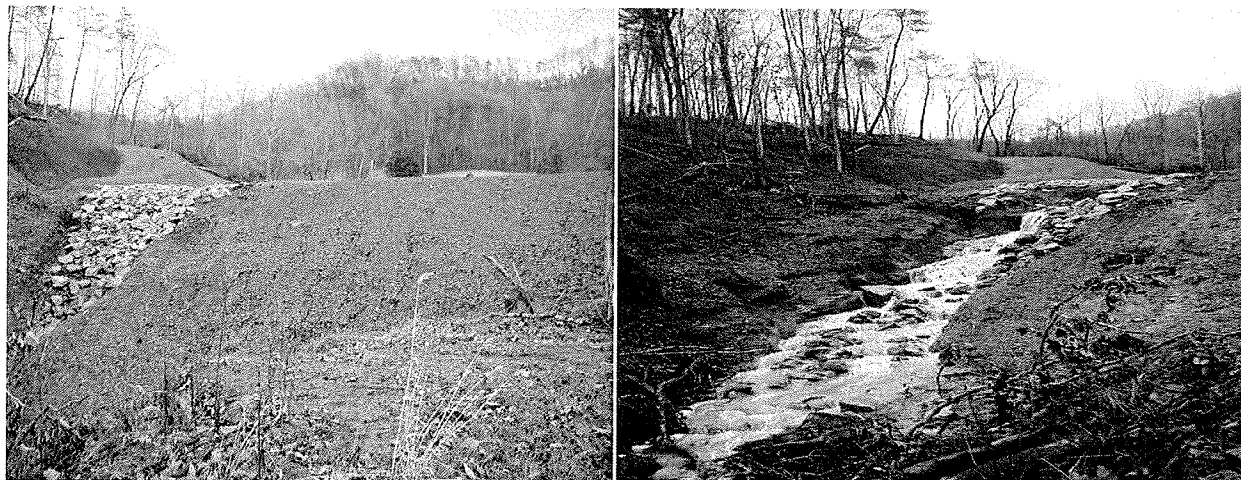
Dams are Sometimes Constructed Without DEP's Knowledge

According to the Dam Control and Safety Act, no one may build a new non-coal dam without first applying for a *Certificate of Approval (COA)* from the OWR. The main reason why it is imperative for the OWR to be notified of new dam construction is so that it can carefully review the design plans, specifications, and perform inspections of the dam while it is under construction. According to the OWR, dams are most vulnerable to overtopping and failure during the construction

phase. Also, as was stated earlier, design problems are usually easier and less expensive to fix during the design and construction phase than after the dam is completed.

However, it is not uncommon for dams to be constructed without DEP's knowledge. The Legislative Auditor's Office attended the draining of one such dam at Fisher's Creek. The dam had to be drained because it was in danger of failing during a recent heavy rain. Had the owner applied for certification, it would have been a **high hazard dam**. Often, the OWR does not learn about new dams until the dams are reported by neighbors who have concerns about the dams, particularly during heavy rains. This was the case with the Fisher's Creek dam. Image 3 shows the Fisher's Creek dam before the erosion and after the erosion by overtopping.

Image 3
Before and After Spillway Erosion at Fisher's Creek



Only a Few Non-Coal Dams have Renewed Certificates of Approvals

According to OWR records, 165 of the 360 (46 %) regulated non-coal dams do not have a Certificate of Approval. Table 3 indicates that most of these dams were constructed prior to the enactment of the Dam Safety Act in 1972. However, the act requires (§22-14-11) that DEP notify owners of dams built prior to the effective date of the act to file an application for a COA. OWR records indicate that the agency has notified owners of their responsibility to file an application. However, to date 165 owners have not responded to the notices. Of the 165 dams without COA's, 48 are NRCS dams.

Table 3
Dams without Certificate of Approval

Built Prior to 1972	Built After 1972	Date Constructed Unknown	Total
122	14	29	165

Furthermore, for the dams with COA's, only a few have been renewed as required by law. According to law (§22-14-7), COA's are valid for only one year. By Legislative Rule (CSR §47-34-18) the necessary requirements for renewing a certificate of approval are as follows:

- An approved and up-to-date Inspection Report;
- Monitoring and Emergency Action Plan;
- Maintenance Plan;
- No outstanding Violations; and
- An Annual Registration Fee has been paid.

If all of these requirements have been satisfied, then the COA will be extended for another year. Although reasons vary from one dam to another, **most non-coal dams do not have a valid certificate of approval** because they have not fulfilled **all** of the necessary requirements to renew the Certificate of Approval. The few dams that have a renewed COA are dams that have been completed just over the last few years.

Monitoring, Emergency Action, and Maintenance Plans

Owners of Class 1 (high hazard) dams are required to submit monitoring and emergency action plans. All dam owners (class 1,2, and 3) are required to submit maintenance plans. Monitoring plans include maps, drawings, contact personnel, inspection frequency, common inspection problems, corrective action to be taken, and the method of notification of the director and county emergency authorities. Emergency Action plan is a plan that is coordinated with county emergency authorities to address emergency conditions. Maintenance plans contain schedules for routine maintenance.

According to the OWR, there are 110 non-coal dam owners who have not submitted monitoring and emergency action plans. Of the 250 dam owners who have submitted monitoring and emergency action plans, only 34 have approved up-to-date plans. Furthermore, according to OWR records, only 7 dam owners have submitted a maintenance plan. Of those seven, only 4 have been approved.

Outstanding Violations

According to the OWR, there are currently 63 dams (18%) with outstanding violations. Some violations have been outstanding for as long as 15 years. However, it should be noted that none of the dams built by the NRCS have outstanding violations.

Many Owners Have Not Paid Their Annual Registration Fee for Years

According to CSR §47-34-18, dams designed and constructed by the NRCS are exempt from the annual registration fee. Therefore, the remaining 195 dams are required to pay the annual registration fee if they were issued a COA. Since 120 of the 195 dams do not have a COA, there are 75 dams that should be paying the annual registration fee. However, the 120 dams without a COA should have one, and therefore should be paying an annual registration fee.

The fee ranges from \$50 dollars for a class 3 dam to \$100 dollars for a class 1 dam. According to OWR records, of the 75 dam owners who should have paid the annual registration fee, 27 owners have **never** submitted an annual registration fee. Furthermore, only 23 of the 75 dams submitted an annual registration fee for 1999. Table 4 shows the number of dams by the last year they submitted an annual registration fee. It is apparent that owners with COA's do not pay the fee every year as required by law. A rough estimate by the Legislative Auditor indicates that since 1992, when annual registration fees were established, **owners have not paid nearly \$100,000 in annual registration fees.**

Table 4
Number of Dams With Paid Annual Registration Fee by Year Paid

Year	1995	1996	1997	1998	1999
Number of Dams Paid	5	16	6	0	23

DEP Should Consider More Forceful Measures to Deal with Unresponsive Owners

In accordance with *WV Code §22-14-14*, after dams were determined to be deficient, each dam (with the exception of the dams owned by the state) have been issued a notice or order to comply. The notices outline the problems that have been identified with each dam and the necessary actions needed to correct the problems. Many dams on the deficient dams list have been issued multiple orders. For example, Lake Washington in Hurricane has been issued seven notices and Lynch Lake Dam in Monongalia County has been issued five notices. In 1992, DEP was given statutory authority to impose a civil administrative penalty. Each notice, if ignored, can carry a civil administrative penalty in the amount of \$200 a day, not to exceed \$400. However, since 1992 no civil administrative penalties have been levied.

In addition to issuing notices, the OWR has written letters to the various individuals or entities reminding them of their legal responsibilities as well as the civil liabilities should the dam fail. The OWR has attended town meetings, written letters and spoke with town officials and state officials. There have also been several articles written in local papers to create a public interest in addressing the dam problems. The deficient dam list currently containing 42 dams was first compiled about five years ago, and according to the Association of Dam Safety Officials (ASDSO), at some point there was originally 49 dams on the deficient list. This means that over a period of five years, 7 dams have affected repairs sufficient to remove them from the deficient list. Furthermore, according to DEP, if the criteria used to establish the current deficient list were extended back to 1982, the deficient list would have totaled 68 deficient dams. This indicates that since 1982, 26 dams are no longer considered deficient.

One possible reason why owners of deficient dams are reluctant to affect costly repairs to the spillway is the high PMP threshold. To take on the expense of increasing the spillway capacity for those dams that conform to the previous standard is a difficult decision to make given that the new standard of 27.5 inches of rainfall in a six hour time period is significantly higher than the previous standard. When asked about deficient dams in his area, one municipal official offered the following comments:

What they're saying is if it would rain 26 inches in four hours it would probably wash out, but so would everything else in the valley. Why this whole valley would be under water.

Another example are dams owned by the DNR. A DNR engineer stated that the deficient DNR dams are **structurally safe** but don't meet new standards for maximum rainfall. These comments suggest that some owners consider their dams to be structurally sound under the old standard, and that the new standard is unrealistically high.

In the case of the dams on the deficient list, many of the deficiencies are of a serious nature and would be costly to fix because they were identified long after construction. Consequently, dam owners often do not have the resources available to effect dam repairs or to bring the dams up to current standards. Municipalities and even the state often must divert resources to other programs. One example of the cost of repairs is Teter Creek Lake Dam which is owned by WV DNR. On February 28th, 2000, the DNR received an estimate from an engineering firm for repairs which would remove deficiencies. The estimate for those repairs totaled \$1,457,422.

Through the Dam Safety and Control Act, the OWR has authority to perform certain actions to encourage compliance with the Act. First, the OWR has the authority to revoke or modify an existing Certificate of Approval. Next, the OWR has the ability to issue Notices and Orders to Comply. After the OWR issues a Notice and Order, the OWR can pursue litigation. The OWR can seek an injunction, civil administrative penalties, and misdemeanor offenses against dam owners. Finally, the more forceful option available that would **ensure** compliance with the act is for OWR to drained the dam reservoir, or for the OWR to actually perform the necessary remedial work

themselves and then seek financial repayment from dam owners through civil action.

Since there are currently no dams operating with a valid COA, revoking certificates is not a viable option. The OWR has issued 462 Notices and Orders since the passage of the Dam Safety and Control Act. Currently, OWR has not issued Civil Administrative penalties.

Despite the fact that OWR issues notices of violation, many dam owners continue to operate dams without a valid COA and therefore illegally. It should be noted that one of the few dams who followed a notice of violation is Lake Chaweva. On March 4, 1997, the dam at Lake Chaweva was exhibiting signs of serious seepage (namely sinkholes). The owner's engineer could not verify that the dam was operating as designed at normal pool conditions. Given the state of the dam and the impending forecast which called for heavy rains, the OWR, under authority of the Dam Safety and Control Act, issued a notice for the Dam at Lake Chaweva to be drained. Given the serious implications of dam failure and the poor conditions of many dams, **the OWR should consider taking more forceful measures under the law in dealing with unresponsive owners of deficient dams such as draining the dam reservoir, or performing the necessary remedial work themselves.**

NRCS Dams and Coal Dams are in Good Condition

Although there are only a few non-coal dams with valid certificates of approval, dams built by the NRCS are generally in better condition than other non-coal dams. There are only two reasons why NRCS dams do not have valid COA's. First, according to the OWR, 48 NRCS dams have applied for COA's, however, OWR has yet to issued them. Second, all NRCS dams are lacking a monitoring/ emergency action plan, or a maintenance plan.

One reason for this that was mentioned previously was the fact that all NRCS dams are supervised during the construction phase by NRCS engineers. Furthermore, according to the WV Soil Conservation Agency (WV SCA), all NRCS dams are inspected annually by a registered professional engineer. If deficiencies are found, the WV SCA establishes a schedule for repairs and maintenance. The WV SCA also has limited funding available that they provide on a matching basis funds from the other owners of each dam. Also, since the other sponsors are municipalities, the WV SCA has the other sponsors build funding into their annual budgets to affect repairs. Because the NRCS dams are designed and built correctly, and because they receive annual inspections and maintenance, many of the deficiencies are minor in nature. Designed and built to standards, inspected annually, and routine maintenance are good reasons that NRCS dams currently have no outstanding violations.

In 1986, the oversight for coal dams was vested within the OMR. OMR currently regulates 134 dams. **Currently, all coal dams except for one (1) hold a valid certificate of approval.** The one dam which does not currently hold a valid certificate of approval was built prior to 1980. It is

not currently impounding any water and has been scheduled to be reclaimed by federal Office of Abandoned Lands Program.

In addition to the inspection frequency mentioned above, coal dams are partially inspected every month by OMR inspectors, and are completely inspected quarterly by OMR engineers. Also, all but 6 coal dams are under regulation by the federal Mine Safety and Health Administration (MSHA). MSHA requires that all dams be inspected by the dam owners at least once every seven (7) days.

Outstanding Violations

In 1999 the OMR issued 35 notices for dam related violations. However, according to the OMR, the majority of dam violations are for relatively minor problems. Furthermore, most dam violations are corrected in a short period of time.

Annual Registration Fee

According to WV Code §22-14-4, the director (of DEP) has the authority to charge an annual registration fee for anyone holding a valid certificate of approval. The OMR has indicated that they are currently not charging this fee. **By not charging this fee, the OMR is foregoing as much as \$13,400 in revenue assuming that the maximum fee allowable was charged for each dam.**

Plans and Reports

According to data provided by the OMR, all coal dams are currently up-to-date on all inspections, monitoring and emergency action plans, as well as maintenance plans.

What can be Done About Deficient Dams?

According to the *American Rivers Organization*, there are only three general solutions to deficient dams: 1) Risk reduction; 2) Repair the dams; or 3) Remove (drain) the dams. This is described in more detail below:

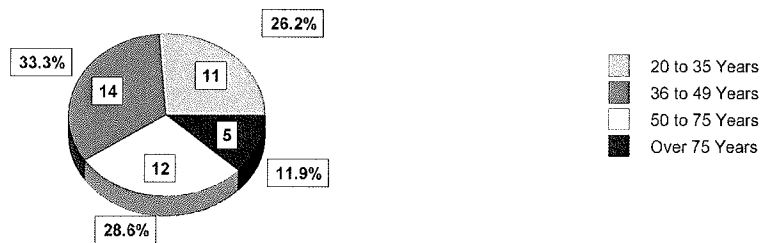
*“First, one could leave the dam as is. **Risk reduction** measures may be implemented, such as moving residents out of the flood-plain, lowering the level of the reservoir, installing an early-warning system, and increasing the frequency of safety inspections. **However, these measures only reduce risk, they do not eliminate it.** Second, one could **repair** the dam. The critical issue in this option is a cost/benefit analysis - do the benefits of a repaired dam warrant the expense? Third, one could **remove** the dam. **If repairing the dam costs an equivalent amount or more than***

dam removal, this may be a preferred option, depending on the use of the dam.”(emphasis added)

Risk minimization is by far the most inexpensive of the three options. However, minimization is not always a viable option. For example, the flood-plain of the Lower Salem Dam consists of a large portion of the City of Salem. It would be unfeasible to relocate the entire city. Also, the Lower Salem Dam serves as a water supply. Because of water quality issues, lowering the reservoir is not a viable option.

The second option of dam repair is not always the correct decision. The first factor to be considered before dam repair is the relative age of the dam. It may not be worthwhile to repair an older dam. Investing valuable resources in a dam which is near the end of its life cycle is not a wise investment. According to the ASDSO, the life expectancy of a dam is 50 years. The average age of all deficient dams is almost 49 years old. Also, 40 percent of all dams on the deficient list are currently over the age of 50. Figure 4 shows the breakdown of deficient dams by age.

Figure 4
Deficient Dams by Age



Also, some dams are in a deficient condition because dam owners did not have the available funds to properly maintain the dam. If repairs are made, it may only be a matter of time before the dam is once again in a deficient condition.

The final option is dam removal. This may be a viable option depending on the function of the dam. Consider again the Lower Salem Dam. As was previously mentioned, this dam serves as the primary water source for the City of Salem and removing the dam is not possible. **It is clear that each dam on the deficient list will need to be considered on an individual basis and that there is no single solution to all deficiencies.**

Conclusion

West Virginia currently has 42 dams that are considered deficient by the OWR. These dams have been deficient for many years while the owners are reluctant or unable to address the

deficiencies. Many of the dams are considered deficient because they do not conform to the revised rainfall standard of 27.5 inches in a six hour period. There is some reluctance on the part of owners to incur the costs to expand spillways to the new standard because the new standard is significantly higher than the previous standard.

Some dams on the deficient dam list contain more serious problems like seepage and instability. These problems could lead to a dam failure if they are not monitored closely and if they are not routinely maintained. However, according to OWR records, it has been an average of two years since owners of deficient dams had their dams inspected and several deficient dams have never been inspected by the owner's engineer. OWR is spending more time on dams under construction and is left with less time to inspect existing dams.

In addition to infrequent inspections, many other non-coal dams are in violation of other parts of the Dam Safety and Control Act. There are only a few non-coal dams with valid COA's because owners have not submitted all required plans needed to renew their COA. Owners also have not paid the annual registration fee, and many owners have not filed an application for a COA.

Also, in addition to dams built by the NRCS, all coal dams with the exception of one currently hold valid COA's. Coal dams are inspected much more frequently than non-coal dams. Furthermore, if coal dams have problems, they are more often than not minor problems which are corrected in a timely manner.

Whatever course of action that the OWR and the Legislature decide to take, these problems cannot go unaddressed. When Buffalo Creek failed and flooded West Virginia infrastructure, the Corps billed the state for \$3.7 million for repairs to roads, bridges, and other structures. The ASDSO describes it this way:

Driving every other issue and all activities within the dam safety community is the risk of dam failure. Although the majority of dams in the U.S. have responsible owners and are properly maintained, still many dams fail every year. In the past several years, there have been hundreds of documented failures across the nation (this includes 250 after the Georgia Flood of 1994). A life was lost in New Hampshire recently as a result of a dam failure. Dam and downstream repair costs resulting from failures in 23 states reporting in one recent year totaled \$54.3 million.

Given the serious nature of this issue, and the relatively poor conditions of some of the State's dams, DEP should consider using more forceful measures under the law to ensure compliance with the Dam Safety Control Act, such as ordering dam reservoirs to be drained, or making repairs to the dams and seeking reimbursement from the owners. The DEP has ordered one dam reservoir drained recently (Lake Chaweva), and it indicated that it does not have funding to repair deficient dams. However, given the serious nature of this issue, and the relatively poor conditions of some of the State's dams, DEP should consider using more forceful measures to ensure compliance with the Dam Safety Control Act.

Recommendation 1:

The Office of Water Resources should make more frequent post-construction inspections that includes more attention given to deficient dams. OWR should also monitor its post-construction inspections.

Recommendation 2:

The Office of Water Resources should consider more forceful measures within its full authority to ensure that owners comply with the Dam Safety Control Act. This includes ensuring that all owners file application for a Certificate of Approval, pay the Annual Registration Fee, submit all necessary plans and remove outstanding violations necessary to renew Certificate of Approvals, and to have all required inspections by a registered engineer in a timely manner.

Recommendation 3:

The Office of Water Resources should consider requiring all owners with or without a Certificate of Approval to pay past due Annual Registration Fees.

Recommendation 4:

The Division of Environmental Protection should require the Office of Mining and Reclamation to collect the Annual Registration Fee from owners of coal dams.

APPENDIX A

Transmittal Letter to Agency

Appendix B
List of Deficient Dams

Deficient Dams						
ID Number	Dam Name	County	Nearest Downstream Town	Last Inspection by Owner's Engineer	Year Built	Hazard Classification
101	Teter Creek Lake Dam	Barbour	Nesterville	no record	1957	1
303	Sleepy Hollow Dam	Berkeley	Hedgesville	10/13/98	1969	1
1102	Lake of Eden Dam	Cabell	Barboursville	no record	1971	1
1105	Hatfield Lake Dam	Cabell	Barboursville	3/6/97	1955	1
2903	Cherry Lake Dam	Hancock	New Cumberland	no record	1972	1
3301	Upper Salem Dam	Harrison	Salem	7/19/94	1970	1
3314	Lower Salem Dam	Harrison	Salem	7/19/94	1955	1
3319	Lake Floyd Dam	Harrison	N/A	2/22/98	1923	1
3322	Deegan Lake Dam	Harrison	Bridgeport	3/31/95	1950	1
3327	Maple Lake Dam	Harrison	Bridgeport	2/22/98	1929	2
3328	Hinkle Lake Dam	Harrison	Bridgeport	3/31/95	1923	1
3904	Poffenbarger # 1 Dam	Kanawha	Cross Lanes	no record	1962	1
3916	Poffenbarger # 2 Dam	Kanawha	Cross Lanes	2/18/94	1960	1
4301	Lee's Fishing Lake Dam	Lincoln	Manoney Creek	no record	1963	1
4702	Berwind Lake Dam	McDowell	Warrriormine	6/17/98	1959	1
4917	Rock Lake Dam	Marion	Hammond	3/16/97	1929	2
5101	Burch Run Dam	Marshall	Wheeling	no record	1962	1
5501	New Bramwell WS Dam	Mercer	Bramwell	9/8/94	1970	1
5519	Bluewell # 1 Dam	Mercer	Bluewell	7/26/99	1966	1
5520	Bluewell # 2 Dam	Mercer	Bluewell	7/26/99	1966	1
5524	Old Bramwell WS Dam	Mercer	Bramwell	no record	1929	1
5722	Old Keyser Dam	Mineral	Limestone	12/17/98	1911	1
6115	Lough Lake Dam	Monongalia	Osgood	no record	1950	1
6116	Lynch Lake Dam	Monongalia	Osgood	no record	1947	1
6301	Moncove Lake Dam	Monroe	Gap Mills	8/20/96	1959	1
6502	Cacapon Reservoir Dam	Morgan	Sleepy Creek	10/8/98	1974	1
6503	Cacapon Park Dam	Morgan	Sleepy Creek	10/8/98	1937	1

6901	Bear Rocks # 1 Dam	Ohio	Middle Creek	9/14/98	1951	1
6902	Bear Rocks # 2 Dam	Ohio	Middle Creek	9/14/98	1948	1
6903	Bear Rocks # 3 Dam	Ohio	Middle Creek	9/14/98	1948	1
7715	B & O Dam	Preston	Newburg	1/20/99	1904	1
7906	Lake Washington Dam	Putnam	Hurricane	8/18/98	1935	1
7909	Hurricane Water Supply Dam	Putnam	Hurricane	no record	1966	1
8101	Flat Top Lake Dam	Raleigh	Ghent	10/19/96	1950	1
8304	Scott Lake Dam	Randolph	Beverly	7/21/95	1949	1
8704	Lake Trotter Dam	Roane	Spencer	no record	1955	1
8705	Charles Fork Dam	Roane	Spencer	4/15/98	1973	1
8903	Long Branch Dam	Summers	Pipestem	8/20/96	1966	1
8904	Sun Valley Dam	Summers	Pipestem	no record	1952	2
9307	Thomas Dam	Tucker	Thomas	no record	1911	1
9905	Asbury Lake Dam	Wayne	Dunlow	no record	1959	1
10703	Tennants Farm Pond Dam	Wood	Tallyho	no record	1953	1